

08 11 13	STEEL DOORS AND FRAMES
08 71 00	DOOR HARDWARE

09 90 00	PAINING AND COATING
09 97 23	CONCRETE AND MASONRY COATINGS

10 21 13.19	PLASTIC TOILET COMPARTMENTS
10 28 00	TOILET AND UTILITY ROOM ACCESSORIES

22 07 19	PLUMBING PIPING INSULATION
22 10 05	PLUMBING PIPING
22 10 06	PLUMBING PIPING SPECIALTIES
22 30 00	PLUMBING EQUIPMENT
22 40 00	PLUMBING FIXTURES

23 05 93	TESTING, ADJUSTING, AND BALANCING FOR HVAC
23 31 00	HVAC DUCTS AND CASINGS
23 33 00	AIR DUCT ACCESSORIES
23 34 16	CENTRIFUGAL HVAC FANS
23 37 00	AIR OUTLETS AND INLETS

26 05 00	BASIC ELECTRICAL REQUIREMENTS
26 05 01	MINOR ELECTRICAL DEMOLITION
26 05 19	LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
26 05 26	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
26 05 29	HANGARS AND SUPPORTS FOR ELECTRICAL SYSTEMS
26 05 34	CONDUIT
26 05 37	BOXES
26 05 53	IDENTIFICATION FOR ELECTRICAL SYSTEMS
26 05 73	OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY
26 08 00	COMMISSIONING OF ELECTRICAL
26 08 20	ELECTRICAL PREFUNCTIONAL CHECKLISTS
26 08 30	ELECTRICAL FUNCTIONAL TESTS
26 09 16	ELECTRIC CONTROLS AND RELAYS
26 09 19	ENCLOSED CONTACTORS
26 09 23	LIGHTING CONTROL DEVICES
26 21 00	LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE
26 24 16	PANELBOARDS
26 27 16	ELECTRICAL CABINETS AND ENCLOSURES
26 27 17	EQUIPMENT WIRING
26 27 26	WIRING DEVICES
26 28 13	FUSES
26 51 10	LUMINAIRES

SITE AND INFRASTRUCTURE SUBGROUP - DIVISIONS 31 THROUGH 35

30 10 00 BASIC CIVIL REQUIREMENTS

DIVISION 31 - EARTHWORK

31 10 00 SITE CLEARING
31 22 00 GRADING
31 23 16 EXCAVATION
31 23 16.13 TRENCHING
31 23 23 FILL
31 32 19 GEOTEXTILE SOIL STABILIZATION AND LAYER SEPARATION
31 66 15 HELICAL PIERS AND ANCHORS

DIVISION 32 - EXTERIOR IMPROVEMENTS

32 11 23 AGGREGATE BASE COURSES
32 12 16 ASPHALT PAVING
32 13 13 CONCRETE PAVING
32 14 40 STONE PAVING
32 92 00 NATIVE SEEDING
32 93 00 PLANTS

DIVISION 33 - UTILITIES

33 05 13 MANHOLES AND STRUCTURES
33 10 00 WATER DISTRIBUTION
33 31 11 SITE SANITARY UTILITY SEWER PIPING
33 41 11 SITE STORM UTILITY DRAINAGE PIPING
33 46 00 SUBDRAINAGE

END OF TABLE OF CONTENTS

SECTION 00 0105

CERTIFICATION PAGE

**PROJECT: Chambers Grove Park Flood - Recovery & Improvements
Duluth, Minnesota**

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision, and that I am a duly Licensed Architect or Licensed Professional Engineer or Licensed Landscape Architect under the Laws of the State of Minnesota.

LHB, INC.

CIVIL

Signature: Megan Goplin
Print Name: Megan Goplin, PE License # 53018 Date: March 24, 2016

LANDSCAPE ARCHITECT

Signature: Heidi Bringman
Print Name: Heidi Bringman, LA License # 46914 Date: March 24, 2016

STRUCTURAL

Signature: Steven Hearn
Print Name: Steven Hearn, PE License # 26409 Date: March 24, 2016

STRUCTURAL

Signature: Christopher J. Miller
Print Name: Christopher J. Miller, PE License # 21833 Date: March 24, 2016

ARCHITECT

Signature: Brandee Lian
Print Name: Brandee Lian, RA License # 42859 Date: March 24, 2016

MECHANICAL

Signature: Todd Mell
Print Name: Todd Mell, PE License # 49842 Date: March 24, 2016

ELECTRICAL

Signature: Nathan Wriedt
Print Name: Nathan Wriedt, PE License # 46305 Date: March 24, 2016

CITY OF DULUTH

CIVIL

Signature: Thomas Alan Johnson
Print Name: Thomas Alan Johnson License # 46744 Date: March 24, 2016

END OF SECTION

SECTION 00 31 00
AVAILABLE PROJECT INFORMATION

PART 1 GENERAL

1.01 EXISTING CONDITIONS

- A. Certain information relating to existing surface and subsurface conditions and structures is available to bidders but will not be part of the Contract Documents, as follows:
- B. Geotechnical Report: Entitled Geotechnical Evaluation Report by Braun Intertec Corporation, dated March 9, 2016.
 - 1. This report identifies properties of below grade conditions and offers recommendations for the design of foundations, prepared primarily for the use of Architect/Engineer.
 - 2. The recommendations described shall not be construed as a requirement of this Contract, unless specifically referenced in the Contract Documents.
 - 3. This report, by its nature, cannot reveal all conditions that exist on the site. Should subsurface conditions be found to vary substantially from this report, changes in the design and construction of foundations will be made, with resulting credits or expenditures to the Contract Price accruing to Owner.
- C. Hazardous Material Survey: To be issued with Addendum 1. .

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 00 41 00

BID FORM

THE PROJECT AND THE PARTIES

1.01 TO:

- A. City of Duluth
411 West First Street
City Hall Room 402
Duluth, MN 55802
Attn: Tari Rayala

1.02 FOR:

- A. Chambers Grove Park Flood - Recovery and Improvements Project

1.03 DATE: _____ (BIDDER TO ENTER DATE)

1.04 SUBMITTED BY: (BIDDER TO ENTER NAME AND ADDRESS)

Bidder's Full Name: _____

Address: _____

City, State, Zip: _____

1.05 OFFER

- A. Having examined the Place of The Work and all matters referred to in the Instructions to Bidders and the Contract Documents prepared by LHB for the above mentioned project, we, the undersigned, hereby offer to enter into a Contract to perform the Work for the Price as shown on the Bid Form immediately following this section.

1.06 CONTRACT TIME

- A. If this Bid is accepted, we will:
- B. Complete the Work by the 28th day of October, 2016.
 - 1. Substantial Completion by the 30th day of September, 2016.

1.07 UNIT PRICES

- A. The following are Unit Prices for specific portions of the Work as listed. The following is the list of Unit Prices:
 - 1. Item 1: Unsuitable Soils Excavation; Section 31 2316 Excavation: For authorized excavation and removal of unsuitable soil beyond the limits defined in the plans and specifications, including excavating to required elevations, loading and removing from site or reusing on site:
 - a. Add/Deduct \$ _____ per ton.
 - 2. Item 2: Engineererd Fill; Section 31 2323 Fill: For supplying fill, stockpiling, scarifying substrate surface, placing where required, compacting, materials and compaction testing:
 - a. Add/Deduct \$ _____ per cubic yard, in place compacted volume.

1.08 ADDENDA

A. The following Addenda have been received. The modifications to the Bid Documents noted below have been considered and all costs are included in the Bid Sum.

1. Addendum # _____ Dated _____.
2. Addendum # _____ Dated _____.
3. Addendum # _____ Dated _____.

BID FORM

Base Bid 1	Restroom Building & Park Improvements	\$
	use words	numerals
Base Bid 2	Chambers Grove Park – GLRI Stormwater Improvements (from Exhibit A – Attach to Bid Form)	\$
	use words	Numerals
TOTAL	Base Bid 1 and Base Bid 2	\$
	use words	Numerals
Alternate 1	Riverwalk Lighting & Associated Electrical Wiring	\$
	use words	Numerals
Alternate 2	Veteran's Memorial Disassembly & Reconstruction	\$
	Use words	Numerals
Alternate 3	Slope Stablization Area 1	\$
	Use words	Numerals
Alternate 4	Slope Stabilization Area 2	\$
	Use words	Numerals
Alternate 5	Drumming Circle and Event Arbor	\$
	Use words	Numerals
Alternate 6	Stone Path to Pond Overlook	\$
	Use words	Numerals
Alternate 7	Stone Steps at Water Trailhead	\$
	Use words	Numerals
Alternate 8	Gazebo Relocation and Refurbishing	\$
	Use words	numerals

Signature _____ Date _____

Name/Title _____

Company Name _____

Address _____

City, State, Zip _____

Tel. _____

If your organization is certified as a disadvantaged business enterprise, please check here - ☐

SECTION 01 10 00

SUMMARY

PART 1 GENERAL

1.01 PROJECT

- A. Project Name: Chambers Grove Park Flood Recovery & Improvements.
- B. Owner's Name: City of Duluth, Parks & Recreation Department.
- C. Architect's Name: LHB, Inc..
- D. The Project consists of the removal of an existing restroom building and associated utilities, along with the removal of existing bituminous walkways and roadway surfaces and the construction of a new restroom building with water and sanitary sewer, concrete sidewalks, gravel paths, a new entrance road and parking lot areas including new subgrade, bituminous surface, paint striping, site lighting, traffic signage, curb and gutter, along with associated grading, storm drainage infrastructure, and site landscaping. The project also includes eight alternates which include relocating a Veteran's memorial, a drumming circle with new event arbor, pedestrian lighting along riverwalk, slope stabilization, and other site related improvements. .

1.02 CONTRACT DESCRIPTION

1.03 OWNER OCCUPANCY

- A. Owner intends to occupy the Project upon Substantial Completion.
- B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- C. Schedule the Work to accommodate Owner occupancy.

END OF SECTION

SECTION 01 23 00

ALTERNATES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Description of Alternates.

1.02 ACCEPTANCE OF ALTERNATES

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.

1.03 SCHEDULE OF ALTERNATES

- A. Alternate No. 1 - Riverwalk Lighting & Associated Electrical Wiring: All work associated with providing lightpoles, conduit, and conductors for complete Riverwalk lighting system.
 - 1. Alternate Item: Section 26 5110 and Drawing numbers E1.02, E2.11 and E8.01.
- B. Alternate No. 2 - Veteran's Memorial Disassembly & Reconstruction: All work associated with the disassembly and reconstruction of the Veteran's Memorial including removals of walkway pavers, and existing foundation 2' feet below grade and site restoration.
 - 1. Alternate Item: Section 04 4301 and Drawing numbers C1.01 and C2.00, C2.02, & S1.00.
- C. Alternate No. 3 - Slope Stabilization Area 1: All work associated with providing live stake, brush bundle, and rip rap installation for complete slope stabilization on eroded hillside.
 - 1. Alternate Item: Section [32 9300 and Drawing numbers C2.00 & C2.05.
- D. Alternate No. 4 - Slope Stabilization Area 2: All work associated with providing brush bundle and live plug installation for complete slope stabilization on eroded hillside.
 - 1. Alternate Item: Section 32 9300 and Drawing numbers C2.00 & C2.05.
- E. Alternate No. 5 - Drumming Circle and Event Arbor: All work associated with providing concrete surfacing and wooden arbor structure for special event space.
 - 1. Alternate Item: Sections 03 3000, 03 3523, & 03 3900, 31 2323, 32 1123 and Drawing numbers C2.00, C2.02, C5.10 and C5.11.
- F. Alternate No. 6 - Stone Path to Pond Overlook: All work associated with providing natural flagstone steppers set in sand for complete pond overlook path.
 - 1. Alternate Item: Sections 32 1123 & 32 1440 and Drawing numbers C1.01, C2.00, C2.02 and C5.12.
- G. Alternate No. 7 - Stone Steppers at Water Trailhead: All work associated with providing 3 natural stone steps with aggregate base for direct water trail access.
 - 1. Alternate Item: Sections 32 1123 & 32 1440 and Drawing numbers C2.00, C2.04 and C5.12.
- H. Alternate No. 8 - Gazebo Relocation and Refurbishing: All work associated with the relocation and refurbishing of the existing gazebo including providing new concrete slab, mounting, priming, painting and reshingling roof in lieu of base bid to remove existing concrete slab and gazebo and return to Owner.
 - 1. Alternate Item: Sections 32 1123, 32 1313 and Drawing numbers C1.01, C2.00 and C2.04.

PART 2 PRODUCTS - NOT USED
PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 30 00
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Submittals for review, information, and project closeout.
- B. Submittal procedures.

PART 3 EXECUTION

2.01 SUBMITTALS FOR REVIEW

- A. When the following are specified in individual sections, submit for review in PDF (electronic format) as an attachment to E-Mail:
 - 1. Product data.
 - 2. Shop drawings.
 - 3. Samples for selection.
 - 4. Samples for verification.
- B. Provide quantity and size as specified in individual sections for review.
 - 1. Samples for selection.
 - 2. Samples for verification.
- C. Submit to Architect for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
- D. Samples will be reviewed only for aesthetic, color, or finish selection.
- E. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 78 00 - Closeout Submittals.

2.02 SUBMITTALS FOR INFORMATION

- A. When the following are specified in individual sections, submit for review in PDF (electronic format) as an attachment to E-Mail:
 - 1. Design data.
 - 2. Certificates.
 - 3. Test reports.
 - 4. Inspection reports.
 - 5. Manufacturer's instructions.
 - 6. Manufacturer's field reports.
 - 7. Other types indicated.
- B. Submit for Architect's knowledge as contract administrator or for Owner.

2.03 SUBMITTALS FOR PROJECT CLOSEOUT

- A. Submit Correction Punch List for Substantial Completion.
- B. Submit Final Correction Punch List for Substantial Completion.
- C. Refer to Section 01 7800 for closeout submittals.
- D. Submit for Owner's benefit during and after project completion.

2.04 SUBMITTAL PROCEDURES

- A. Shop Drawing Procedures:
 - 1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting the Contract Documents and coordinating related Work.
 - 2. Generic, non-project specific information submitted as shop drawings do not meet the requirements for shop drawings.
- B. Transmit each submittal with a copy of approved submittal form.

- C. Transmit each submittal with approved form. Reference Specification Section Number and description of submittal on each transmittal.
- D. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.
- E. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate on each copy.
- F. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents.
- G. Schedule submittals to expedite the Project, and coordinate submission of related items.
- H. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
- I. Identify variations from Contract Documents and Product or system limitations that may be detrimental to successful performance of the completed Work.
- J. Provide space for Contractor and Architect review stamps.
- K. When revised for resubmission, identify all changes made since previous submission.
- L. Distribute reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.
- M. Submittals not requested will not be recognized or processed.

END OF SECTION

SECTION 01 40 00
QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Submittals.
- B. Quality assurance.
- C. Testing and inspection services.
- D. Control of installation.
- E. Mock-ups.
- F. Tolerances.
- G. Manufacturers' field services.
- H. Defect Assessment.

1.02 RELATED REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Requirements for material and product quality.

1.03 REFERENCE STANDARDS

- A. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008 (Reapproved 2014).
- B. ASTM C1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation; 2014.
- C. ASTM C1093 - Standard Practice for Accreditation of Testing Agencies for Masonry; 2013.
- D. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2012a.
- E. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2014a.
- F. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2013.

1.04 SUBMITTALS

- A. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents, or for Owner's information.
- B. Test Reports: After each test/inspection, promptly submit two copies of report to Architect and to Contractor.
 - 1. Include:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of inspector.
 - d. Date and time of sampling or inspection.
 - e. Identification of product and specifications section.
 - f. Location in the Project.
 - g. Type of test/inspection.
 - h. Date of test/inspection.
 - i. Results of test/inspection.
 - j. Conformance with Contract Documents.
 - k. When requested by Architect, provide interpretation of results.
- C. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.

1. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
 2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.
- D. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- E. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner.
1. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.
- F. Erection Drawings: Submit drawings for Architect's benefit as contract administrator or for Owner.
1. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.
 2. Data indicating inappropriate or unacceptable Work may be subject to action by Architect or Owner.

1.05 QUALITY ASSURANCE

- A. Testing Agency Qualifications:
1. Prior to start of Work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
 2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.

1.06 REFERENCES AND STANDARDS

- A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.
- C. Obtain copies of standards where required by product specification sections.
- D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.
- E. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.
- F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.07 TESTING AND INSPECTION AGENCIES AND SERVICES

- A. Contractor shall employ and pay for services of an independent testing agency to perform specified testing.
- B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- C. Contractor Employed Agency:
1. Testing agency: Comply with requirements of ASTM E329, ASTM E543, ASTM C1021, ASTM C1077, ASTM C1093, and ASTM D3740.
 2. Inspection agency: Comply with requirements of ASTM D3740 and ASTM E329.
 3. Laboratory: Authorized to operate in the State in which the Project is located.

4. Laboratory Staff: Maintain a full time registered Engineer on staff to review services.
5. Testing Equipment: Calibrated at reasonable intervals either by NIST or using an NIST established Measurement Assurance Program, under a laboratory measurement quality assurance program.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have Work performed by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 MOCK-UPS

- A. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.
- B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- C. Accepted mock-ups shall be a comparison standard for the remaining Work.
- D. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

3.03 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

3.04 TESTING AND INSPECTION

- A. See individual specification sections for testing required.
- B. Testing Agency Duties:
 1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
 2. Perform specified sampling and testing of products in accordance with specified standards.
 3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 4. Promptly notify Architect and Contractor of observed irregularities or non-conformance of Work or products.
 5. Perform additional tests and inspections required by Architect.
 6. Submit reports of all tests/inspections specified.
- C. Limits on Testing/Inspection Agency Authority:

1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 2. Agency may not approve or accept any portion of the Work.
 3. Agency may not assume any duties of Contractor.
 4. Agency has no authority to stop the Work.
- D. Contractor Responsibilities:
1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
 2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
 3. Provide incidental labor and facilities:
 - a. To provide access to Work to be tested/inspected.
 - b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
 - c. To facilitate tests/inspections.
 - d. To provide storage and curing of test samples.
 4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
 5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
 6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
- E. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Architect.
- F. Re-testing required because of non-conformance to specified requirements shall be paid for by Contractor.

3.05 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment as applicable, and to initiate instructions when necessary.
- B. Submit qualifications of observer to Architect 30 days in advance of required observations.
 1. Observer subject to approval of Architect.
- C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.06 DEFECT ASSESSMENT

- A. Replace Work or portions of the Work not conforming to specified requirements.
- B. If, in the opinion of Architect, it is not practical to remove and replace the Work, Architect will direct an appropriate remedy or adjust payment.

END OF SECTION

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Temporary utilities.
- B. Temporary Controls: Barriers, enclosures, and fencing.
- C. Security requirements.
- D. Vehicular access and parking.
- E. Waste removal facilities and services.
- F. Field offices.

1.02 CONTRACTOR RESPONSIBILITIES

- A. Contractor is responsible for:
 - 1. Dumpsters.
 - 2. Connections/coordination with Owner for water and electricity.

1.03 TEMPORARY UTILITIES

- A. Electrical Power
 - 1. Notify Owner 14-days in advance of utility outages associated with connection and disconnection of the temporary utility systems to ensure that long-term, expensive research experiments conducted throughout the University are not disrupted.
- B. Water
 - 1. Water shall be provided from the existing building service for remodeling work.
 - 2. The Contractor shall maintain the system in a manner that will prevent freezing, flooding or contamination.
 - 3. The Contractor shall provide a back-flow prevention device between the existing water system and the temporary construction system. Use trigger-operated nozzles for water hoses, to avoid waste of water.

1.04 TEMPORARY SANITARY FACILITIES

- A. Use of existing facilities is permitted.
- B. Where the owner's representative approves the use of existing toilet facilities, the contractor shall clean the facilities daily and at the final comprehensive conclusion of the project.

1.05 DUST CONTROL

- A. Contractor is responsible to contain construction-related dust, contaminants and odors within the construction limits. Construction-related dust, contaminants and odors shall not interfere with normal operations.

1.06 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.07 FENCING

- A. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.08 WEATHER PROTECTION

- A. Provide necessary measures to protect temporary and final work, existing and adjacent buildings, material and equipment from weather damage. This includes groundwater, rainwater, wind, ice, snow and the backing up of sewers and drains.

- B. Provide temporary enclosures to withstand gale force wind.
- C. The contractor shall inspect, protect, maintain and ensure intended operation of existing site drainage, exterior catch basins and areaway drains within the construction site so water does not pond.

1.09 SECURITY

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

1.10 VEHICULAR ACCESS AND PARKING

- A. Contractor shall comply with all posted regulations, signs and directions regarding traffic, parking and loading/unloading.
- B. Coordinate access and haul routes with governing authorities and Owner.
- C. Provide and maintain access to fire hydrants, free of obstructions.
- D. Onsite parking is available.

1.11 CONSTRUCTION STAGING

- A. Construction staging areas shall occupy the smallest possible space without compromising safety of the project. The Contractors shall install temporary fencing at the perimeter of the staging area.
- B. The Contractors may use the staging area as indicated on the drawings for material storage, equipment or other necessary purpose directly related to the work.

1.12 WASTE REMOVAL

- A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- B. Provide containers with lids. Remove trash from site periodically to prevent vermin and pests from the job site.

1.13 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.
- B. Clean and repair damage caused by installation or use of temporary work.
- C. Restore existing facilities used during construction to original condition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 57 13
TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Prevention of erosion due to construction activities.
- B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.
- C. Restoration of areas eroded due to insufficient preventive measures.

1.02 RELATED REQUIREMENTS

- A. Section 31 10 00 - Site Clearing: Limits on clearing; disposition of vegetative clearing debris.
- B. Section 31 22 00 - Grading: Temporary and permanent grade changes for erosion control.
- C. Section 32 92 23 - Sodding: Permanent turf for erosion control.

1.03 REFERENCE STANDARDS

- A. ASTM D4355/D4355M - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc Type Apparatus; 2014.
- B. ASTM D4491-99A(2014)E - Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
- C. ASTM D4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles; 2011.
- D. ASTM D4632/D4632M-08(2013)e2 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
- E. ASTM D4751 - Standard Test Method for Determining Apparent Opening Size of a Geotextile; 2012.
- F. ASTM D4873 - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples; 2002 (Reapproved 2009).
- G. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit; current edition.
- H. FHWA FLP-94-005 - Best Management Practices for Erosion and Sediment Control; Federal Highway Administration; 1995.
- I. USDA TR-55 - Urban Hydrology for Small Watersheds; USDA Natural Resources Conservation Service; 2009.

1.04 PERFORMANCE REQUIREMENTS

- A. Comply with all requirements of U.S. Environmental Protection Agency for erosion and sedimentation control, as specified for the National Pollutant Discharge Elimination System (NPDES), Phases I and II, under requirements for the Construction General Permit (CGP).
- B. Comply with all requirements of the City of Duluth for erosion and sedimentation control.
- C. Develop and follow an Erosion and Sedimentation Prevention Plan and submit periodic inspection reports.
- D. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.
- E. Timing: Put preventive measures in place as soon as possible after disturbance of surface cover and before precipitation occurs.
- F. Storm Water Runoff: Control increased storm water runoff due to disturbance of surface cover due to construction activities for this project.
- G. Erosion On Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.

1. Control movement of sediment and soil from temporary stockpiles of soil.
 2. Prevent development of ruts due to equipment and vehicular traffic.
 3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.
- H. Erosion Off Site: Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this project.
1. Prevent windblown soil from leaving the project site.
 2. Prevent tracking of mud onto public roads outside site.
 3. Prevent mud and sediment from flowing onto sidewalks and pavements.
 4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.
- I. Sedimentation of Waterways On Site: Prevent sedimentation of waterways on the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
 2. If sediment basins are used as temporary preventive measures, pump dry and remove deposited sediment after each storm.
- J. Sedimentation of Waterways Off Site: Prevent sedimentation of waterways off the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
- K. Open Water: Prevent standing water that could become stagnant.
- L. Maintenance: Maintain temporary preventive measures until permanent measures have been established.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Certificate: Mill certificate for silt fence fabric attesting that fabric and factory seams comply with specified requirements, signed by legally authorized official of manufacturer; indicate actual minimum average roll values; identify fabric by roll identification numbers.
- C. Inspection Reports: Submit report of each inspection; identify each preventive measure, indicate condition, and specify maintenance or repair required and accomplished.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Mulch: Use one of the following:
 1. Straw or hay.
 2. Wood waste, chips, or bark.
 3. Erosion control matting or netting.
- B. Grass Seed For Temporary Cover: Select a species appropriate to climate, planting season, and intended purpose. If same area will later be planted with permanent vegetation, do not use species known to be excessively competitive or prone to volunteer in subsequent seasons.
- C. Silt Fence Fabric: Polypropylene geotextile resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; fabric including seams with the following minimum average roll lengths:
 1. Average Opening Size: 30 U.S. Std. Sieve, maximum, when tested in accordance with ASTM D4751.
 2. Permittivity: 0.05 sec^{-1} , minimum, when tested in accordance with ASTM D4491.

3. Ultraviolet Resistance: Retaining at least 70 percent of tensile strength, when tested in accordance with ASTM D4355 after 500 hours exposure.
 4. Tensile Strength: 100 lb-f, minimum, in cross-machine direction; 124 lb-f, minimum, in machine direction; when tested in accordance with ASTM D4632/D4632M.
 5. Elongation: 15 to 30 percent, when tested in accordance with ASTM D4632/D4632M.
 6. Tear Strength: 55 lb-f, minimum, when tested in accordance with ASTM D4533.
 7. Color: Manufacturer's standard, with embedment and fastener lines preprinted.
- D. Silt Fence Posts: One of the following, minimum 5 feet long:
1. Steel U- or T-section, with minimum mass of 1.33 lb per linear foot.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

3.02 PREPARATION

- A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

3.03 SCOPE OF PREVENTIVE MEASURES

- A. In all cases, if permanent erosion resistant measures have been installed temporary preventive measures are not required.
- B. Construction Entrances: Traffic-bearing aggregate surface.
1. Width: As required; 20 feet, minimum.
 2. Length: 50 feet, minimum.
 3. Provide at each construction entrance from public right-of-way.
 4. Where necessary to prevent tracking of mud onto right-of-way, provide wheel washing area out of direct traffic lane, with drain into sediment trap or basin.
- C. Linear Sediment Barriers: Made of silt fences.
1. Provide linear sediment barriers:
 - a. Along downhill perimeter edge of disturbed areas, including soil stockpiles.
- D. Storm Drain Drop Inlet Sediment Traps: As detailed on drawings.
- E. Soil Stockpiles: Protect using one of the following measures:
1. Cover with polyethylene film, secured by placing soil on outer edges.
 2. Cover with mulch at least 4 inches thickness of pine needles, sawdust, bark, wood chips, or shredded leaves, or 6 inches of straw or hay.
- F. Temporary Seeding: Use where temporary vegetated cover is required.

3.04 INSTALLATION

- A. Silt Fences:
1. Store and handle fabric in accordance with ASTM D4873.
 2. Install with top of fabric at nominal height and embedment indicated on drawings.
 3. Do not splice fabric width; minimize splices in fabric length; splice at post only, overlapping at least 18 inches, with extra post.
 4. Fasten fabric to steel posts using wire, nylon cord, or integral pockets.
 5. Wherever runoff will flow around end of barrier or over the top, provide temporary splash pad or other outlet protection; at such outlets in the run of the barrier, make barrier not more than 12 inches high with post spacing not more than 4 feet.
- B. Mulching Over Small and Medium Areas:
1. Dry Straw and Hay: Apply 4 to 6 inches depth.
 2. Wood Waste: Apply 2 to 3 inches depth.
 3. Erosion Control Matting: Comply with manufacturer's instructions.
- C. Temporary Seeding:
1. When hydraulic seeder is used, seedbed preparation is not required.

2. When surface soil has been sealed by rainfall or consists of smooth undisturbed cut slopes, and conventional or manual seeding is to be used, prepare seedbed by scarifying sufficiently to allow seed to lodge and germinate.
3. If temporary mulching was used on planting area but not removed, apply nitrogen fertilizer at 1 pound per 1000 sq ft.
4. On soils of very low fertility, apply 10-10-10 fertilizer at rate of 12 to 16 pounds per 1000 sq ft.
5. Incorporate fertilizer into soil before seeding.
6. Apply seed uniformly; if using drill or cultipacker seeders place seed 1/2 to 1 inch deep.
7. Irrigate as required to thoroughly wet soil to depth that will ensure germination, without causing runoff or erosion.
8. Repeat irrigation as required until grass is established.

3.05 MAINTENANCE

- A. Inspect preventive measures weekly, within 24 hours after the end of any storm that produces 0.5 inches or more rainfall at the project site, and daily during prolonged rainfall.
- B. Repair deficiencies immediately.
- C. Silt Fences:
 1. Promptly replace fabric that deteriorates unless need for fence has passed.
 2. Remove silt deposits that exceed one-third of the height of the fence.
 3. Repair fences that are undercut by runoff or otherwise damaged, whether by runoff or other causes.
- D. Clean out temporary sediment control structures weekly and relocate soil on site.
- E. Place sediment in appropriate locations on site; do not remove from site.

3.06 CLEAN UP

- A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Architect.
- B. Clean out temporary sediment control structures that are to remain as permanent measures.
- C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

END OF SECTION

SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General product requirements.
- B. Transportation, handling, storage and protection.
- C. Product option requirements.
- D. Substitution limitations and procedures.
- E. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS

- A. Section 01 4000 - Quality Requirements.

1.03 SUBMITTALS

- A. Proposed Products List: Submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
 - 1. Submit within 15 days after date of Agreement.
 - 2. For products specified only by reference standards, list applicable reference standards.
- B. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- C. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- D. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
 - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.
- E. Indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

- A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by the Contract Documents.
- B. Unforeseen historic items encountered remain the property of the Owner; notify Owner promptly upon discovery; protect, remove, handle, and store as directed by Owner.
- C. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.
- D. Reused Products: Reused products include materials and equipment previously used in this or other construction, salvaged and refurbished as specified.

2.02 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by the Contract Documents.
- B. DO NOT USE products having any of the following characteristics:
 - 1. Made using or containing CFC's or HCFC's.
 - 2. Made of wood from newly cut old growth timber.
 - 3. Containing lead, cadmium, asbestos.
- C. Where all other criteria are met, Contractor shall give preference to products that:
 - 1. If used on interior, have lower emissions.

2. If wet-applied, have lower VOC content.
3. Are extracted, harvested, and/or manufactured closer to the location of the project.
4. Have longer documented life span under normal use.
5. Result in less construction waste.
6. Are made of recycled materials.
7. Have a published GreenScreen Chemical Hazard Analysis.

2.03 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed after bidding.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named 10 days prior to bidding.

2.04 MAINTENANCE MATERIALS

- A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
- B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION PROCEDURES

- A. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.
- B. A request for substitution constitutes a representation that the submitter:
 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
 2. Agrees to provide the same warranty for the substitution as for the specified product.
 3. Agrees to coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
 4. Waives claims for additional costs or time extension that may subsequently become apparent.
 5. Agrees to reimburse Owner and Architect for review or redesign services associated with re-approval by authorities.
- C. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.
- D. Contractor and Owner shall take responsibility for any substitution performed after Bidding.

3.02 TRANSPORTATION AND HANDLING

- A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
- B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
- C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- D. Transport and handle products in accordance with manufacturer's instructions.
- E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

- G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.
- H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.03 STORAGE AND PROTECTION

- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.
- D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.
- G. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- H. Comply with manufacturer's warranty conditions, if any.
- I. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- J. Prevent contact with material that may cause corrosion, discoloration, or staining.
- K. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- L. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION



PERFORMANCE
DRIVEN DESIGN.
LHBcorp.com

Substitution Request

(Incomplete forms will not be processed)

REQUEST FOR SUBSTITUTION FORMS MUST BE RECEIVED BY
TUESDAY, APRIL 5TH AT 10:00 AM.

LHB # 150589

PROJECT NAME: Chambers Grove Park Flood
Recovery and Improvements

TO: Heidi Bringman
(Heidi.Bringman@LHBcorp.com)

SUBSTITUTION REQUEST # _____

FROM: _____

DATE: _____

Specification

Section Title: _____

Paragraph: _____

Section Number: _____

Description: _____

Proposed Substitution *(Note: Limit this Request to one substitution)*

Manufacturer: _____ Address: _____

Trade Name: _____ Model Number: _____

Phone Number: _____ Contact Person: _____

Installer: _____ Address: _____

Phone Number: _____ Contact Person: _____

History: ☐ New Product ☐ 2 to 5 years old
☐ 5 to 10 years old ☐ More than 10 years old

Differences between proposed substitution and specified product:

Point by point comparison data attached – REQUIRED

Reason for Not Providing Specified Item:

Similar Installation: Include Date Installed

Project: _____

Address: _____

Architect: _____

Owner: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; Explain _____

Amount of Savings to Owner for this Substitution: \$ _____

Will Requested Substitution Impact Schedule: ☐ No ☐ Yes, Add _____ days.

Attached Supporting Data: ☐ Product Data ☐ Drawings ☐ Tests ☐ Reports ☐ Samples

21 West Superior Street, Suite 500 | Duluth, MN 55802 | 218.727.8446
701 Washington Avenue North, Suite 200 | Minneapolis, MN 55401 | 612.338.2029
63 East Second Street, Suite 150 | Superior, WI 54880 | 715.392.2902

Contractor's Certification

The undersigned party, proposing this Substitution, certifies the following as true and correct and accepts all conditions relating to this request:

- This Substitution has been fully investigated and determined to be equal or superior in all respects.
- The same warranty will be furnished.
- The same maintenance service and source of replacement parts, as applicable, is available.
- The change to the Construction Progress Schedule is as stated above.
- The cost data as stated above is complete. All claims for any additional costs related to this Substitution, if accepted, are explicitly waived by the Contractor.
- The Substitution does not affect dimensions or functional clearances.
- All architectural/engineering design fees associated with the review, evaluation, and or design and detailing changes as a result of this Substitution Request are the responsibility of the Contractor. The amount of these fees will be deducted from the Contract Sum due to the Contractor.
- Coordination, installation, and changes to the Work as necessary for an accepted Substitution will be complete in all respects.

Submitted By: _____
Signature: _____
Firm: _____
Address: _____
Telephone: _____

Architect's Review and Recommendation

- ☐ Substitution Recommended: Make submittals in accordance with Specifications.
- ☐ Substitution Recommended as Noted: Make submittals in accordance with Specifications.
- ☐ Substitution Rejection Recommended: Use specified products. Architect shall not be held responsible for the performance of any substitution accepted or approved by Owner over the recommendation of the Architect (Release and Indemnification Agreement between Owner and Architect required).
- ☐ Substitution Request received after deadline: Use specified products.
- ☐ Substitution Request returned: Incomplete submittal, use specified products.

Comments: _____

Signature: _____ Date: _____

SECTION 01 70 00
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Examination, preparation, and general installation procedures.
- B. Requirements for alterations work, including selective demolition, except removal, disposal, and/or remediation of hazardous materials and toxic substances.
- C. Cleaning and protection.
- D. Closeout procedures, except payment procedures.
- E. General requirements for maintenance service.

1.02 SUBMITTALS

- A. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
 - 1. On request, submit documentation verifying accuracy of survey work.
 - 2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in conformance with Contract Documents.
 - 3. Submit surveys and survey logs for the project record.

1.03 PROJECT CONDITIONS

- A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- B. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.
- C. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
- D. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
 - 1. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
 - 2. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
 - 3. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
- E. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
- F. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 LAYING OUT THE WORK

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of any discrepancies discovered.
- C. Control datum for survey is that established by Owner provided survey.
- D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- F. Utilize recognized engineering survey practices.
- G. Establish a minimum of two permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on project record documents.
- H. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
 - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
 - 2. Grid or axis for structures.
 - 3. Building foundation, column locations, ground floor elevations.
- I. Periodically verify layouts by same means.
- J. Periodically verify layouts relative to existing site / building components that are to remain.
- K. Maintain a complete and accurate log of control and survey work as it progresses.

3.04 GENERAL INSTALLATION REQUIREMENTS

- A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- C. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- D. Make neat transitions between different surfaces, maintaining texture and appearance.

3.05 ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 - 1. Verify that construction and utility arrangements are as shown.
 - 2. Report discrepancies to Architect before disturbing existing installation.
 - 3. Beginning of alterations work constitutes acceptance of existing conditions.
- B. Keep areas in which alterations are being conducted separated from other areas that are still occupied.
 - 1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 50 00 in locations indicated on drawings.
- C. Remove existing work as indicated and as required to accomplish new work.
 - 1. Remove items as required for new construction and as indicated on drawings.
 - 2. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
 - 3. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.
- D. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
- E. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
- F. Clean existing systems and equipment.
- G. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.
- H. Do not begin new construction in alterations areas before demolition is complete.
- I. Comply with all other applicable requirements of this section.

3.06 CUTTING AND PATCHING

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. See Alterations article above for additional requirements.
- C. Perform whatever cutting and patching is necessary to:
 - 1. Complete the work.
 - 2. Fit products together to integrate with other work.
 - 3. Provide openings for penetration of mechanical, electrical, and other services.
 - 4. Match work that has been cut to adjacent work.
 - 5. Repair areas adjacent to cuts to required condition.
 - 6. Repair new work damaged by subsequent work.
 - 7. Remove samples of installed work for testing when requested.
 - 8. Remove and replace defective and non-conforming work.
- D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
- E. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- F. Restore work with new products in accordance with requirements of Contract Documents.
- G. Patching:
 - 1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
 - 2. Match color, texture, and appearance.

3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.07 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.08 PROTECTION OF INSTALLED WORK

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Remove protective coverings when no longer needed; reuse or recycle plastic coverings if possible.

3.09 ADJUSTING

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.10 FINAL CLEANING

- A. Use cleaning materials that are nonhazardous. Verify they are appropriate to material being cleaned.
- B. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.11 CLOSEOUT PROCEDURES

- A. Refer to the following:
 1. Section 01 7800.
- B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.
- C. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.
- D. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.
- E. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
- F. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.
- G. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

END OF SECTION

SECTION 01 74 19

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.01 WASTE MANAGEMENT REQUIREMENTS

- A. Owner requires that this project generate the least amount of trash and waste possible.
- B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
- C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.
- D. Provide for the management of construction and demolition waste through reuse, recycling and reduction methods. Typical designated waste streams are land clearing debris, concrete and masonry, metals, dimensional wood and lumber, wooden pallets, gypsum wallboard, paper and cardboard. Depending upon the project, other large volume wastes may be included such as bricks, asphalt and carpeting.
- E. Required Recycling, Salvage, and Reuse: The following may not be disposed of in landfills or by incineration:
 - 1. Aluminum and plastic beverage containers.
 - 2. Corrugated cardboard.
 - 3. Wood pallets.
 - 4. Clean dimensional wood: May be used as blocking or furring.
 - 5. Land clearing debris, including brush, branches, logs, and stumps; see Section 31 10 00 - Site Clearing for use options.
 - 6. Metals, including packaging banding, metal studs, sheet metal, structural steel, piping, reinforcing bars, door frames, and other items made of steel, iron, galvanized steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.
- F. Contractor shall submit periodic Waste Disposal Reports; all landfill disposal, incineration, recycling, salvage, and reuse must be reported regardless of to whom the cost or savings accrues; use the same units of measure on all reports.
- G. Contractor shall develop and follow a Waste Management Plan designed to implement these requirements.
- H. The following sources may be useful in developing the Waste Management Plan:
- I. Methods of trash/waste disposal that are not acceptable are:
 - 1. Burning on the project site.
 - 2. Burying on the project site.
 - 3. Dumping or burying on other property, public or private.
 - 4. Other illegal dumping or burying.
- J. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.02 DEFINITIONS

- A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.
- B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.
- C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.
- D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.

- E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.
- F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
- G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.
- H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- I. Reduction: Eliminating excess material or waste by ordering materials to fit the module of the design. Two ways to achieve reduction is to eliminate cut-off waste from lumber, drywall or carpeting; and working with suppliers to eliminate or reduce packaging.
- J. Return: To give back reusable items or unused products to vendors for credit.
- K. Reuse: To reuse a construction waste material in some manner on the project site.
- L. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.
- M. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.
- N. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
- O. Toxic: Poisonous to humans either immediately or after a long period of exposure.
- P. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- Q. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.03 SUBMITTALS

- A. Submit Waste Management Plan within 10 calendar days after receipt of Notice of Award of Bid, or prior to any trash or waste removal, whichever occurs sooner; submit projection of all trash and waste that will require disposal and alternatives to landfilling.
- B. Waste Management Plan: Include the following information:
 - 1. Analysis of the trash and waste projected to be generated during the entire project construction cycle, including types and quantities.
 - 2. Landfill Options: The name, address, and telephone number of the landfill(s) where trash/waste will be disposed of, the applicable landfill tipping fee(s), and the projected cost of disposing of all project trash/waste in the landfill(s).
 - 3. Landfill Alternatives: List all waste materials that will be diverted from landfills by reuse, salvage, or recycling.
 - 4. Meetings: Describe regular meetings to be held to address waste prevention, reduction, recycling, salvage, reuse, and disposal.
 - 5. Materials Handling Procedures: Describe the means by which materials to be diverted from landfills will be protected from contamination and prepared for acceptance by designated facilities; include separation procedures for recyclables, storage, and packaging.
 - 6. Transportation: Identify the destination and means of transportation of materials to be recycled; i.e. whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler.
- C. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
 - 1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
 - 2. Submit Report on a form acceptable to Owner.

3. Landfill Disposal: Include the following information:
 - a. Identification of material.
 - b. Amount, in tons or cubic yards, of trash/waste material from the project disposed of in landfills.
 - c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
4. Recycled and Salvaged Materials: Include the following information for each:
 - a. Identification of material, including those retrieved by installer for use on other projects.
 - b. Amount, in tons or cubic yards, date removed from the project site, and receiving party.
 - c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
5. Material Reused on Project: Include the following information for each:
 - a. Identification of material and how it was used in the project.
 - b. Amount, in tons or cubic yards.
 - c. Include weight tickets as evidence of quantity.
6. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 WASTE MANAGEMENT PROCEDURES

- A. See Section 01 50 00 for additional requirements related to trash/waste collection and removal facilities and services.
- B. See Section 01 60 00 for waste prevention requirements related to delivery, storage, and handling.
- C. See Section 01 70 00 for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

3.02 WASTE MANAGEMENT PLAN IMPLEMENTATION

- A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.
- B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Architect.
- C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.
- D. Meetings: Discuss trash/waste management goals and issues at project meetings.
 1. Pre-bid meeting.
 2. Pre-construction meeting.
 3. Regular job-site meetings.
 4. Job safety meetings.
- E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
 1. Provide containers as required.
 2. Provide adequate space for pick-up and delivery and convenience to subcontractors.

- 3. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.
- F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.
- G. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.
- H. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.
- I. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

END OF SECTION

SECTION 01 78 00
CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Project Record Documents.
- B. Operation and Maintenance Data.
- C. Warranties and bonds.
- D. Forms Required at Project Closeout

1.02 RELATED REQUIREMENTS

- A. Section 01 70 00 - Execution and Closeout Requirements: Contract closeout procedures.
- B. Individual Product Sections: Specific requirements for operation and maintenance data.
- C. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

- A. Project Record Documents: Submit documents to Owner two-weeks prior to claim for final Application for Payment].
- B. Operation and Maintenance Data:
 - 1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.
 - 2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
 - 3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
 - 4. Submit two sets of revised final documents in final form within 10 days after final inspection.
- C. Warranties and Bonds:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
 - 2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
 - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
 - 5. Reviewed shop drawings, product data, and samples.
 - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.

- E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
 - 1. Manufacturer's name and product model and number.
 - 2. Product substitutions or alternates utilized.
 - 3. Changes made by Addenda and modifications.
- F. Record Drawings : Mark each item to record actual construction including:
 - 1. Measured depths of foundations in relation to finish first floor datum.
 - 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 - 4. Field changes of dimension and detail.
 - 5. Details not on original Contract drawings.

3.02 OPERATION AND MAINTENANCE DATA

- A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

- A. For Each Product, Applied Material, and Finish:
 - 1. Product data, with catalog number, size, composition, and color and texture designations.
- B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
- C. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.
- D. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

- A. For Each Item of Equipment and Each System:
 - 1. Description of unit or system, and component parts.
 - 2. Identify function, normal operating characteristics, and limiting conditions.
 - 3. Include performance curves, with engineering data and tests.
 - 4. Complete nomenclature and model number of replaceable parts.
- B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
- C. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- D. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

- E. Provide servicing and lubrication schedule, and list of lubricants required.
- F. Include manufacturer's printed operation and maintenance instructions.
- G. Include sequence of operation by controls manufacturer.
- H. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- I. Additional Requirements: As specified in individual product specification sections.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

- A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.
- B. Where systems involve more than one specification section, provide separate tabbed divider for each system.
- C. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.
- F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.
- G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
- H. Text: Manufacturer's printed data, or typewritten data on 24 pound paper.
- I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- J. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, in three parts as follows:
 - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect, Contractor, Subcontractors, and major equipment suppliers.

3.06 WARRANTIES AND BONDS

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.
- E. Manual: Bind in commercial quality 8-1/2 by 11 inch three D side ring binders with durable plastic covers.
- F. Cover: Identify each binder with typed or printed title WARRANTIES AND BONDS, with title of Project; name, address and telephone number of Contractor and equipment supplier; and name of responsible company principal.
- G. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.

- H. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

END OF SECTION

SECTION 03 10 00
CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Formwork for cast-in place concrete, with shoring, bracing and anchorage.
- B. Openings for other work.
- C. Form accessories.
- D. Form stripping.

1.02 RELATED REQUIREMENTS

- A. Section 03 20 00 - Concrete Reinforcing.
- B. Section 03 30 00 - CAST-IN-PLACE CONCRETE.
- C. Section 03 39 00 - Concrete Curing.

1.03 REFERENCE STANDARDS

- A. ACI 301 - Specifications for Structural Concrete; American Concrete Institute International; 2010 (Errata 2012).
- B. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute International; 2011.
- C. ACI 347R - Guide to Formwork for Concrete; American Concrete Institute; 2014.
- D. PS 1 - Structural Plywood; 2009.

1.04 DESIGN REQUIREMENTS

- A. Design, engineer and construct formwork, shoring and bracing to conform to design and code requirements; resultant concrete to conform to required shape, line and dimension.

1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 347, ACI 301, and ACI 318.
 - 1. Maintain one copy of standards on project site.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver prefabricated forms and installation instructions in manufacturer's packaging.
- B. Store prefabricated forms off ground in ventilated and protected manner to prevent deterioration from moisture.
- C. Protect expanding water stops from exposure to moisture that may cause premature water stop expansion.
- D. Store products under cover to protect from oil, dirt, and sunlight.

PART 2 PRODUCTS

2.01 FORMWORK - GENERAL

- A. Provide concrete forms, accessories, shoring, and bracing as required to accomplish cast-in-place concrete work.
- B. Design and construct to provide resultant concrete that conforms to design with respect to shape, lines, and dimensions.
- C. Comply with applicable State and local codes with respect to design, fabrication, erection, and removal of formwork.

2.02 WOOD FORM MATERIALS

- A. Softwood Plywood: PS 1, B-B High Density Concrete Form Overlay, Class I.

2.03 REMOVABLE PREFABRICATED FORMS

- A. Preformed Steel Forms: Minimum 16 gage matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
- B. Preformed Plastic Forms: Thermoplastic polystyrene form liner, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
- C. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.
- D. Tubular Column Type: Round, spirally wound laminated fiber material, surface treated with release agent, non-reusable, of sizes indicated.
- E. Void Forms: Moisture resistant treated paper faces, biodegradable, structurally sufficient to support weight of wet concrete mix until initial set; , or as otherwise noted on the Drawings.

2.04 FORMWORK LINERS

- A. Board formed concrete
 - 1. Lumber: SPF/Hem Fir; #2 or better grade
 - 2. Size: 8"
 - 3. Orientation: Horizontal and Vertical, refer to Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

3.02 EARTH FORMS

- A. Earth forms are not permitted.

3.03 ERECTION - FORMWORK

- A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301.
- B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.
- C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.
- D. Align joints and make watertight. Keep form joints to a minimum.
- E. Obtain approval before framing openings in structural members that are not indicated on drawings.
- F. Install void forms in accordance with manufacturer's recommendations. Protect forms from moisture or crushing.
- G. Coordinate this section with other sections of work that require attachment of components to formwork.
- H. If formwork is placed after reinforcement, resulting in insufficient concrete cover over reinforcement, request instructions from Architect before proceeding.

3.04 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
- C. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

- D. At concrete scheduled to receive waterproofing, use only form release agent with prior approval from waterproofing manufacturer.

3.05 INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Provide formed openings where required for items to be embedded in passing through concrete work.
- B. Locate and set in place items that will be cast directly into concrete.
- C. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.
- D. Install accessories in accordance with manufacturer's instructions, so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- E. Install waterstops in accordance with manufacturer's instructions, so they are continuous without displacing reinforcement. Heat seal joints so they are watertight.
- F. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- G. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

3.06 FORM CLEANING

- A. Clean forms as erection proceeds, to remove foreign matter within forms.
- B. Clean formed cavities of debris prior to placing concrete.
 - 1. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
 - 2. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.07 FORMWORK TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI 117, unless otherwise indicated.

3.08 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.
- B. Loosen forms carefully. Cut and remove formwork to a level below adjacent concrete pavement. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
- C. Store removed forms to prevent damage to form materials or to fresh concrete. Discard damaged forms.

END OF SECTION

SECTION 03 20 00
CONCRETE REINFORCING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Reinforcing steel for cast-in-place concrete.
- B. Supports and accessories for steel reinforcement.

1.02 RELATED REQUIREMENTS

- A. Section 03 10 00 - Concrete Forming and Accessories.
- B. Section 03 30 00 - CAST-IN-PLACE CONCRETE.

1.03 REFERENCE STANDARDS

- A. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 2011
- B. ACI 318 - Building Code Requirements For Structural Concrete and Commentary; American Concrete Institute International; 2011.
- C. ACI SP-66 - ACI Detailing Manual; American Concrete Institute International; 2004.
- D. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2015.
- E. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2009a (Reapproved 2014).
- F. ASTM A706/A706M - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement; 2014.
- G. ASTM A775/A775M - Standard Specification for Epoxy-Coated Steel Reinforcing Bars; 2007b (Reapproved 2014).
- H. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2015.
- I. CRSI (DA4) - Manual of Standard Practice; Concrete Reinforcing Steel Institute; 28th Edition.
- J. CRSI (P1) - Placing Reinforcing Bars; Concrete Reinforcing Steel Institute; 2011.

1.04 SUBMITTALS

- A. Shop Drawings: Comply with requirements of ACI SP-66. Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.
- B. Manufacturer's Certificate: Certify that reinforcing steel and accessories supplied for this project meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301, ACI SP-66, MnDOT Specifications, and CRSI Manual of Standard Practice.
- B. Reinforcing materials will be verified by Owner's representative in accordance with Section 01 4000 Quality Requirements.

PART 2 PRODUCTS

2.01 REINFORCEMENT

- A. Reinforcing Steel: ASTM A 615/A 615M Grade 60 (420)
 - 1. Unfinished, except as noted.
 - 2. Epoxy coated in accordance with ASTM A 775/A 775M.
- B. Reinforcement Accessories:
 - 1. Tie Wire: Annealed, minimum 16 gage, 0.0508 inch.
 - 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.

- a. Precast concrete blocks of strength equal to or greater than specified strength of concrete or Class 3 supports equipped with sand plates, where concrete will be cast against earth. Concrete masonry units will not be acceptable.
- 3. Epoxy Coating Repair Compound: Meeting ASTM A775 with minimum 70% solids.

2.02 FABRICATION

- A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice.
- B. Welding of reinforcement is not permitted, unless specifically noted on the Drawings.

PART 3 EXECUTION

3.01 PLACEMENT

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position.
- B. Repair epoxy coating with epoxy coating repair compound. Follow manufacturer's recommendations.
- C. Do not displace or damage vapor retarder.
- D. Accommodate placement of formed openings.
- E. Conform to ACI 318 code for concrete cover over reinforcement.

3.02 FIELD QUALITY CONTROL

- A. An independent testing agency, as specified in Section 01 4000 Quality Requirements, will inspect installed reinforcement for conformance to contract documents before concrete placement.

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete building frame members.
- B. Floors and slabs on grade.
- C. Concrete footings and foundations.
- D. Joint devices associated with concrete work.
- E. Miscellaneous concrete elements, including equipment pads and light pole bases.
- F. Installation of embedments and bearing plates in concrete.

1.02 RELATED REQUIREMENTS

- A. Section 03 10 00 - Concrete Forming and Accessories: Forms and accessories for formwork.
- B. Section 03 20 00 - Concrete Reinforcing.
- C. Section 03 39 00 - Concrete Curing.

1.03 REFERENCE STANDARDS

- A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute International; 1991 (Reapproved 2009).
- B. ACI 301 - Specifications for Structural Concrete; American Concrete Institute International; 2010 (Errata 2012).
- C. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International; 2000 (Reapproved 2009).
- D. ACI 305R - Hot Weather Concreting; American Concrete Institute International; 2010.
- E. ACI 306R - Cold Weather Concreting; American Concrete Institute International; 2010.
- F. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute International; 2014.
- G. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2013.
- H. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2015a.
- I. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2015.
- J. ASTM C 138 - Standard Test Method for Density (Unit Weight), Yield and Air Content (Gravimetric) of Concrete; 2014.
- K. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2012.
- L. ASTM C150/C150M - Standard Specification for Portland Cement; 2015.
- M. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2013.
- N. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2015.

1.04 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301 and ACI 318.
 - 1. Maintain one copy of each document on site.
- B. Acquire cement from same source and aggregate from same source for entire project.
- C. Follow recommendations of ACI 305R when concreting during hot weather.
- D. Follow recommendations of ACI 306R when concreting during cold weather.

PART 2 PRODUCTS

2.01 FORMWORK

- A. Comply with requirements of Section 03 10 00 Concrete Forming and Accessories.

2.02 REINFORCEMENT

- A. Comply with requirements of Section 03 20 00 Concrete Reinforcing.

2.03 CONCRETE MATERIALS

- A. Cement: ASTM C150/C150M, Type I - Normal Portland type.
 - 1. Acquire all cement for entire project from same source.
- B. Fine and Coarse Aggregates: ASTM C 33.
 - 1. Acquire all aggregates for entire project from same source.
- C. Fly Ash: ASTM C618, Class C or F.
- D. Water: Clean and not detrimental to concrete.

2.04 ADMIXTURES

- A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.
- B. Accelerating Admixture: ASTM C494/C494M Type C.
- C. Retarding Admixture: ASTM C494/C494M Type B.
- D. Water Reducing Admixture: ASTM C 494/C 494M Type A and/or Type F.
- E. Air Entrainment Admixture: ASTM C 260.

2.05 CONCRETE MIX DESIGN

- A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
- B. Normal Weight Concrete:
 - 1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: As indicated on drawings.
 - 2. Admixtures: Add acceptable admixtures as recommended in ACI 211.1, as appropriate for environmental conditions, and at rates recommended by manufacturer.
 - 3. Fly Ash Content: Maximum 25 percent of cementitious materials by weight, except maximum 15 percent in floor slabs.

2.06 CONTROL OF MIX IN THE FIELD

- A. Slump: A tolerance of up to 1 inch above that specified will be permitted for one batch in five consecutive batches tested. Concrete of lower slump than that specified may be used, provided proper placing and consolidation is obtained.
 - 1. If slump upon arrival at the site is lower than 1 inch below the value specified, one addition of water in accordance with ASTM C 94 will be permitted to bring slump within tolerance, provided that:
 - a. A positive means is available to measure the amount of water added at the site.
 - b. The specified (or approved) maximum water-cement ratio is not exceeded.
 - c. Not more than 45 minutes have elapsed since batching.

2.07 MIXING

- A. Transit Mixers: Comply with ASTM C94/C94M.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION

- A. Verify that forms are clean before applying release agent.

- B. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.

3.03 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

- A. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with concrete placement.

3.04 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304R.
- B. Place concrete for floor slabs in accordance with ACI 302.1R.
- C. Notify Architect not less than 24 hours prior to commencement of placement operations.
- D. It is recommended that truck deliveries be spaced for lightweight concrete such that minor mix adjustments may be made to subsequent batches as needed.
- E. Ensure embedded parts will not be disturbed during concrete placement.

3.05 CURING AND PROTECTION

3.06 DEFECTIVE CONCRETE

- A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- B. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.
- C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

END OF SECTION

SECTION 03 35 23
EXPOSED AGGREGATE CONCRETE FINISHING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Exposed aggregate concrete finish on concrete walks.

1.02 RELATED REQUIREMENTS

- A. Section 03 10 00 - Concrete Forming and Accessories.
- B. Section 32 1313 - Concrete Paving

1.03 REFERENCE STANDARDS

- A. ACI 301 - Specifications for Structural Concrete; American Concrete Institute International; 2010 (Errata 2012).
- B. ACI 303R - Guide to Cast-in-Place Architectural Concrete Practice; American Concrete Institute International; 2012.
- C. ASTM C150/C150M - Standard Specification for Portland Cement; 2015.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Samples: Submit one, 5 lb plastic bags of aggregate specified, illustrating size, color and the extremes of color range. Submit for color and size range approval to Landscape Architect.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301 and ACI 303R.
- B. Obtain cementitious materials from same source throughout.

1.06 MOCK-UP

- A. Prepare one mock up sample at drumming circle location.
- B. If approved, this panel will represent the remainder of the exposed aggregate for for the project and may be used as part of the final paving. If not approved, remove and prepare another panel for approval.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide pigment, surface retarder, and acid etch solution in manufacturer's original packaging, including use instructions.

PART 2 PRODUCTS

2.01 CONCRETE MATERIALS

- A. Exposed Aggregate: Blueston washed natural mineral aggregate, 1/4 inch minimum and 1/2 inch maximum size, blue/grey color from a single source.

2.02 ACCESSORY MATERIALS

- A. Liquid Surface Sealer: Cureseal S clear sealer by Scofield.
- B. Surface Retarder: Top surface retarder type. Provide Lithotex manufactured by Schofield.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that items to be cast into concrete are placed securely and will not impede placing concrete.
- B. Notify Landscape Architect minimum 24 hours prior to commencement of concreting operations.

3.02 PREPARATION

- A. Clean formwork surfaces.

- B. Apply surface retarder to formwork in accordance with manufacturer's instructions.
- C. Clean previously placed concrete with steel brush and apply bonding agent in accordance with manufacturer's instructions.

3.03 PLACING CONCRETE

- A. Place concrete in accordance with Section 03 30 00.

3.04 AGGREGATE EXPOSURE

- A. Immediately after removal of formwork, wash retarded concrete surfaces with water and scrub with stiff bristle brush exposing aggregate to match accepted sample panel.

3.05 CURING

- A. Cure concrete surfaces as specified in 03 30 00 & 03 3900.

3.06 CLEANING

- A. When desired finish is achieved, wash and rinse exposed aggregate surfaces.

3.07 PROTECTION

- A. Protect concrete from premature drying or staining, excessively hot or cold temperatures, or mechanical injury.

END OF SECTION

SECTION 03 39 00
CONCRETE CURING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Initial and final curing of horizontal and vertical concrete surfaces.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete.

1.03 REFERENCE STANDARDS

- A. ACI 302.1R - Guide for Concrete Floor and Slab Construction; American Concrete Institute International; 2004 (errata 2007) .
- B. ACI 308R - Guide to Curing Concrete; American Concrete Institute International; 2001 (Reapproved 2008).
- C. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete; 2007.
- D. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2011.
- E. ASTM D2103 - Standard Specification for Polyethylene Film and Sheeting; 2015.

1.04 SUBMITTALS

- A. Product Data: Provide data on curing compounds and moisture-retaining sheet, including compatibility of different products and limitations.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301 and ACI 302.1R.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver curing materials in manufacturer's sealed packaging, including application instructions.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Moisture-Retaining Sheet: ASTM C171.
 - 1. White-burlap-polyethylene sheet, weighing not less than 10 oz/per linear yd, 40 inches wide.
- B. Polyethylene Film: ASTM D2103, 4 mil thick, clear.
- C. Water: Potable, not detrimental to concrete.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to be cured.

3.02 EXECUTION - HORIZONTAL SURFACES

- A. Ponding: Maintain 100 percent coverage of water over floor slab areas, continuously for 4 days.
- B. Moisture-Retaining Sheet: Lap strips not less than 3 inches and seal with waterproof tape or adhesive; secure at edges; maintain in place for not less than 3 days.
- C. Absorptive Moisture-Retaining Sheet: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place for 3 days.

3.03 EXECUTION - VERTICAL SURFACES

- A. Cure surfaces in accordance with ACI 308.
- B. Spraying: Spray water over surfaces and maintain wet for 5 days.

3.04 PROTECTION

- A. Do not permit traffic over unprotected floor surface.

3.05 FIELD QUALITY CONTROL

- A. Owner's representative will check maintenance of curing procedures in accordance with Section 01 4000 Quality Requirements.

3.06 SCHEDULES

- A. All Other Floor Areas: Membrane curing compound.

END OF SECTION

SECTION 04 23 00
GLASS UNIT MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Glass masonry units.
- B. Mortar.
- C. Accessories.

1.02 RELATED REQUIREMENTS

Section 07 90 00 - Sealant

1.03 REFERENCE STANDARDS

- A. ASTM A82—Spec. for Cold Drawn Steel Wire
- B. ASTM A153—Class B-2, Spec. for Zinc Coating (Hot dip) on Iron and Steel Hardware
- C. ASTM A167, Spec. for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
- D. ASTM A580, Spec. for Stainless Steel Wire
- E. ASTM C144, Spec. for Aggregate for Masonry
- F. ASTM C150, Spec. for Portland Cement
- G. H. ASTM C207, Spec. for Hydrated Lime for Masonry Purposes
- H. ASTM D1227, Type III—Spec. for Emulsified Asphalt (For Porous Surfaces)
- I. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- J. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2014a.
- K. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2012.
- L. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2010.

1.04 SUBMITTALS

- A. Product Data: Provide data for glass units and accessories.
- B. Samples: Submit one glass units illustrating color, design, and face pattern.
- C. Manufacturer's Installation Instructions: Indicate special procedures, positioning of reinforcement, perimeter conditions requiring special attention.

1.05 QUALITY ASSURANCE

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

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store unopened cartons of glass block in a clean, cool, dry area.
- B. Protect opened cartons of glass block against windblown rain or water run-off with tarpaulins or plastic covering.
- C. Accept glass units on site on pallets; inspect for damage.

1.07 FIELD CONDITIONS

- A. Maintain materials and surrounding air temperature to minimum 40 degrees F prior to, during, and 48 hours after completion of masonry work.

- B. Maintain materials and surrounding air temperature to maximum 90 degrees F prior to, during, and 48 hours after completion of masonry work.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Glass Units:
 - 1. Pittsburgh Corning Corporation: www.pittsburghcorning.com.
 - 2. Seves Group: www.sevesglassblock.com
 - 3. Weck Glass Blocks: www.glashaus.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 GLASS UNITS

- A. Basis of Design: Pittsburgh Corning Corporation; Premiere Series Glass Block, Essex AA Pattern.
- B. Hollow Glass Units: Permanently seal hollow unit by heat fusing joint; factory coat unit edges to improve bond with mortar.
 - 1. Nominal Size: 8 inch by 8 inch by 4 inch.
 - 2. Color: Clear glass.
 - 3. Pattern and Design: horizontal striation.

2.03 ACCESSORIES

- A. Panel Reinforcing: two parallel 9 gauge wires either 15/8 inch or 2 inch on center with electrically butt-welded crosswires spaced at regular intervals, hot dipped galvanized after welding or Type 304 stainless steel.
- B. Panel Anchors: 20 gauge perforated steel strips 24 inches long by 1¾ inches wide, hot dipped galvanized after perforation or 22 gauge by 16 inches long by 1¾ inches wide of Type 304 stainless steel.
- C. C. Expansion Strips: made of polyethylene foam with a thickness of 3/8 inch.
- D. Asphalt Emulsion: water based.

2.04 MORTAR AND POINTING MATERIAL

- A. Mortar: Limit cementitious materials in mortar to Portland Cement and lime. Type S in accordance with ASTM C270. Mortar shall be 1 part Portland Cement, ½ part lime, and sand equal to 2¼ to 3 times the amount of cementitious material (cement plus lime), all measured by volume. No antifreeze compounds or accelerators allowed.
 - 1. Integral Type Water-repellent: Streatate type by Sonneborn Building Products or equal. Note: add hydrocide powder to dry mortar mix. Do not add powder to wet mortar mix.
- B. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
 - 1. Color(s): As selected by Architect from manufacturer's full range.
 - 2. Manufacturers: Davis Colors or equal.

2.05 MORTAR MIXING

- A. Thoroughly mix mortar ingredients in accordance with ASTM C270 in quantities needed for immediate use.
- B. Add mortar color in accordance with manufacturer's instructions. Provide uniformity of mix and coloration.
- C. Do not use anti-freeze compounds to lower the freezing point of mortar.
- D. Use mortar within two hours after mixing at temperatures of 90 degrees F, or two-and-one-half hours at temperatures under 40 degrees F.

2.06 MIX TESTS

- A. Testing of Mortar Mix: In accordance with ASTM C780 for compressive strength, consistency, mortar aggregate ratio, water content, air content, and splitting tensile strength.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that openings are ready to receive work.

3.02 PREPARATION

- A. Clean glass units of substances that may impair bond with mortar or sealant.
- B. Establish and protect lines, levels, and coursing.

3.03 INSTALLATION

- A. Erect glass units and accessories in accordance with manufacturer's instructions.
- B. Install block with striation pattern oriented horizontally (parallel to floor).
- C. Coat sill under units with asphalt emulsion as a bond breaker, and allow to dry.
- D. Mix all mortar components to a consistency that is drier than mortar for ordinary masonry. Retempering the mortar after it has taken its initial set shall not be permitted.
- E. Provide full mortar joints. Furrowing is not permitted. Remove excess mortar.
- F. Set a full mortar bed joint, applied to sill.
- G. Maintain uniform joint width of 1/4 inch.
- H. Where panel anchors are used at jambs and heads in lieu of channel or chase surrounds, install panel anchors in the same joints (16 inches o.c. maximum starting after first course) where panel reinforcing will be laid. Panel anchors are to be embedded a minimum of 12 inches into the mortar joints.
- I. Place panel reinforcement at every second horizontal joint in full mortar bed and at first course above and below openings within the glass unit panel.
- J. Place or adhere expansion strips to jambs and head. Make certain expansion strip extends to sill and covers leg of panel anchor that is attached to jambs and head.
- K. Lap reinforcement joints 6 inches. Discontinue reinforcement at expansion joints.
- L. Isolate panel from adjacent construction on sides and top with expansion strips. Keep expansion joint voids clear of mortar.
- M. Set succeeding courses of block. Spaces at head of panel and jambs must remain free of mortar for caulking with sealant.
- N. Shore assembly until setting bed will maintain panel in position without movement.
- O. Neatly tool mortar surface to a concave profile
- P. Apply sealant evenly to the full depth of recesses as indicated on the drawings and in accordance with the manufacturers' published application manual and instructions.
- Q. Remove excess sealant.

3.04 TOLERANCES

- A. Variation From Joint Width: Plus 1/8 inch and minus 0 inches.

3.05 CLEANING

- A. Clean and polish faces of glass unit masonry, using materials and technique that will not scratch or deface units.

END OF SECTION

SECTION 04 43 01
STONE MASONRY RESTORATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This work consists of the removal/ disassembly and ensuing relocation and rebuilding of the Veterans Memorial Monument and footing as detailed in the plans, including documentation by the Contractor prior to disassembly. The work includes documentation, removal, cleaning and re-installation of existing stones. The work includes preparation of areas to receive stone, fitting, installation and pointing of stones. The work shall be performed in accordance with the applicable provisions of Mn/DOT 2433, the plans, as directed by the Engineer, and as outlined in this specification.
- B. Cleaning exposed stone masonry surfaces.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Method of Measurement: Measurement for Veterans Memorial Monument removal, disassembly, relocation and reconstruction will be made by lump sum. In addition, no separate measurement will be made for any required surface preparation, field measurement, photographing and documentation of original stones, shop drawings, or cleaning that may be required.
- B. Basis of Payment: Payment for relocated and rebuilt Veterans Memorial Monument will be made under Alternate 2 by lump sum and shall be considered payment in full for all work associated with the complete rebuilding of the Veterans Memorial Monument including but not limited to existing condition documentation and photography, removals, removal of all old mortar and cleaning of stone for re-use, existing surface preparation, footing construction, rebuilding of monument, mortar and pointing, transporting and installing the stone in the areas indicated and in the manner described in the plans and this specification.

1.03 REFERENCE STANDARDS

- A. ACI 530/530.1/ERTA - Building Code Requirements and Specification for Masonry Structures and Related Commentaries; American Concrete Institute International; 2011.
- B. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2014a.
- C. ASTM C1713 - Standard Specification for Mortars for the Repair of Historic Masonry; 2015.
- D. ASTM E2260 - Standard Guide for Repointing (Tuckpointing) Historic Masonry; 2003, Reapproved 2012.
- E. Preservation Brief 15, "Preservation of Historic Concrete"; U.S. Dept. of the Interior; National Parks Services; Heritage Preservation Service; 2007.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Bidders shall be responsible to visit the site to inform themselves of the existing conditions of Chambers Grove Park and existing monument prior to bidding.
- B. Preinstallation Meeting: Convene two weeks before starting work (including any demolition) of this section.

1.05 SUBMITTALS

- A. Product Data: Submit data on mortar including material sources, make-up and proportions. Include trial test reports and certifications substantiating that products comply with requirements.
- B. Restoration Program: Submit written program for each phase of restoration process including protection of materials during operations. Describe in detail materials, methods and equipment to be used for each phase of restoration work.
- C. Certification and Testing:
 - 1. Submit documentation of qualifications required in this section for Masons.

- D. Documentation of Existing Conditions: Submit documentation described in this specification for approval prior to removal. Document for the purposes of replicating the original stone layout with existing salvaged stones, replaced to their original location including joint widths and overall dimensions. Documentation shall include field numbering of all stones, sketches, photographs and shall clearly indicate field measurements taken by Contractor.

1.06 QUALITY ASSURANCE

- A. Work must be performed by a firm having not less than 5 years successful experience in comparable historic masonry restoration projects and employing personnel skilled in the restoration processes and operations indicated.
- B. On-site Lead/Supervising mason shall have a minimum of 10 years of similar masonry rehabilitation experience. Lead stone mason meeting the experience requirement shall be on site when stone masonry removal, surface preparation, stone installation and tuckpointing is occurring. Past experience and project detail for stone mason shall be submitted for review with the Bid.
- C. Documentation of Existing Conditions: Prior to any stone removal, the monument shall be thoroughly photographed and stone sizes, arrangement and pattern dimensionally mapped/ drawn. All photography shall be digital images and shall be taken with a minimum sensor resolution of 10 megapixels. The following shall be placed on a board or paper that is placed within each image such that it can be clearly read:
 - 1. Name of Project
 - 2. Date photograph was taken
 - 3. Reference to vantage point in relation to a key plan for the site / structureMapping shall include an orthogonal 2' x 2' grid drawn to scale with stone perimeters and masonry joints accurately represented within the grid, to scale. Minimum drawing scale shall be 2" = 1'. The photographs and dimensional mapping shall be furnished to the engineer for approval prior to disassembly/ removal of the existing monument. Mapping shall be further updated and additional photographs taken during performance of the work to reflect further information revealed during removals including but not limited to stone depths, buried mortar joint widths, anchors, other embedded items uncovered and other hidden conditions. One copy of photographs taken and mapping produced shall be available for viewing in the field office at all times. Active documenting, updating and furnishing of the updated mapping and photographs at the close of the work shall be a condition to final payment.
- D. Work shall be conducted in accordance with applicable portions of Preservation Brief 15.

1.07 MORTAR SAMPLE

- A. Mortar samples for demonstration and selection of mortar color and surface texture shall be prepared in advance of disassembly/ removal of existing monument.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Carefully pack, handle, and transport stone masonry units. Unload and handle to prevent chipping and breakage.
- B. Protect grout, mortar and other materials from deterioration by moisture and temperature. Store in a dry location or in waterproof containers. Keep containers tightly closed and away from open flames. Protect liquid components from freezing.

1.09 PROJECT CONDITIONS

- A. Do not repoint mortar joint's repair or install stone masonry unless air temperatures are between 40 degF (4 degC) and 80 degF (27 degC) and will remain so for at least 48 hours after completion of work.
- B. Prevent grout or mortar used in repointing and repair work from staining face of surrounding masonry and other surfaces. Remove immediately grout and mortar in contact with exposed stone masonry and other surfaces.
- C. Protect concrete footing/ monument pedestal from mortar droppings.

PART 2 PRODUCTS

2.01 STONE

- A. Stone: Existing granite.
- B. Pattern: To match existing appearance, stone location and construction.
- C. Clean stone for re-use including removal of all mortar.
- D. Slope exposed top surfaces of stone and horizontal sill surfaces for shedding water.

2.02 MORTAR

- A. Setting and Pointing Mortar: Type N Mortar Mix. Mortar shall match existing mortar in overall appearance, texture and color.
 - 1. 28-day mortar compressive strength range shall be a minimum 750 psi.
 - 2. Mortar shall be air entrained (7-10%).
 - 3. Aggregate shall conform to ASTM C144 standards.
 - 4. Mortar color shall match in place mortar color. (Engineer will designate location on structure to match, use of an integral color additive may be required).
 - 5. Water: Clean, free of soils, acids, alkalis and organic matter.

2.03 CLEANING MATERIALS

- A. Water for Cleaning: Clean, potable, free of oils, acids, alkalis, salts, and organic matter warmed to between 120 and 140 degrees F.
- B. Brushes: Fiber bristle only.

2.04 MORTAR MIXES

- A. Measurement and Mixing: Measure cementitious and aggregate material in a dry condition by volume or equivalent weight. Do not measure by shovel, use known measure. Mix materials in a clean mechanical batch mixer.
- B. Mixing Pointing Mortar: Thoroughly mix cementitious and aggregate materials together before adding any water. Then mix again adding only enough water to produce a damp, unworkable mix which will retain its form when pressed into a ball. Maintain mortar in this dampened condition for 1 to 2 hours. Add remaining water in small portions until mortar of desired consistency is reached. Use mortar within 30 minutes of final mixing; do not retemper or use partially hardened material.
- C. Do not use admixtures of any kind in mortar, unless otherwise indicated.
- D. Setting Mortar: Same as pointing mortar.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that support work and site conditions are ready to receive work of this section.

3.02 PREPARATION

- A. Prevent cleaning solutions from coming into contact with pedestrians, landscaping and other surfaces which could be injured or damaged by such contact.
- B. Do not clean masonry during winds of sufficient force to spread cleaning solutions to unprotected surfaces.
- C. Dispose of run-off from cleaning operations by legal means and in manner which prevents soil erosion, damage to landscaping, and pollution to river.

3.03 STONE REMOVAL AND PREPARATION

- A. Notify Engineer at least 24 hours in advance of start of operations.
- B. Photograph and document existing conditions as outlined in this specification. Mark individual stones for re-use with suitable temporary marking method.

- C. The Contractor shall take extreme care to perform selective removal of in-place stones so as to preserve their condition. Use of sawcutting (without cutting stones) and selective removal through small chipping hammers is anticipated.
- D. Prepare surface to be rebuilt as detailed in the plans and as directed by the Engineer. Surface shall be completely sound and true.

3.04 STONE INSTALLATION

- A. Notify Engineer at least 24 hours in advance of start of operations.
- B. Conditions of surfaces shall be verified so that all surfaces that are to receive stones are accurately located, plumb, true, square, solid, secure, and otherwise properly prepared.
- C. Selectively clean and chip/ grind existing mortar from all stones to be re-used. Work shall proceed in a fashion which does not cause any damage to stones to remain (bidders/ Contractor shall review existing stone condition to determine necessary procedures and equipment to ensure this requirement is met).
- D. Dampen surfaces of surrounding stones before new stones are placed. Allow existing stones to absorb surface moisture prior to starting installation of successive units.
- E. Prepare full mortar setting bed to fully support stone over bearing surface. Use setting buttons or shims to maintain correct joint width. Ensure mortar bed is solid and free of voids. Fabrication of setting beds and joints shall be straight and at right angles to face.
- F. Butter contact surfaces of stones with mortar. Align replacement masonry stones in opening and press into position. Remove excess mortar with a trowel.
- G. Alignment and position of individual stones shall be within 1/4" of adjacent stones in both the vertical and horizontal direction.
- H. Wedges shall be provided when and where necessary to prevent mortar crushing by weights of stones being set.
- I. Joint Pointing
 - 1. When mortar is thumbprint hard, tool joints slightly concave to match existing monument pointing. Remove excess mortar from edge of joint by brushing.
 - 2. Cure mortar by maintaining in a damp condition for not less than 72 hours.

3.05 CLEANING

- A. Remove mortar stains on stones as work progresses. In the event that ordinary cleaning is not adequate, special methods as approved by the Engineer may be used to clean the surface.
- B. After mortar has cured for at least 14 days but less than 28 days, fully hardened, thoroughly clean all exposed masonry surfaces of all excess mortar and foreign matter using stiff nylon or bristle brushes and clean water, spray applied at low to medium pressure. Care shall be taken to ensure stones and mortar are not abraded or damaged in any manner by the cleaning process.
 - 1. Use of metal scrapers will not be permitted.
 - 2. Use of muriatic acid as a cleaning agent will not be permitted.
 - 3. Proceed with cleaning in an orderly manner; work from top to bottom and from one end of each elevation to the other. Clean only after mortar has cured to its full strength, not less than 14 days.
 - 4. Perform cleaning in a manner which results in uniform coverage of all surfaces, including corners, moldings, interstices and which produces an even effect without streaking or damage to masonry surfaces.

3.06 DISPOSAL OF MATERIALS

- A. Under no circumstances shall wash water, concrete, mortar or other construction by-products be allowed to contaminate the site. All such materials shall be completely removed from the site by the Contractor.

3.07 FIELD QUALITY CONTROL

- A. The Owner's independent testing agency will perform field inspection and mortar compressive testing in accordance with Section 01 40 00 Quality Requirements.

END OF SECTION

SECTION 05 50 00
METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Shop fabricated steel items.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - CAST-IN-PLACE CONCRETE: Placement of metal fabrications in concrete.
- B. Section 06 1000 - Rough Carpentry
- C. Section 09 90 00 - Painting and Coating: Paint finish.

1.03 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel: 2012
- B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2013
- E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- F. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength;" 2013
- G. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes: 2011
- H. ASTM A 992/A 992M - Standard Specification for Structural Steel Shapes; 2004a.
- I. ASTM F 1554 - Standard Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength; 2004.
- J. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society; 2012.
- K. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2015.
- L. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; Society for Protective Coatings; 1999 (Ed. 2004).
- M. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); Society for Protective Coatings; 2002 (Ed. 2004).
- N. SSPC-SP 2 - Hand Tool Cleaning; Society for Protective Coatings; 1982 (Ed. 2004).

1.04 SUBMITTALS

- A. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
 - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

- A. Steel Sections and Plates: ASTM A 36/A 36M, A 572 or A 992.
- B. Steel Tubing: ASTM A 500, Grade B cold-formed structural tubing.

- C. Anchor Bolts: ASTM F 1554, Grade 36 or weldable Grade 55 with cut threads and ASTM A 563 heavy hex nuts and ASTM F 436 hardened steel washers. Galvanized to ASTM A 153 for galvanized hardware
- D. Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, galvanized to ASTM A 153/A 153M where connecting galvanized components.
- E. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- F. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction, ZRC Galvalite Galvanizing Repair Compound ZRC Worldwide. Material for brush application.

2.02 FABRICATION

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 FABRICATED ITEMS

- A. Wood beam hangers, wood beam to wood column brackets, and wood column bases
- B. Steel Braces and brackets

2.04 FINISHES - STEEL

- A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- B. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements. Provide minimum 1.7 oz/sq ft galvanized coating.

2.05 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch.
- C. Maximum Misalignment of Adjacent Members: 1/16 inch.
- D. Maximum Bow: 1/8 inch in 48 inches.
- E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

SECTION 06 10 00
ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Structural dimension lumber framing.
- B. Exposed timber structural framing.
- C. Non-structural dimension lumber framing.
- D. Rough opening framing for doors, windows, and roof openings.
- E. Structural roof framing.
- F. Sheathing.
- G. Roofing nailers.
- H. Preservative treated wood materials.
- I. Miscellaneous framing and sheathing.
- J. Wood nailers and curbs for roofing and items installed on roof.
- K. Concealed wood blocking, nailers, and supports.

1.02 RELATED REQUIREMENTS

- A. Section 06 17 53 - Shop-Fabricated Wood Trusses.
- B. Section 07 62 00 - Sheet Metal Flashing and Trim: Sill flashings.

1.03 REFERENCE STANDARDS

- A. AFPA (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings; American Forest and Paper Association; 2012.
- B. APA PRP-108, Form E445S - Performance Standards and Qualification Policy for Structural-Use Panels; June 2001.
- C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016.
- D. AWPAC C2 - Lumber, Timber, Bridge Ties and Mine Ties -- Preservative Treatment by Pressure Processes; American Wood-Preservers' Association; 2003.
- E. AWPAC C20 - Structural Lumber -- Fire Retardant Treatment by Pressure Processes; American Wood-Preservers' Association; 2003.
- F. AWPAC U1 - Use Category System: User Specification for Treated Wood; American Wood Protection Association; 2015.
- G. PS 1 - Structural Plywood; 2009.
- H. PS-20 - American Softwood Lumber Standard: National Institute of Standards and Technology (Department of Commerce) 2010.
- I. RIS (GR) - Standard Specifications for Grades of California Redwood Lumber; Redwood Inspection Service; 2000.
- J. SPIB (GR) - Grading Rules: Southern Pine Inspection Bureau, Inc. 2014
- K. WCLIB (GR) - Standard Grading Rules for West Coast Lumber No. 17; West Coast Lumber Inspection Bureau; 2004, and supplements.
- L. WWPA G-5 - Western Lumber Grading Rules; Western Wood Products Association; 2011.

1.04 QUALITY ASSURANCE

- A. Lumber: Comply with PS 20 and approved grading rules and inspection agencies.
 - 1. Acceptable Lumber Inspection Agencies: RIS, SPIB, WCLB, and WWPA.

2. Lumber of other species or grades, or graded by other agencies, is acceptable provided structural and appearance characteristics are equivalent to or better than products specified.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

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

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Sizes: Nominal sizes as indicated on drawings, S4S.
- B. Moisture Content: S-dry or MC19.
- C. Plates, Joist and Rafter Framing (2 by 6 through 4 by 16):
 1. Species: Douglas Fir-Larch.
 2. Grade: No. 2.
- D. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 1. Lumber: S4S, No. 2 or Standard Grade.
 2. Boards: Standard or No. 3.
- E. Miscellaneous Blocking, Furring, and Nailers:
 1. Lumber: S4S, No. 2 or Standard Grade.
 2. Boards: Standard or No. 3.

2.03 EXPOSED DIMENSION LUMBER FOR ARBOR

- A. Sizes: Nominal sizes as indicated on drawings.
- B. AC2 Cedar Tone Pressure Treated CS Lumber (Menards.com)
- C. Joist, Rafter, and Small Beam Framing (2 by 6 through 4 by 16):
 1. Species: Southern Pine.
 2. Grade: No. 1.

2.04 EXPOSED TIMBERS

- A. Submit manufacturer's certificate that products meet or exceed specified requirements, in lieu of grade stamping.
- B. Moisture Content: Kiln-dry (20 percent maximum).
- C. Surfacing: S4S.
- D. Species: Douglas Fir.
- E. Grade: Select Structural.

2.05 EXPOSED BOARDS

- A. Submit manufacturer's certificate that products meet or exceed specified requirements, in lieu of grade stamping.
- B. Moisture Content: Kiln-dry (15 percent maximum).
- C. Surfacing: S4S.
- D. Species: Douglas Fir.
- E. Grade: No. 2, 2 Common, or Construction.

2.06 CONSTRUCTION PANELS

- A. Roof Sheathing: Refer to drawings ,
 - 1. Structural I.
 - 2. Span Rating: 24/16.
 - 3. Thickness: 3/4 inch, nominal.
- B. Other Applications:
 - 1. Plywood Concealed From View But Located Within Exterior Enclosure: PS 1, C-C Plugged or better, Exterior grade.
 - 2. Plywood Exposed to View But Not Exposed to Weather: PS 1, A-D, or better.
 - 3. Other Locations: PS 1, C-D Plugged or better.
 - 4. Electrical Component Mounting: APA rated sheathing, fire retardant treated.

2.07 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Metal and Finish: Hot-dipped galvanized steel per ASTM A 153/A 153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.

2.08 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWP A U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
 - 1. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWP A standards.
- B. Preservative Pressure Treatment of Lumber Above Grade: AWP A U1, Use Category UC3B, Commodity Specification A using Treatment AC2 Cedar tone to .15 lb/cu ft retention.
 - 1. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
 - a. Treat lumber exposed to weather.
 - 2. Treat lumber in contact with concrete.
- C. Preservative Pressure Treatment of Lumber in Contact with Soil or Water: AWP A Use Category UC4A, Commodity Specification A (Treatment AC2 Cedar tone) to .25 lb/cu ft retention.
 - 1. Preservative for Field Application to Cut Surfaces: As recommended by manufacturer of factory treatment chemicals for brush-application in the field.

PART 3 EXECUTION

3.01 PREPARATION

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

3.02 INSTALLATION - GENERAL

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

3.03 FRAMING INSTALLATION

- A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.
- B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.
- C. Install structural members full length without splices unless otherwise specifically detailed.
- D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes and AFPA Wood Frame Construction Manual.

3.04 INSTALLATION OF ACCESSORIES AND MISCELLANEOUS WOOD

- A. Place sill gasket directly on sill flashing. Puncture gasket cleanly and fit tightly to protruding foundation anchor bolts.
- B. Coordinate installation of wood decking.
- C. Coordinate blocking installation with installation of decking and support of deck openings.

3.05 INSTALLATION OF CONSTRUCTION PANELS

- A. Roof Sheathing: Secure panels with long dimension perpendicular to framing members, with ends staggered and over firm bearing.
 - 1. Use sheathing clips between roof framing members.
 - 2. Provide solid edge blocking between sheets.
 - 3. Nail panels to framing; staples are not permitted.

3.06 TOLERANCES

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

END OF SECTION

SECTION 06 17 53
SHOP-FABRICATED WOOD TRUSSES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Shop fabricated wood trusses for roof framing.
- B. Bridging, bracing, and anchorage.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Material requirements for blocking, bridging, plates, and miscellaneous framing.

1.03 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- B. TPI 1 - National Design Standard for Metal Plate Connected Wood Truss Construction; Truss Plate Institute; 2007 and errata (ANSI/TPI 1).
- C. TPI DSB-89 - Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses; Truss Plate Institute; 1989.
- D. TPI HIB-91 - Commentary and Recommendations for Handling, Installing & Bracing Metal Plate Connected Wood Trusses; Truss Plate Institute; 1991.
- E. WWPA G-5 - Western Lumber Grading Rules; Western Wood Products Association; 2011.

1.04 DESIGN REQUIREMENTS

- A. See drawings and applicable codes for structural loading and deflection criteria.

1.05 SUBMITTALS

- A. Shop Drawings: Show truss configurations, sizes, spacing, size and type of plate connectors, cambers, framed openings, bearing and anchor details, and bridging and bracing.
 - 1. Include identification of engineering software used for design.
 - 2. Provide shop drawings stamped or sealed by design engineer licensed in the state which the project is located.
 - 3. Submit design calculations stamped or sealed by Design Engineer licensed in the state which the project is located.

1.06 QUALITY ASSURANCE

- A. Truss Design, Fabrication, and Installation: In accordance with TPI 1, TPI DSB-89, and BCSI 1.
- B. Fabricator Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- C. Designer Qualifications: Perform design by or under direct supervision of a Professional Engineer experienced in design of this Work and licensed in the state which the project is located.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Handle and erect trusses in accordance with TPI BCSI 1.
- B. Store trusses in vertical position resting on bearing ends.

1.08 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated.

PART 2 PRODUCTS

2.01 TRUSSES

- A. Wood Trusses: Designed and fabricated in accordance with TPI 1 and TPI DSB-89 to achieve structural requirements indicated.

1. Connectors: Steel plate.

2.02 MATERIALS

- A. Lumber:
 1. Grade: as required to meet performance requirements .
 2. Moisture Content: Between 7 and 19 percent.
 3. Lumber fabricated from old growth timber is not permitted.
- B. Lumber Grading Rules: WWPA G-5.
- C. Wood Members: Moisture content between 7 and 19 percent .
- D. Steel Connectors: Hot-dipped galvanized steel sheet, ASTM A653/A653M Structural Steel (SS) Grade 33/230, with G185/Z550 coating; die stamped with integral teeth; thickness as indicated.
- E. Truss Bridging: Type, size and spacing recommended by truss manufacturer.

2.03 ACCESSORIES

- A. Wood Blocking and Framing for Openings: Softwood lumber, S/P/F species, construction grade, 19 percent maximum and 7 percent minimum moisture content.
- B. Fasteners: Electrogalvanized steel, type to suit application.
- C. Bearing Plates: Electrogalvanized steel.

2.04 FABRICATION

- A. Fabricate trusses to achieve structural requirements specified.
- B. Brace wood trusses in accordance with TPI DSB-89 and BCSI 1.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that supports and openings are ready to receive trusses.

3.02 ERECTION

- A. Install trusses in accordance with manufacturer's instructions and TPI DSB-89 and TPI BCSI 1; maintain a copy of each TPI document on site until installation is complete.
- B. Set members level and plumb, in correct position.
- C. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure plumb, and in true alignment until completion of erection and installation of permanent bracing.
- D. Do not field cut or alter structural members without approval of Architect.
- E. Install permanent bridging and bracing.
- F. Install headers and supports to frame openings required.
- G. Frame openings between trusses with lumber in accordance with Section 06 10 00 Rough Carpentry.
- H. Coordinate placement of decking with work of this section.
- I. After erection, touch-up galvanized surfaces with zinc primer.

3.03 TOLERANCES

- A. Framing Members: 1/2 inch maximum, from true position.

END OF SECTION

SECTION 06 20 00
FINISH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wood trim & fascia boards.
- B. Plywood exterior siding.
- C. Hardware and attachment accessories.
- D. Products installed but not supplied under the work of this Section.
 - 1. Shelving.
 - 2. Toilet accessories.

1.02 RELATED SECTIONS

- A. Section 06 10 00 - Rough Carpentry: Support framing, grounds, and concealed blocking.
- B. Section 09 90 00 - Painting and Coating.
- C. Section 10 2810 - Toilet and Utility Room Accessories.

1.03 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
- B. AWI/AWMAC (QSI) - Architectural Woodwork Quality Standards Illustrated; Architectural Woodwork Institute and Architectural Woodwork Manufacturers Association of Canada; 2006, 8th Ed., Version 2.0.
- C. PS 20 - American Softwood Lumber Standard; National Institute of Standards and Technology (Department of Commerce); 2010.
- D. FSC-US; Forest Stewardship Council - Certified Products, www.findfsc.org.
- E. WMMPA WM Series - Softwood Moulding Patterns catalog; current edition.
- F. ANSI A208.1 - American National Standard for Medium Density Fiberboard for Interior Use; current edition.

1.04 SUBMITTALS

- A. Samples: Submit three samples of the following:
 - 1. Trim: 6 inch long indicating wood grain and finish.
 - 2. Fascia Board: 6 inch long indicating wood grain and finish.
 - 3. Plywood Exterior Siding: 24"X24" section indicating wood grain and finish.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with AWI Architectural Woodwork Quality Standards Illustrated, Custom grade.
- B. Grade materials in accordance with the following:
 - 1. Lumber Grading Agency: Certified by ALSC.
 - 2. Plywood: Certified by the American Plywood Association.
 - 3. Hardwood Lumber Grading: NHLA Grading Rules.
- C. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
- D. Preinstallation Conference
 - 1. A Preinstall-Conference shall be conducted at the site prior to the associated construction activity. The Owner's Representative, Contractor, related subcontractors and representatives of manufacturer and fabricators involved in or affected by the installation, and its coordination or integration with other materials and installation shall attend. Any related Testing and Inspecting firms retained by the owner may also attend.
 - 2. Verify all required submittals have been approved.

3. Verify all site conditions are acceptable to the installer for the associated scheduled construction.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect work from moisture damage.

PART 2 PRODUCTS

2.01 FINISH CARPENTRY ITEMS

- A. Quality Grade: Unless otherwise indicated provide products of quality specified by AWI/AWMAC/WI (AWS) for Premium Grade.
- B. Unless otherwise indicated provide products of quality specified by AWI Architectural Woodwork Quality Standards Illustrated for Premium grade.
- C. Unless otherwise indicated provide products of quality specified by Woodwork Institute Manual of Millwork for Premium grade.
- D. Exterior/Interior Woodwork Items:
 1. Interior/exterior wood trim and fascia boards: cedar; prepare for stained and sealed finish.
 - a. Nominal size as indicated on the drawings.
 2. Plywood exterior Siding:
 - a. Nominal size: 4'-0" x 8'-0" sheets. Nominal thickness: 5/8".
 - b. Primary Species: Doug Fir.
 - c. Pattern type: T1-11 with 8" on center grove spacing.
 - d. Finish type: rough sawn and prepare for a stained and sealed finish.
 - e. Plywood suitable for repeated wetting and redrying or long-term exposure to weather and other conditions of similar severity.

2.02 WOOD-BASED COMPONENTS

- A. Wood fabricated from old growth timber is not permitted.
- B. Forest Stewardship Council - certified wood is preferred.

2.03 FASTENINGS

- A. Provide nails, screws and other anchoring devices of type, size, material and finish suitable for intended use and required to provide secure attachment, concealed where possible. Hot-dip galvanize fasteners for work exposed to exterior and high humidity to comply with ASTM A153.

2.04 ACCESSORIES

- A. Lumber for Shimming, Blocking, and non-exposed supports: Softwood lumber of species specified in Section 06 1000 Rough Carpentry, for blocking and furring, etc.
- B. Primer: Alkyd primer sealer.
- C. Wood Filler: Solvent base, tinted to match surface finish color.

2.05 FABRICATION

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

2.06 FINISHING

- A. Apply wood filler in exposed nail and screw indentations.
- B. Finish all materials in accordance with finish specified and Section 09 9000 - Painting and Coating.
- C. Seal internal surfaces and semi-concealed surfaces. Brush apply only.
- D. Prime paint surfaces in contact with cementitious materials.
- E. Back prime woodwork items to be field finished, prior to installation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.02 INSTALLATION

- A. Install work in accordance with AWI/AWMAC/WI (AWS) requirements for grade indicated.
- B. Set and secure materials and components in place, plumb and level.
- C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.
- D. Anchor finish carpentry work securely to supports and substrates, using concealed fasteners and blind nailing where possible. Use fine finishing nails for exposed nailing except as indicated, countersunk and filled flush with finished surface. Make exterior joints water resistant by careful fitting. Use double dipped galvanized nails to nail exterior trim. Exterior trim to be pre-primed on all sides. Prime end cuts during installation. Finish work shall be free of defects including hammer marks. Exposed edges shall be coped and mitered. Miter and return handrail ends to the wall.
- E. Installation of Standing, Running Trim & Fascia Boards:
 - 1. Install with minimum number of joints possible, using full-length pieces from maximum length of lumber available. Cope at returns, miter at corners to produce tight fitting joints. Use scarf joints for end-to-end joints.

3.03 PREPARATION FOR SITE FINISHING

- A. Set exposed fasteners. Apply wood filler in exposed fastener indentations. Sand work smooth.
- B. Site Finishing: See Section 09 90 00 - Painting and Coating.
- C. Before installation, prime paint surfaces of items or assemblies to be in contact with cementitious materials.

3.04 ERECTION TOLERANCES

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

END OF SECTION

SECTION 07 21 00
THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Board insulation at underside of floor slabs.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - CAST-IN-PLACE CONCRETE: Field-applied termiticide for concrete slabs and foundations.

1.03 REFERENCE STANDARDS

- A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2010.
- B. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2015a.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

1.04 SUBMITTALS

- A. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

PART 2 PRODUCTS

2.01 APPLICATIONS

- A. Insulation Under Concrete Slabs: Extruded polystyrene board.

2.02 FOAM BOARD INSULATION MATERIALS

- A. Extruded Polystyrene Board Insulation: Extruded polystyrene board; ASTM C578; with either natural skin or cut cell surfaces, and the following characteristics:
 - 1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 - 3. R-value; 1 inch of material at 72 degrees F: 5, minimum.
 - 4. Board Edges: Square.
 - 5. Water Absorption, Maximum: 0.3 percent, by volume.
 - 6. Manufacturers:
 - a. Dow Chemical Co: www.dow.com.
 - b. Owens Corning Corporation: www.ocbuildingspec.com.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 ACCESSORIES

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION UNDER CONCRETE SLABS

- A. Place insulation under slabs on grade after base for slab has been compacted.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- C. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

3.03 PROTECTION

- A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 07 61 00
SHEET METAL ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sheet metal roofing, associated flashings, and underlayment.
- B. Counterflashings.
- C. Accessories, including Snow guards.
- D. Sealants for joints within sheet metal fabrications.

1.02 REFERENCE STANDARDS

- A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2012.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- C. SMACNA (ASMM) - Architectural Sheet Metal Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2012.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
- C. Product Data: Provide data on metal types, finishes, characteristics .
- D. Submit two samples 24 x 24 inch in size illustrating metal finish color.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA Architectural Sheet Metal Manual requirements and standard details, except as otherwise noted.
- B. Installer Qualifications: Company specializing in performing sheet metal roof installations with minimum 5 years of experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- B. Prevent contact with materials that could cause discoloration or staining.

1.06 WARRANTY

- A. Correct defective Work within a five year period after Date of Substantial Completion. Defective work includes degradation of metal finish.
- B. Provide twenty five year manufacturer warranty for sheet metal roofing. Warranty shall include degradation of metal finish.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

- A. Manufacturers:
 - 1. Firestone Building Products Company: www.firestonebpco.com.
 - 2. Pac-Clad by Petersen Aluminum Corporation: www.pac-clad.com
 - 3. ColorKlad by Ryerson Building Products: www.ryerson.com
- B. Base Manufacturer: Firestone Building Products Company, unless noted otherwise.
 - 1. Firestone Building Products Company; Uniclاد; Standing Seam Panel Roof; UC-4.
- C. Pre-Finished Galvanized Steel Sheet: ASTM A653/A653M, with G90/Z275 zinc coating; 24 gage core steel, shop pre-coated with modified silicone coating; Patina color.
- D. Self-locking, architectural standing seam metal roof panel.

2.02 ACCESSORIES

- A. Fasteners: Galvanized steel, with soft neoprene washers.
- B. Underlayment Basis of Design: Clad-Guard SA, Firestone Building Products Co. Provide underlayment as required to achieve any warranty as described in this section.
- C. Snow guard Basis of Design: ColorGard; S-5 Solutions or approved equal.
- D. Provide non-penetrating prefinished, preformed metal snow guards as indicated on architectural drawings as required to maintain any warranty as described in this section.
 - 1. Color: to match roof.

2.03 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Fabricate cleats of same material as sheet, same gage as roofing sheet, minimum 2 inches wide, interlockable with sheet.
- C. Fabricate starter strips, interlockable with sheet.
- D. Form pieces in longest practical lengths.
- E. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- F. Form material with standing seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

2.04 FACTORY FINISHING

- A. Color Anodized Finish: AAMA 611 AA-M12C22A42/44 Class I integrally or electrolytically colored anodic coating not less than 0.7 mils thick.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Inspect roof deck to verify deck is clean and smooth, free of depressions, waves, or projections, properly sloped to drains.
- B. Verify deck is dry and free of snow or ice. Verify joints in wood deck are solidly supported and fastened.
- C. Verify correct placement of wood nailers and insulation positioning between nailers.
- D. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, reglets are in place, and nailing strips located.
- E. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.
- B. Back paint concealed metal surfaces and surfaces in contact with dissimilar metals with protective backing paint to a minimum dry film thickness of 15 mil.

3.03 INSTALLATION - ROOFING

- A. Install roofing in accordance with manufacturer's instructions.
- B. Apply underlayment over entire roof area.
- C. Apply slip sheet in one layer, laid loose.
- D. Cleat and seam all joints.
- E. Use plastic cement for joints between metal and bitumen and for joints between metal and felts.

3.04 INSTALLATION - STANDING SEAM ROOFING

- A. Space standing seams as dimensioned on drawings.
- B. Lay sheets with long dimension perpendicular to eaves. Apply pans beginning at eaves.
- C. Lock cleats into seams and flatten.

- D. Stagger transverse joints of roofing sheets.
- E. At eaves and gable ends, terminate roofing by hooking over edge strip.
- F. Bend up one side edge 1-1/2 inches and other edge 1-3/4 inches.
- G. Make first fold 1/4 inch wide single fold and second fold 1/2 inch wide, providing locked portion of standing seam, 5 plies in thickness.
- H. Fold lower ends of seams at eaves over at 45 degree angle.
- I. Terminate standing seams at ridge and hips by turning down with tapered fold.

3.05 INSTALLATION - FLASHINGS

- A. Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted.
- B. Cleat and seam all joints.
- C. Apply plastic cement compound between metal flashings and felt flashings.
- D. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- E. Seal metal joints watertight.

3.06 PROTECTION

- A. Do not permit traffic over unprotected roof surface.

END OF SECTION

SECTION 07 62 00
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fabricated sheet metal items, including flashings, counterflashings, gutters, and downspouts.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood nailers for sheet metal work.
- B. Section 07 61 00 - Sheet Metal Roofing.

1.03 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2013.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- C. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2009.
- D. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2012)e1.
- E. SMACNA (ASMM) - Architectural Sheet Metal Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2012.

1.04 SUBMITTALS

- A. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
- B. Samples: Submit two samples 6"x6" inch in size illustrating metal finish color.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.
- B. Fabricator and Installer Qualifications: Company specializing in sheet metal work with five years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

- A. Sheet metal to be provided by the same manufacturer as the Sheet Metal Roofing.
- B. Manufacturers:
 - 1. Firestone Building Products Company: www.firestonebpco.com.
 - 2. Pac-Clad by Petersen Aluminum Corporation: www.pac-clad.com
 - 3. ColorKlad by Ryerson Building Products: www.ryerson.com
- C. Color: Patina.
- D. Color-coated steel: kynar 500 flouropolymer coating factory applied to 24-guage galvanized steel, ASTM A635. Touch -up paint for color-coated sheet metal shall be color match as recommended and supplied by the sheet metal manufacturer.

2.02 ACCESSORIES

- A. Fasteners: Same material and finish as flashing metal, with soft neoprene washers.

- B. Underlayment: ASTM D226/D226M, organic roofing felt, Type I ("No. 15").
- C. Primer: Zinc chromate type.
- D. Protective Backing Paint: Zinc molybdate alkyd.
- E. Plastic Cement: ASTM D4586, Type I.

2.03 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Fabricate cleats of same material as sheet, minimum 2 inches wide, interlocking with sheet.
- C. Form pieces in longest possible lengths.
- D. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- E. Form material with flat lock seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- F. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.
- G. Fabricate flashings to allow toe to extend 2 inches over roofing gravel. Return and brake edges.

2.04 GUTTER AND DOWNSPOUT FABRICATION

- A. Gutters: SMACNA (ASMM), Rectangular profile.
- B. Downspouts: Rectangular profile.
- C. Gutters and Downspouts: Size indicated.
- D. Accessories: Profiled to suit gutters and downspouts.
 - 1. Anchorage Devices: In accordance with SMACNA requirements.
 - 2. Gutter Supports: Brackets.
 - 3. Downspout Supports: Brackets.
- E. Downspout Boots: Steel.
- F. Seal metal joints.

PART 3 EXECUTION

3.01 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.
- B. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

3.02 INSTALLATION

- A. Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted.
- B. Apply plastic cement compound between metal flashings and felt flashings.
- C. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- D. Seal metal joints watertight.
- E. Secure gutters and downspouts in place using concealed fasteners.
- F. Connect downspouts to downspout boots. Grout connection watertight.

3.03 FIELD QUALITY CONTROL

- A. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

END OF SECTION

SECTION 07 90 00

SEALANT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sealing expansion joints and control joints.
- B. Sealing metal flashing.
- C. All other sealing work indicated on the Drawings and not specified under other Sections.

1.02 SUBMITTALS

- A. Samples: Submit color samples of sealant exposed to view in the finished work to the Owner's Representative. Sealant colors selected from Manufacturer's standard range.
- B. Manufacturer's Product Data: Submit sealant Manufacturer's product data to the Architect.
- C. Manufacturer's Installation Instructions, Approval, and Recommendations: Submit Manufacturer's instructions for joint size, joint preparation and priming, back-up material and sealant storage, mixing and application instructions.

1.03 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to project in original, unopened containers or bundles with information labels on manufacturer, product name, date of manufacture, shelf-life and application instructions.
- B. Sealant having a date of manufacture in excess of 6 months from date of delivery shall be returned and not used on the project.
- C. Store and handle materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.04 PROJECT CONDITIONS

- A. Do not apply sealant materials at temperatures below 40 degrees F., during rain or snow, or to a damp or frosted surface.
- B. Do not proceed with installation of sealant when joint widths are less than allowed by joint sealant Manufacturer for application required.

1.05 QUALITY ASSURANCE

- A. Installer shall be a firm with five (5) years experience specializing in the installation of sealant.
- B. All sealant application conditions shall have written approval by joint sealant manufacturers prior to sealant installation preparation and application.

1.06 WARRANTY

- A. Warrant sealant joints, against adhesive and cohesive failure of the sealant and against air and water penetration through the sealed joint for not less than five years. Provide manufacturer's written warranties for each product used on the Project.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Polyurethane, Exterior and Interior: Two-component, complying with Federal Specification TT-S-00227E, Type II, Class A:
 - 1. Sonolastic NP 2 by Sonneborn Building Products, Division of Contech, Inc.
 - 2. DyMeric 240 FC by Tremco.
 - 3. Approved Equal: See Section 01 6000 - Product Requirements.
- B. Silicone:
 - 1. Dow 795 by Dow Corning.
 - 2. Spectrum 2 by Tremco.
 - 3. GE Silpruf by General Electric.
 - 4. Sonolastic NP 2 by Sonneborn

- C. Primer: Product as recommended by sealant Manufacturer for substrate compatibility.
- D. Backer Rod: Type B - ASTM C 1330; Cylindrical, non-oily, non-gassing, non-absorbent, non-staining polyolefin foam with a bi-cellular structure and/or acceptable material as recommended or accepted by the sealant manufacturer.
 - 1. Similar to "Sof Rod" by Nomaco.
- E. Cleaning Solvents: Use products compatible with surfaces to be cleaned and with primer and per sealant Manufacturer's recommendations.

2.02 MIXING

- A. Prepare and mix sealant strictly according to the Manufacturer's instructions. Do not thin the materials.
- B. Use two-component sealant within the maximum period of time after mixing recommended by the Manufacturer for the specific material and job conditions, and discard sealant not used within this time.

PART 3 EXECUTION

3.01 PREPARATION

- A. Surfaces to be sealed shall be sound, thoroughly dry, clean and free of oil, grease, laitance, rust and other foreign material that would prevent proper adhesion. Concrete and mortar shall be thoroughly cured.
- B. Remove existing sealant, backer rod, and other debris at existing sealant joints at exterior elevations noted as having new sealants.
- C. Clean and prepare joints and surfaces to receive sealant strictly according to sealant Manufacturer's instructions. Rake and clean out mortar joints to full depth and width.
- D. Clean concrete and porous surfaces by brushing, grinding, sand-blasting or other mechanical means as necessary to provide a sound, clean surface. Remove dust, dirt and loose particles resulting from mechanical cleaning by vacuuming joints or blowing out joints with compressed air.
- E. Clean glass, metal and other non-porous surfaces, including the subflashing membrane. Use clean white cloths or lintless paper towels to apply solvent, and wipe surfaces dry with dry cloths or paper towels. Do not allow solvent to dry without wiping.
- F. Mask joints as necessary to protect adjacent surfaces. Apply masking tape in continuous strips and carefully align with edge of joint.
- G. Design Professional to review sealant substrate on-site with Manufacturer and Owner's Representative to observe that surface preparation is acceptable. Placed concrete, mortar, and grout require 28-days of field curing before sealant or primer application.

3.02 APPLICATION OF SEALANTS

- A. Install backer rod in all butt joints to receive sealant. Use proper size and shape pieces so that installed foam is compressed approximately 30% and face of foam is at the required depth. Do not twist or braid rod stock. Carefully roll rod stock into the joint without stretching.
- B. Joints to receive polyurethane sealant shall not be less than ¼" wide. Maintain proper joint depth ratio at ½ the width of the joint, with a maximum depth of ½" and a minimum of ¼".
- C. Apply primer to all substrates. Prime surfaces strictly according to the sealant Manufacturer's instructions. Do not prime backer rod.
- D. Install bond breaker tape, as instructed by the manufacturer, where three-sided adhesion is likely. Three-sided adhesion must be avoided.
- E. Apply sealant strictly according to the Manufacturer's instructions. Material shall be gun-applied using a nozzle of sufficient size to fill the joint completely. Caulk wide joints with three passes. Run a bead at each inside corner, and fill joint with a third pass. Tool joints immediately after application of material to insure full contact with adjacent surfaces. Strike off excess material.

The finished bead shall be flush with the adjoining surfaces, unless otherwise indicated on the Drawings.

- F. Trowel all cap seals. Remove and replace any sealant which develops gas bubbles.
- G. Remove masking immediately after joints have been sealed and tooled and leave adjacent surfaces clean and free of sealant and primer.
 - 1. Test Frequency: Once for each substrate type.
 - 2. Complete surface preparation.
- H. Check that primers have been used. Review applications for sealant joint wetting, tooling, shoulder bond, and general cross-section configuration. Review identifications and mixing time (typically 5 to 7 minutes).
 - 1. Test Frequency: Spot-check basis for each type of substrate.
 - 2. Remove unsound sealant and adjust application.
 - 3. Installation of sealant and priming activities shall not be applied when the air or substrate temperatures are 40 degrees or less.

3.03 FIELD QUALITY CONTROL

- A. Adhesion tests shall be performed on field samples per Quality Assurance.
- B. Comply with joint sealant manufacturer's instructions.

3.04 SCHEDULE FOR APPLICATION OF SEALANTS

- A. Applications:
 - 1. Exterior, exposed above-grade, masonry, stone or concrete bonding surface.
 - a. Sealant Type: Polyurethane, two-part
 - 2. Exterior, exposed above-grade, masonry, to metal bonding surfaces
 - a. Sealant Type: Polyurethane, two-part
 - 3. Exterior, exposed above-grade, metal-to-metal bonding surfaces
 - a. Sealant Type: Silicone
 - 4. Exterior, exposed above-grade, glass-to-metal or glass-to-glass bonding surface
 - a. Sealant Type: Silicone
 - 5. Exterior, concealed above-grade, metal-to-metal or metal-to-masonry or metal-to-concrete or glass-to-metal bonding surfaces
 - a. Sealant Type: Silicone
 - 6. Exterior, concealed above-grade, metal-to-metal bonding surfaces in lap joints in flashings
 - a. Sealant Type: Silicone
 - 7. Interior, exposed metal, masonry, stone or concrete bonding surfaces
 - a. Sealant Type: Polyurethane, two-part

END OF SECTION

SECTION 08 11 13
STEEL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Steel doors and frames.

1.02 RELATED SECTIONS

- A. Section 08 71 00 - Door Hardware.
- B. Section 09 91 13 - Exterior Painting: Field painting.

1.03 REFERENCE STANDARDS

- A. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2003.
- B. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2014.
- C. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- E. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2014 (ANSI/BHMA A156.115).
- F. DHI A115 Series - Specifications for Steel Doors and Frame Preparation for Hardware; Door and Hardware Institute; 2000 (ANSI/DHI A115 Series).
- G. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc.; current edition.
- H. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; 2007.
- I. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2014.
- J. UL (BMD) - Building Materials Directory; current edition.
- K. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- L. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- M. UL 1784 - Standard for Air Leakage Tests of Door Assemblies and Other Opening Protectives; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Maintain at the project site a copy of all reference standards dealing with installation.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store in accordance with NAAMM HMMA 840.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Steel Doors and Frames:
 - 1. Ceco Door Products: www.cecodoor.com.

2. Republic Doors: www.republicdoor.com.
3. Steelcraft: www.steelcraft.com.
4. Curries: www.curries.com.
5. Kewaunee: www.kewaunee.com.
6. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 DOORS AND FRAMES

- A. Requirements for All Doors and Frames:
 1. Hardware Preparation: In accordance with BHMA A156.115, with reinforcement welded in place, in addition to other requirements specified in door grade standard.
 2. Finish: Factory primed, for field finishing.
- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with all the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 STEEL DOORS

- A. Exterior Doors :
 1. Grade: ANSI A250.8 Level 3, physical performance Level A, Model 2, seamless; 16 gauge.
 2. Core: Polyurethane.
 3. Galvanizing: All components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A 653/A 653M, with manufacturer's standard coating thickness.
 4. Texture: Smooth faces.
 5. Weatherstripping: Separate, see Section 08 71 00 Door Hardware.
 6. Factory primed for field painting.

2.04 STEEL FRAMES

- A. General:
 1. Finish: Same as for door.
 2. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
 3. Provide factory recommended anchorage for wall type.
- B. Exterior Door Frames: Fully welded.
 1. Galvanizing: All components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A 653/A 653M, with manufacturer's standard coating thickness.
 2. Weatherstripping: Separate, see Section 08 71 00 Door Hardware.

2.05 ACCESSORY MATERIALS

- A. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws. Removable Stops shall be on secured side of the opening.
- B. Grout for Frames: Portland cement grout of maximum 4-inch slump for hand troweling; thinner pumpable grout is prohibited.
- C. Silencers: Resilient rubber, fitted into drilled hole; 3 on strike side of single door, 3 on center mullion of pairs, and 2 on head of pairs without center mullions.
- D. Temporary Frame Spreaders: Provide for all factory- or shop-assembled frames.
- E. Fibered Asphalt Emulsion: GAF Topcoat Matrix 305 or approved equal.

2.06 FINISH MATERIALS

- A. Primer: Rust-inhibiting, complying with ANSI A250.10, door manufacturer's standard.
- B. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

- A. Coat inside of frames to be installed in masonry or to be grouted, with fibered asphalt emulsion, prior to installation.

3.03 INSTALLATION

- A. Install in accordance with the requirements of the specified door grade standard and NAAMM HMMA 840.
- B. Coordinate frame anchor placement with wall construction.
- C. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- D. Coordinate installation of hardware.
- E. Touch up damaged factory finishes.

3.04 TOLERANCES

- A. Maximum Diagonal Distortion: 1/16 in measured with straight edge, corner to corner.

3.05 ADJUSTING

- A. Adjust for smooth and balanced door movement.

3.06 SCHEDULE

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

END OF SECTION

SECTION 08 71 00
DOOR HARDWARE

PART 1 GENERAL

1.01 WORK INCLUDED

- A. This section includes the following:
1. Furnish door hardware specified herein, listed in the hardware schedule, and/or required by the drawings.
 2. Thresholds and Weather-stripping
 3. Where items of hardware are not definitely or correctly specified and is required for the intended service, such omission, error or other discrepancy should be directed to the Architect prior to the bid date for clarification by addendum. Otherwise furnish such items in the type and quantity established by this specification for the appropriate service intended.

1.02 REFERENCES

- A. Publications of agencies and organizations listed below form a part of this specification section to the extent referenced.
1. DHI - Recommended Locations for Builders' Hardware.
 2. NFPA 80 - Standards for Fire Doors and Windows.
 3. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures.
 4. UL - Building Material Directory.
 5. DHI - Door and Hardware Institute
 6. WHI - Warnock Hersey
 7. BHMA - Builders Hardware Manufacturers Association
 8. IBC 2006 - International Building Code 2006 Edition (as amended by local building code)

1.03 SUBMITTALS

- A. Schedule format shall be consistent with recommendations for a vertical format as set forth in the Door & Hardware Institute's (DHI) publication "Sequence and Format for the Hardware Schedule". Hardware sets shall be consolidated to group multiple door openings which share similar hardware requirements. Schedule shall include the following information:
1. Door number, location, size, handing, and rating.
 2. Door and frame material, handing.
 3. Degree of swing.
 4. Manufacturer
 5. Product name and catalog number
 6. Function, type and style
 7. Size and finish of each item
 8. Mounting heights
 9. Explanation of abbreviations, symbols, etc.
 10. Numerical door index, indicating the hardware set/ group number for each door.
 11. The schedule will be prepared under the direct supervision of a certified Architectural Hardware Consultant (AHC) employed by the hardware distributor. The hardware schedule shall be signed and embossed with the DHI certification seal of the supervising AHC. The supervising AHC shall attend any meetings related to the project when requested by the architect.
 12. Check the specified hardware for suitability and adaptability to the details and surrounding conditions.
 13. Review drawings from related trades as required to verify compatibility with specified hardware. Indicate unsuitable or in compatible items, and proposed substitutions in the hardware schedule.
 14. Furnish manufacturers' catalog data for each item of hardware
 15. Furnish approved hardware schedules, template lists, and pertinent templates as requested by related trades.

16. Furnish necessary diagrams, schematics, voltage and amperage requirements for all electro-mechanical devices or systems as required by related trades. Wiring diagrams shall be opening specific and include both a riser diagram and point to point diagram showing all wiring terminations.
17. After receipt of approved hardware schedule, Hardware supplier shall initiate a meeting including the owner's representative to determine keying requirements. Upon completion of the initial key meeting, hardware supplier shall prepare a proposed key schedule with symbols and abbreviations as set forth in the door and hardware institute's publication "Keying Procedures, Systems, and Nomenclature". Submit copies of owner approved key schedule for review and field use in quantities

1.04 QUALITY ASSURANCE

- A. Manufacturers and model numbers listed are to establish a standard of function and quality. Similar items by approved manufacturers that are equal in design, function, and quality, may be considered for prior approval of the architect, provided the required data and physical samples are submitted for approval as set forth in Division One General Requirements.
- B. Obtain each type of hardware (hinges, latch & locksets, exit devices, closers, etc.) from a single manufacturer, although several may be indicated as offering products complying with requirements.
- C. Hardware supplier shall be factory trained and certified by the manufacture to provide and support all computer managed locks and system components.
- D. Installation of hardware shall be installed or directly supervised and inspected by a skilled installer certified by the manufacturer of locksets, door closers, and exit devices used on the project, or with not less than 3 years experience in successful completion of projects similar in size and scope.
- E. Hardware supplier shall participate when reasonably requested to meet with the contractor and or architect to inspect any claim for incorrect or non-functioning materials; following such inspection, the hardware supplier shall provide a written statement documenting the cause and proposed remedy of any unresolved items.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Hardware supplier shall deliver hardware to the job site unless otherwise specified.
- B. All hardware shall be delivered in manufacturers' original cartons and shall be clearly marked with set and door number.
- C. Coordinate with contractor prior to hardware delivery and recommend secure storage and protection against loss and damage at job site.
- D. Contractor shall receive all hardware and provide secure and proper protection of all hardware items to avoid delays caused by lost or damaged hardware. Contractor shall report shortages to the Architect and hardware supplier immediately after receipt of material at the job site.
- E. Coordinate with related trades under the direction of the contractor for delivery of hardware items necessary for factory installation.

1.06 PRE-INSTALLATION MEETING

- A. Schedule a hardware pre-installation meeting on site to review and discuss the installation of continuous hinges, locksets, door closers, exit devices, overhead stops.
- B. Meeting attendees shall be notified 7 days in advance and shall include: Architect, Contractor, Door Hardware Installers (including low voltage hardware), Manufacturers representatives for above hardware items, and any other effected subcontractors or suppliers.
- C. All attendees shall be prepared to distribute installation manuals, hardware schedules, templates, and physical hardware samples.

1.07 WARRANTY

- A. All hardware items shall be warranted against defects in material and workmanship as set forth in Division One General Requirements.

- B. Repair, replace, or otherwise correct deficient materials and workmanship without additional cost to owner.

PART 2 PRODUCTS

2.01 FASTENERS

- A. All exposed fasteners shall be Phillips head or as otherwise specified, and shall match the finish of the adjacent hardware. All fasteners exposed to the weather shall be non-ferrous or stainless steel. Furnish correct fasteners to accommodate surrounding conditions.
- B. Where torx tamper resistant fasteners have been specified for a specific hardware group, provide torx head fasteners with center pin on ALL exposed fasteners.
- C. Coordinate required reinforcements for doors and frames. Seek approval of the architect prior to furnishing through-bolts. Furnish through-bolts as required for materials not readily reinforced.

2.02 BUTT HINGES

- A. Acceptable manufacturers and respective catalog numbers:
- B.

	Stanley	Hager	McKinney
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- C. Heavy Weight, Ball Bearing, Non-Ferrous
T4B3386

	5BB1HW	FBB199	BB1199
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 - 1. Unless otherwise specified, furnish the following hinge quantities for each door leaf.
 - a. 3 hinges for doors up to 90 inches.
 - b. 1 additional hinge for every 30 inch on doors over 90 inches.
 - c. 4 hinges for Dutch door applications.
 - 2. Unless otherwise specified, top and bottom hinges shall be located as specified in division 8 Section "Hollow Metal Doors and Frames". Intermediate hinges shall be located equidistant from others.
 - 3. Unless otherwise specified, furnish hinge weight and type as follows:
 - a. Heavyweight: 4 ball bearing hinge 5BB1HW Stainless Steel
 - 4. Unless otherwise specified, furnish hinges in the following sizes:
- D. 4-1/2" x 4-1/2" 1-3/4" thick doors
 - 1. Unless otherwise specified, furnish all hinges to template standards.

2.03 LOCKS AND LATCHES

- A. Acceptable manufacturers and respective catalog numbers:
- B.

	Schlage	Best	Sargent
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- C. Grade 1 Mortise

L Series 06N	45H Series 15J	8200 LW1L
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- D. Small Case Mortise Deadbolt

L400 Series	39H Series	4870 Series
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 - 1. Unless otherwise specified, all locks and latches to have:
 - a. 2-3/4" Backset
 - b. 1/2" minimum throw latchbolt
 - c. 1" throw deadbolt
 - d. 6 pin cylinders
 - e. ANSI A115.2 strikes
 - 2. Provide guarded latch bolts for all locksets, and latch bolts with sufficient throw to maintain fire rating of both single and paired door assemblies.
 - 3. Length of strike lip shall be sufficient to clear surrounding trim.
 - 4. Provide wrought boxes for strikes at inactive doors, wood frames, and metal frames without integral mortar covers.

2.04 CLOSERS

- A. Acceptable manufacturers and respective catalog numbers:
- B. No Substitution

C. 4510 EDA

1. Obtain door closers from a single manufacturer, although several may be indicated as offering products complying with requirements.
2. Provide extra heavy duty arm (EDA / HD).
3. Closers shall use high strength cast iron cylinders, forged main arms, and 1 piece forged steel pistons.
4. Closers shall utilize a stable fluid withstanding temperature range of +120deg F to -30deg F without seasonal adjustment of closer speed to properly close the door. Closers for fire-rated doors shall be provided with temperature stabilizing fluid that complies with standards UL10C.
5. Unless otherwise specified, all door closers shall have full metal covers and separate adjusting valves for sweeps, latch, and backcheck.
6. Provide closers for all labeled doors. Provide closer series and type consistent with other closers for similar doors specified elsewhere on the project.
7. Provide closers with adjustable spring power. Size closers to insure exterior and fire rated doors will consistently close and latch doors under existing conditions. Size all other door closers to allow for reduced opening force not to exceed 5 lbs.
8. Install closers on the room side of corridor doors, stair side of stairways and interior side of exterior doors.
9. Closers shall be furnished complete with all mounting brackets and cover plates as required by door and frame conditions, and by adjacent hardware.
10. Door closers shall be provided with a powder coat finish to provide superior protection against the effects of weathering. Powder coat finish shall successfully pass a 100 hour salt spray test.

2.05 KICK PLATES AND MOP PLATES

- A. Furnish protective plates as specified in hardware groups.
- B. Where specified, provide 10" kick plates, 34" armor plates, and 4" mop plates. Unless otherwise specified, metal protective plates shall be .050" thick; plastic plates shall be 1/8" thick.
- C. Protective plates shall be 2" less door width, or 1" less door width at pairs. All protective plates shall be beveled 4 sides and counter sunk. Protection plates over 16" shall not be provided for labeled doors unless specifically approved by door manufacturers listing.
- D. Where specified, provide surface mounted door edges. Edges shall butt to protective plates. Provide edges with cutouts as required adjacent hardware.
- E. Adjust dimensions of protection plates to accommodate stile and rail dimensions, lite and louver cutouts, and adjacent hardware. Where required by adjacent hardware, protection plates shall be factory drilled for cylinders or other mortised hardware.

2.06 OVERHEAD STOPS

- A. Acceptable manufacturers and respective catalog numbers:
- B.

Glynn-Johnson	Rixson	Sargent
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- C. Heavy Duty Surface Mount

GJ900 Series	9 Series	590
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 1. Overhead stops (including slide block and end caps) shall be fabricated from metal.
 2. Unless otherwise specified, furnish GJ900 series overhead stop for doors equipped with regular arm surface type closers that swing more than 140 degrees before striking a wall, for doors that open against equipment, casework, sidelights, or other objects that would make wall bumpers inappropriate, and as specified in hardware groups.

2.07 WALL STOPS AND HOLDERS

- A. Acceptable manufacturers and respective catalog numbers:
- B.

Hager	Burns
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- C. Wrought Convex Wall Bumper

WS406CVX 232W	570
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 1. Furnish a stop or holder for all doors. Furnish floor stops only where specifically specified.

2. Where wall stops are not applicable, furnish overhead stops.

2.08 WEATHERSTRIP, GASKETING

- A. Acceptable manufacturers and respective catalog numbers:
- B.

	Zero	Pemko	NGP	Reese
--	------	-------	-----	-------
- C. Weatherstrip

429	2891_PK	700NA	755
-----	---------	-------	-----
- D. Sweeps

8192	18061_NB	B606	964
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- E. Drip Cap

142	346	16	R201
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 1. Where specified in the hardware groups, furnish the above products unless otherwise detailed in groups.
 2. Provide weatherstripping all exterior doors and where specified.

2.09 THRESHOLDS

- A. Acceptable manufacturers and respective catalog numbers:
- B.

	Zero	Pemko	NGP	Reese
--	------	-------	-----	-------
- C. Saddle Thresholds

554	270	413	S404
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 1. Hardware supplier shall verify all finish floor conditions and coordinate proper threshold as required to insure a smooth transition between threshold and interior floor finish.

2.10 FINISHES AND BASE MATERIALS

- A. Unless otherwise indicated in the hardware groups or herein, hardware finishes shall be applied over base metals as specified in the following finish schedule:
- B. HARDWARE ITEM BHMA FINISH AND BASE MATERIAL
- C. Butt Hinges: 630 (US32D - Satin Stainless Steel)
- D. Locks and Latches 626 (US26D - Satin Chromium)
- E. Closers 689 (Powder Coat Aluminum)
- F. Protective Plates 630 (US32D - Satin Stainless Steel)
- G. Overhead Stops 630 (US32D - Satin Stainless Steel)
- H. Wall Stops and Holders 630 (US32D - Satin Stainless Steel)
- I. Thresholds 628 (Mill Aluminum)
- J. Weather-strip, Sweeps Drip Caps Aluminum Anodized
- K. Miscellaneous 626 (US26D - Satin Chromium)

2.11 KEYING

- A. Provide all cylinders in keyways as required to accommodate owners existing key system.
- B. All locks under this section shall be keyed as directed by the owner to an existing Master Key System.
- C. Furnish a total of 2 keys per cylinder. Actual cut keys to be determined by owner.
- D. Master keys, control keys, and change keys shall be delivered by registered mail to the owner. Construction keys shall be delivered to the contractor.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Prior to installation of hardware, installer shall examine door frame installation to insure frames have been set square and plumb. Installer shall examine doors, door frames, and adjacent wall, floor, and ceiling for conditions, which would adversely effect proper operation and function of door assemblies. Do not proceed with hardware installation until such deficiencies have been corrected.

3.02 INSTALLATION

- A. Before hardware installation, general contractor/construction manager shall coordinate a hardware installation seminar with a 1 week notice to all parties involved. The seminar is to be conducted on the installation of hardware, specifically of locksets, closers, exit devices, continuous hinges and overhead stops. Manufacturer's representative of the above products to present seminar. Seminar to be held at the job site and attended by installers of hardware (including low voltage hardware) for aluminum, hollow metal and wood doors. Training to include use of installation manuals, hardware schedule, templates and physical products samples.
- B. Install all hardware in accordance with the approved hardware schedule and manufacturers instructions for installation and adjustment.
- C. Set units level, plumb and true to the line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- D. Drill and countersink units which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accord with industry standards.
- E. Drill appropriate size pilot holes for all hardware attached to wood doors and frames.
- F. Shim doors as required to maintain proper operating clearance between door and frame.
- G. Unless otherwise specified, locate all hardware in accordance with the recommended locations for builders hardware for standard doors and frames as published by the Door and Hardware Institute.
- H. Use only fasteners supplied by or approved by the manufacturer for each respective item of hardware.
- I. Mortise and cut to close tolerance and conceal evidence of cutting in the finished work.
- J. Conceal push and pull bar fasteners where possible. Do not install through bolts through push plates.
- K. Install hardware on UL labeled openings in accordance with manufacturer's requirements to maintain the label.
- L. Apply self-adhesive gasketing on frame stop at head & latch side and on rabbet of frame at hinge side.
- M. Install hardware in accordance with supplemental "S" label instructions on all fire rated openings.
- N. Install wall stops to contact lever handles or pulls. Do not mount wall stops on casework, or equipment.
- O. Where necessary, adjust doors and hardware as required to eliminate binding between strike and latchbolt. Doors should not rattle.
- P. Overhead stops used in conjunction with electrified hold open closers shall be templated and installed to coincide with engagement of closer hold open position.
- Q. Install door closers on corridor side of lobby doors, room side of corridor doors, and stair side of stairways.
- R. Adjust spring power of door closers to the minimum force required to insure exterior and fire rated doors will consistently close and latch doors under existing conditions. Adjust all other door closers to insure opening force does not to exceed 5 lbs.
- S. Adjust "sweep", "latch", & "back check" valves on all door closers to properly control door through out the opening and closing cycle. Adjust total closing speed as required to comply with all applicable state and local building codes.
- T. Install "hardware compatible" (bar stock) type weatherstripping continuously for an uninterrupted seal. Adjust templating for parallel arm door closers, exit devices, etc., as required to accommodate weatherstripping.

- U. Unless otherwise specified or detailed, install thresholds with the bevel in vertical alignment with the outside door face. Notch and closely fit thresholds to frame profile. Set thresholds in full bed of sealant.
- V. Compress sweep during installation as recommended by sweep manufacturer to facilitate a water resistant seal.
- W. Deliver to the owner 1 complete set of installation and adjustment instructions, and tools as furnished with the hardware.

3.03 FIELD QUALITY CONTROL

- A. After installation has been completed, the hardware supplier and manufacturers representative for locksets, door closers, exit devices, and overhead stops shall check the project and verify compliance with installation instructions, adjustment of all hardware items, and proper application according to the approved hardware schedule. Hardware supplier shall submit a list of all hardware that has not been installed correctly.
- B. After installation has been completed, the hardware supplier and manufacturers representative shall meet with the owner to explain the functions, uses, adjustment, and maintenance of each item of hardware. Hardware supplier shall provide the owner with a copy of all wiring diagrams. Wiring diagrams shall be opening specific and include both a riser diagram and point to point diagram showing all wiring terminations.

3.04 ADJUSTMENT AND CLEANING

- A. At final completion, and when H.V.A.C. equipment is in operation, installer shall make final adjustments to and verify proper operation of all door closers and other items of hardware. . Lubricate moving parts with type lubrication recommended by the manufacturer.
- B. All hardware shall be left clean and in good operation. Hardware found to be disfigured, defective, or inoperative shall be repaired or replaced.

3.05 HARDWARE SCHEDULE

- A. The following schedule of hardware groups are intended to describe opening function. The hardware supplier is cautioned to refer to the preamble of this specification for a complete description of all materials and services to be furnished under this section.

HW SET: 01

3 EA	HINGE	5BB1HW 4.5 X 4.5 NRP (TORX)	630	IVE
1 EA	MORTISE DEADBOLT	L464L (TORX)	626	SCH
1 EA	CYLINDER			
1 EA	PRIVACY SET	L9040 06N (TORX)	626	SCH
1 EA	SURFACE CLOSER	4511 EDA SRI	689	LCN
1 EA	OVERHEAD STOP	900S (TORX)	630	GLY
1 EA	WEATHERSTRIP	429A AL	ZER	
1 EA	DOOR SWEEP	39A AL	ZER	
1 EA	THRESHOLD	544A AL	ZER	

MOUNT WEATHERSTRIP BEFORE OVERHEAD STOP

HW SET: 02

EA	HINGE	5BB1HW 4.5 X 4.5	630	IVE
EA	STOREROOM LOCK	LV9480L 06N	626	SCH
EA	CYLINDER			
EA	WALL STOP	WS406CVX	630	IVE
EA	WEATHERSTRIP	429A AL	ZER	
EA	DOOR SWEEP	39A AL	ZER	
EA	THRESHOLD	544A AL	ZER	

END OF SECTION

SECTION 09 90 00
PAINTING AND COATING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints, stains, and other coatings.
- C. Scope: Finish all interior and exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
- D. Do Not Paint or Finish the Following Items:
 - 1. Items fully factory-finished unless specifically so indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
 - 5. Floors, unless specifically so indicated.
 - 6. Glass.
 - 7. Concealed pipes, ducts, and conduits.
- E. Painting materials and methods for conduit identification specified in Section 26 05 53 Identification for Electrical Systems.
- F. See Schedule - Surfaces to be Finished, at end of Section.

1.02 RELATED SECTIONS

- A. Section 03 3000 - Cast-in-Place Concrete
- B. Section 03 3900 - Concrete Curing
- C. Section 05 50 00 - Metal Fabrications: Shop-primed items.
- D. Section 06 1000 - Rough Carpentry
- E. Section 06 2000 - Finish Carpentry
- F. Section 08 1113 - Hollow Metal Doors and Frames.

1.03 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2014.
- C. ASTM D 4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials; 1992 (Reapproved 2003).
- D. GreenSeal GS-11 - Paints and Coatings; 2013.

1.04 DEFINITIONS

- A. Conform to ASTM D 16 for interpretation of terms used in this section.

1.05 SUBMITTALS

- A. Product Data: Provide data on all finishing products, including VOC content.
- B. Samples: Submit four (4) painted samples, 5 x 7 inches in size, illustrating selected colors and textures for each color and system selected with specified coats cascaded.
- C. Certification: By manufacturer that all paints and coatings comply with VOC limits specified.
- D. Manufacturer's Instructions: Indicate special surface preparation procedures.
- E. Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum five years documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum five years experience.

1.07 REGULATORY REQUIREMENTS

- A. Conform to applicable code for flame and smoke rating requirements for products and finishes.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.09 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- D. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

1.10 EXTRA MATERIALS

- A. Supply 1 gallon of each color and type; store where directed by Owner.
- B. Label each container with color and type in addition to the manufacturer's label.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide all paint and coating products used in any individual system from the same manufacturer; no exceptions.
- B. Paints
 - 1. Sherwin-Williams Co: www.sherwin-williams.com
 - 2. Benjamin Moore & Co: www.benjaminmoore.com
 - 3. PPG Architectural Finishes, Inc: www.ppgaf.com.
- C. Stains, Sealers:
 - 1. Penofin: www.penofin.com, or approved equal.
- D. Epoxy Coatings
 - 1. Tnemec; www.tnemec.com
 - 2. Corotech: www.insl-x.com
 - 3. PPG Architectural Finishes, Inc: www.ppgaf.com.

2.02 PAINTS AND COATINGS - GENERAL

- A. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.
 - 1. Provide paints and coatings of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 - 2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

3. Supply each coating material in quantity required to complete entire project's work from a single production run.
 4. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.
- B. Volatile Organic Compound (VOC) Content:
1. Provide coatings that comply with the most stringent requirements specified in the following:
 - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - b. Ozone Transport Commission (OTC) Model Rule, Architectural, Industrial, and Maintenance Coatings; www.otcair.org; specifically:
 - 1) Opaque, Flat: 50 g/L, maximum.
 - 2) Opaque, Nonflat: 150 g/L, maximum.
 - 3) Opaque, High Gloss: 250 g/L, maximum.

2.03 PAINT SYSTEMS

- A. Plywood Exterior Siding, Trim & Fascia Boards
1. Wood, Transparent, Sealer, Stain:
 - a. Basis for design: Penofin; TWP 100
 - b. Provide two coats of stain, sealer.
 - c. Color: to be selected by Architect from manufacturer's standard color selection.
- B. Heavy Timber Assembly
1. Wood, Transparent, Sealer, Stain:
 - a. Basis for design: Penofin; TWP 100
 - b. Provide two coats of stain, sealer.
 - c. Color: to be selected by Architect from manufacturer's standard color selection.
- C. Ferrous Metals, Primed, Alkyd, 2 Coat:
1. Touch-up with rust-inhibitive primer as recommended by top coat manufacturer.
 2. Semi-gloss: Two coats of alkyd enamel.
 - a. Color: to be selected by Architect from manufacturer's standard color selection.
- D. Galvanized Metals, Alkyd, 3 Coat:
1. Galvanized primer: 1 Coat.
 - a. Semi-Gloss Top Coats: 2 Coats.
 2. Color: to be selected by Architect from manufacturer's standard color selection.

2.04 EPOXY COATINGS - EXTERIOR STEEL

- A. Basis of Design: 66 Hi-Build Epoxoline by Tnemec; 2.0 - 3.0. or Endura Shield 73 by Tnemec; 2.0 - 3.0 mils dry film thickness.
1. Color: to be selected by Architect from manufacturer's standard color selection.

2.05 ACCESSORY MATERIALS

- A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required to achieve the finishes specified whether specifically indicated or not; commercial quality.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.

- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
 - 2. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
 - 3. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to coating application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D. Surfaces: Correct defects and clean surfaces which affect work of this section. Remove or repair existing coatings that exhibit surface defects.
- E. Seal surfaces that might cause bleed through or staining of topcoat.
- F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- G. Concrete and Unit Masonry Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
- H. Insulated Coverings to be Painted: Remove dirt, grease, and oil from canvas and cotton.
- I. Uncorroded Uncoated Steel and Iron Surfaces to be Painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.
- J. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
- K. Interior Wood Surfaces to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats. Prime concealed surfaces with gloss varnish reduced 25 percent with thinner.
- L. Exterior Wood to Receive Transparent Finish: Remove dust, grit, and foreign matter; seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes with tinted exterior calking compound after sealer has been applied. Prime concealed surfaces.
- M. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION

- A. Apply products in accordance with manufacturer's instructions.
- B. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
- C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- D. Apply each coat to uniform appearance.
- E. Sand wood and metal surfaces lightly between coats to achieve required finish.
- F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- G. Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.

- H. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.
- I. Projector screen paint shall be spray-applied. Protect adjacent finishes from overspray.

3.04 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

- A. Refer to Section 26 0553 Identification for Electrical Systems for schedule of color coding of equipment, duct work, piping, and conduit.
- B. Paint shop-primed equipment, where indicated.
- C. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- D. Finish equipment, piping, conduit, and exposed duct work in utility areas in colors according to the color coding scheme indicated.
- E. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.05 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.06 SCHEDULE - SURFACES TO BE FINISHED

- A. Do Not Paint or Finish the Following Items:
 - 1. Items fully factory-finished unless specifically noted.
 - 2. Fire rating labels, equipment serial number and capacity labels.
 - 3. Stainless steel items.
- B. Paint the surfaces as indicated in the Room Finish Schedule and as indicated on the Drawings.
- C. Mechanical and Electrical: Use paint systems defined for the substrates to be finished.
 - 1. Paint all insulated and exposed pipes occurring in finished areas to match background surfaces, unless otherwise indicated.
 - 2. Paint shop-primed items occurring in finished areas.
 - 3. Paint interior surfaces of air ducts and convectors and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
 - 4. Paint dampers exposed behind louvers, grilles, and convectors and baseboard cabinets to match face panels.

END OF SECTION

SECTION 09 97 23
CONCRETE AND MASONRY COATINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. High build, moisture resistant graffiti control coatings.
- B. Concrete floor sealers.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete

1.03 REFERENCE STANDARDS

- A. ASTM D2243 - Standard Test Method for Freeze-Thaw Resistance of Water-Borne Coatings; 1995 (Reapproved 2014).
- B. ASTM D6904 - Standard Practice for Resistance to Wind-Driven Rain for Exterior Coatings Applied on Masonry; 2003 (Reapproved 2013).
- C. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.

1.04 SUBMITTALS

- A. Product Data: Provide copies of the manufacturer's printed instructions for evaluating, preparing, and treating masonry, technical data, and tested physical and performance properties, and printed instructions for application of protective coatings, including procedures for protecting adjacent construction and landscaping during work of this section.
- B. Test reports: Submit test reports and certifications substantiating that products comply with requirements, including compliance with federal, state, and local environmental Volatile Organic Compounds (VOC) regulations.
- C. Submit a copy of the manufacturer's written approval of the Installer/Applicator.
- D. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- E. Maintenance Data: Include cleaning procedures and repair and patching techniques.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.
- B. Applicator Qualifications: Company specializing in performing the work of this section with minimum five years documented experience.

1.06 MOCK-UP

- A. Provide mock-up of graffiti control coating, eight feet long by eight feet wide, illustrating coating, color, and surface sheen, for each specified coating.
- B. Locate where directed.
- C. Mock-up may remain as part of the Work.

1.07 FIELD CONDITIONS

- A. Do not install materials when temperature is below 40 degrees F or above 90 degrees F.
- B. Maintain this temperature range, 24 hours before, during, and 72 hours after installation of coating.
- C. Provide lighting level of 80 ft candles measured mid-height at substrate surface.
- D. Restrict traffic from area where coating is being applied or is curing.

1.08 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 HIGH BUILD, MOISTURE RESISTANT GRAFFITI CONTROL COATINGS

- A. Manufacturers:
 - 1. Prosoco: www.prosoco.com.
 - 2. Chem Solutions: www.chem-solutions.com
 - 3. G-Shield: www.thegshield.com
- B. Base Manufacturer: Prosoco, unless noted otherwise.
 - 1. Prosoco Sure Klean Weather Seal Blok-Guard & Graffiti Control.
- C. Two coats of graffiti control coating as recommended by manufacturer.
- D. Clear, solvent-based silicone elastomer formulated to weatherproof concrete block and other porous masonry materials and protect treated surfaces from repeated graffiti attacks without altering the natural appearance.

2.02 CONCRETE FLOOR SEALER

- A. Manufacturers:
 - 1. BASF: www.degussabuildingsystems.com
 - 2. Applied Technologies: www.appliedtechnologies.com
 - 3. Sonneborn: www.sonneborn.com
- B. Base Manufacturer: BASF, unless noted otherwise.
 - 1. BASF; Masterkure 200W
- C. water-based polymer and wax-emulsion curing and sealing compound.
- D. Contains no VOCs.

2.03 MATERIALS

- A. Coatings - General: Provide complete systems formulated and recommended by manufacturer for the applications indicated, in the thicknesses indicated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that substrate surfaces are ready to receive work as instructed by the coating manufacturer. Obtain and follow manufacturer's instructions for examination and testing of substrates.
- C. Cementitious Substrates: Do not begin application until substrate has cured 28 days minimum and measured moisture content is not greater than 16 percent.

3.02 PREPARATION

- A. Clean surfaces of loose foreign matter.
- B. Remove substances that would bleed through finished coatings.
- C. Remove finish hardware, fixture covers, and accessories and store.
- D. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent.
- E. Protect adjacent surfaces and materials not receiving coating from spatter and overspray; mask if necessary to provide adequate protection. Repair damage.

3.03 PRIMING

- A. Apply primer to all surfaces, unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.

3.04 COATING APPLICATION

- A. Apply coatings in accordance with manufacturer's instructions, to thicknesses specified.

- B. Spray apply in uniform thickness coats, without runs, drips, pinholes, brush marks, or variations in color, texture, or finish. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.

3.05 PROTECTION

- A. Protect finished work from damage.

END OF SECTION

SECTION 10 21 13.19
PLASTIC TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Solid plastic toilet compartments.
- B. Urinal and vestibule screens.

1.02 RELATED REQUIREMENTS

- A. Section 10 28 00 - Toilet and Utility Room Accessories.

1.03 REFERENCE STANDARDS

- A. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2015.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

1.05 SUBMITTALS

- A. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
- B. Product Data: Provide data on panel construction, hardware, and accessories.
- C. Samples: Submit two samples of partition panels, 2x2 inch in size illustrating panel finish, color, and sheen.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Solid Plastic Toilet Compartments:
 - 1. Ampco Products, Inc: www.ampco.com.
 - 2. Scranton Products (Santana/Comtec/Capital): www.scrantonproducts.com.
 - 3. Substitutions: Section 01 60 00 - Product Requirements.

2.02 SOLID PLASTIC TOILET COMPARTMENTS

- A. Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid molded high density polyethylene (HDPE), tested in accordance with NFPA 286, floor-mounted headrail-braced.
 - 1. Color: Onyx.
- B. Doors:
 - 1. Thickness: 1 inch.
 - 2. Width: 24 inch.
 - 3. Width for Handicapped Use: 36 inch, out-swinging.
 - 4. Height: 55 inch.
- C. Panels:
 - 1. Thickness: 1 inch.
 - 2. Height: 55 inch.
- D. Pilasters:
 - 1. Thickness: 1 inch.
 - 2. Width: As required to fit space; minimum 3 inch.
- E. Screens: Without doors; to match compartments; mounted to wall with two panel brackets.

2.03 ACCESSORIES

- A. Pilaster Shoes: Formed chromed steel with polished finish, 3 in high, concealing floor fastenings.

1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.
- B. Head Rails: Hollow anodized aluminum, 1 by 1-1/2 inch size, with anti-grip profile and cast socket wall brackets.
- C. Pilaster Brackets: Polished stainless steel.
- D. Wall Brackets: Continuous type, polished stainless steel.
- E. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
- F. Hardware: Polished stainless steel:
 1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.
 2. Door Latch: Slide type with exterior emergency access feature.
 3. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
 4. Coat hook with rubber bumper; one per compartment, mounted on door.
 5. Provide door pull for outswinging doors.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify correct spacing of and between plumbing fixtures.

3.02 INSTALLATION

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
- B. Maintain 3/8 to 1/2 inch space between wall and panels and between wall and end pilasters.
- C. Attach panel brackets securely to walls using anchor devices.
- D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.
- E. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.03 TOLERANCES

- A. Maximum Variation From True Position: 1/4 inch.
- B. Maximum Variation From Plumb: 1/8 inch.

3.04 ADJUSTING

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.
- B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.
- C. Adjust adjacent components for consistency of line or plane.

END OF SECTION

SECTION 10 28 00
TOILET AND UTILITY ROOM ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Accessories for toilet rooms and utility rooms.
- B. Electric hand/hair dryers.
- C. Grab bars.

1.02 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ASTM C1036 - Standard Specification for Flat Glass; 2011e1.
- C. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.
- D. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use; 2004 (Reapproved 2010).

1.03 SUBMITTALS

- A. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Bradley Corporation; www.bradleycorp.com.
- B. Other Acceptable Manufacturers:
 - 1. ASI - American Specialties, Inc: www.americanspecialties.com.
 - 2. Bobrick. www.bobrick.com
 - 3. Substitutions: Section 01 60 00 - Product Requirements.
- C. Electric Hand/Hair Dryers:
 - 1. World Dryer Corporation; SlimDRI: www.worlddryer.com.
 - 2. Substitutions: Section 01 60 00 - Product Requirements.
- D. For non-electrical products specified in the section, all items of each type to be made by the same manufacturer.

2.02 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
- B. Keys: Provide 2 keys for each accessory to Owner; master key lockable accessories.
- C. Mirror Glass: Tempered safety glass, ASTM C1048; and ASTM C1036 Type I, Class 1, Quality Q2, with silvering as required.
- D. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.

2.03 FINISHES

- A. Stainless Steel: No. 4 Brushed finish, unless otherwise noted.

2.04 TOILET ROOM ACCESSORIES

- A. Electric Hand Dryers:
 - 1. Operation: Automatic, sensor-operated on and off.
 - 2. Style: Traditional horizontal, rectangular case, fixed nozzle.
 - 3. Mounting: Surface mounted.
 - 4. Cover: White plastic.
 - a. Color: White.
 - b. Tamper-resistant screw attachment of cover to mounting plate.

5. Air Velocity: 15,000 linear feet per minute, minimum.
6. Runtime: Field adjustable or automatic, up to 35 seconds.
7. Supply Voltage: As indicated on drawings.
8. Warranty: 3 years.
9. Electric Hand Dryer Products:
 - a. Excel Dryer Inc.; ThinAir: www.exceldryer.com.
 - b. Substitutions: Section 01 60 00 - Product Requirements.
- B. Mirrors: Stainless steel framed, 1/4 inch thick tempered safety glass; ASTM C1048.
 1. Size: 24x36.
 2. Frame: 0.05 inch angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; No.4 finish.
 3. Product: 781 manufactured by Bradley Corp..
- C. Grab Bars: Stainless steel, nonslip grasping surface finish.
 1. Standard Duty Grab Bars:
 - a. Push/Pull Point Load: 250 pound-force, minimum.
 - b. Dimensions: 1-1/4 inch outside diameter, minimum 0.05 inch wall thickness, exposed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
 - c. Length and Configuration: As indicated on drawings.
 - d. Products:
 - 1) Bradley Corp 812 Series.
- D. Sanitary Napkin Disposal Unit: Stainless steel, surface-mounted, self-closing door, locking bottom panel with full-length stainless steel piano-type hinge, removable receptacle.
 1. Product: 4781-15 manufactured by Bradley Corp.
- E. Diaper Changing Station: Wall-mounted folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F2285.
 1. Style: Horizontal.
 2. Material: Polyethylene.
 3. Mounting: Surface.
 4. Manufacturers:
 - a. American Specialties, Inc: www.americanspecialties.com.
 - b. Diaper Deck & Company: www.diaperdeck.com.
 - c. Koala Kare Products: www.koalabear.com.
 - d. Substitutions: 01 60 00 - Product Requirements.

2.05 UTILITY ROOM ACCESSORIES

- A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.
 1. Drying rod: Stainless steel, 1/4 inch diameter.
 2. Hooks: 3, 0.06 inch stainless steel rag hooks at shelf front.
 3. Mop/broom holders: 4 spring-loaded rubber cam holders at shelf front.
 4. Length: 36 inches.
 5. Product: 9984 manufactured by Bradley Corp.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.

3.02 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on the drawings.

- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.

3.03 PROTECTION

- A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION

SECTION 22 07 19
PLUMBING PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Piping insulation.
- B. Jackets and accessories.

1.02 REFERENCE STANDARDS

- A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2013.
- B. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2013).
- C. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2013).
- D. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2014.
- E. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2015.
- F. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2013).
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- H. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- I. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- B. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.05 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER

- A. Manufacturers:
 - 1. CertainTeed Corporation; : www.certainteed.com.
 - 2. Johns Manville Corporation; : www.jm.com.
 - 3. Knauf Insulation; : www.knaufusa.com.
 - 4. Owens Corning Corporation; : www.ocbuildingspec.com.
- B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
 - 1. 'K' Value: ASTM C177, 0.24 at 75 degrees F.

2. Maximum Service Temperature: 850 degrees F.
3. Maximum Moisture Absorption: 0.2 percent by volume.
- C. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.
- D. Vapor Barrier Lap Adhesive: Compatible with insulation.
- E. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
- F. Fibrous Glass Fabric:
 1. Cloth: Untreated; 9 oz/sq yd weight.
 2. Blanket: 1.0 lb/cu ft density.
 3. Weave: 5x5.
- G. Indoor Vapor Barrier Finish:
 1. Cloth: Untreated; 9 oz/sq yd weight.
 2. Vinyl emulsion type acrylic, compatible with insulation, black color.
- H. Insulating Cement: ASTM C449.

2.03 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturer:
 1. Aeroflex USA, Inc; : www.aeroflexusa.com.
 2. Armacell LLC; : www.armacell.us.
 3. K-Flex USA LLC; : www.kflexusa.com.
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 3; use molded tubular material wherever possible.
 1. Minimum Service Temperature: Minus 40 degrees F.
 2. Maximum Service Temperature: 220 degrees F.

2.04 JACKETS

- A. PVC Plastic.
 1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: 0 degrees F.
 - b. Maximum Service Temperature: 150 degrees F.
 - c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil.
 - e. Connections: Brush on welding adhesive.
 2. Covering Adhesive Mastic: Compatible with insulation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.
- C. Exposed Piping: Locate insulation and cover seams in least visible locations.
- D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- E. Glass fiber insulated pipes conveying fluids below ambient temperature:

1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
- F. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- G. Glass fiber insulated pipes conveying fluids above ambient temperature:
1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

3.03 SCHEDULES

- A. Plumbing Systems:
1. Domestic Hot & Tempered Water Supply:
 - a. Glass Fiber Insulation:
 - 1) Pipe Size Range: Less than 1 inch.
 - 2) Thickness: 1/2 inch.
 2. Domestic Cold Water:
 - a. Glass Fiber Insulation:
 - 1) Pipe Size Range: Less than 2 inch.
 - 2) Thickness: 1 inch.

END OF SECTION

SECTION 22 10 05
PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pipe, pipe fittings, valves, and connections for piping systems.
 - 1. Sanitary sewer.
 - 2. Domestic water.
 - 3. Pipe hangers and supports.
 - 4. Valves.

1.02 REFERENCE STANDARDS

- A. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2012 (ANSI B16.18).
- B. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; The American Society of Mechanical Engineers; 2013.
- C. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; The American Society of Mechanical Engineers; 2013.
- D. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).
- E. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes; 2015a.
- F. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2014.
- G. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2013.
- H. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2010.
- I. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2002 (Reapproved 2010).
- J. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2012.
- K. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2014.
- L. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings; 1996 (Reapproved 2010).
- M. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2014.
- N. AWWA C651 - Disinfecting Water Mains; American Water Works Association; 2005 (ANSI/AWWA C651).
- O. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications; Cast Iron Soil Pipe Institute; 2009.
- P. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; Cast Iron Soil Pipe Institute; 2011
- Q. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2009.
- R. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2010.
- S. NSF 61 - Drinking Water System Components - Health Effects; 2014 (Errata 2015).
- T. NSF 372 - Drinking Water System Components - Lead Content; 2011.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.02 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Cast Iron Pipe: CISPI 301, hubless.
 - 1. Fittings: Cast iron.
 - 2. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies.
- B. PVC Pipe: ASTM D2665 or ASTM D3034.
 - 1. Fittings: PVC.
 - 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.03 SANITARY SEWER PIPING, ABOVE GRADE

- A. Cast Iron Pipe: CISPI 301, hubless, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.
- B. PVC Pipe: ASTM D2665.
 - 1. Fittings: PVC.
 - 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.04 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Copper Pipe: ASTM B42, annealed.
 - 1. Fittings: ASME B16.26, cast bronze.
 - 2. Joints: Flared.

2.05 DOMESTIC WATER PIPING, ABOVE GRADE

- A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints: ASTM B32, alloy Sn95 solder.

2.06 PIPE HANGERS AND SUPPORTS

- A. Provide hangers and supports that comply with MSS SP-58.
 - 1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
 - 2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
 - 3. Trapeze Hangers: Welded steel channel frames attached to structure.
 - 4. Vertical Pipe Support: Steel riser clamp.

2.07 BALL VALVES

- A. Construction, 4 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze or two piece body, chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder ends with union.

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.

- C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- H. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- I. Provide support for utility meters in accordance with requirements of utility companies.
- J. Install valves with stems upright or horizontal, not inverted.
- K. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.
- L. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

3.03 APPLICATION

- A. Use grooved mechanical couplings and fasteners only in accessible locations.
- B. Install unions downstream of valves and at equipment or apparatus connections.
- C. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

3.04 TOLERANCES

- A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/8 inch per foot slope.
- B. Water Piping: Slope at minimum of 1/32 inch per foot and arrange to drain at low points.

3.05 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Prior to starting work, verify system is complete, flushed and clean.
- B. Ensure Ph of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
- D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- E. Maintain disinfectant in system for 24 hours.
- F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- H. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

END OF SECTION

SECTION 22 10 06
PLUMBING PIPING SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Drains.
- B. Cleanouts.
- C. Hose bibbs.
- D. Hydrants.
- E. Water hammer arrestors.
- F. Thermostatic mixing valves.
- G. Thermometers
- H. Curb Stops

1.02 REFERENCE STANDARDS

- A. ASME A112.6.3 - Floor and Trench Drains; The American Society of Mechanical Engineers; 2001 (R2007).
- B. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance; American Society of Sanitary Engineering; 2011 (ANSI/ASSE 1019).
- C. NSF 61 - Drinking Water System Components - Health Effects; 2014 (Errata 2015).
- D. NSF 372 - Drinking Water System Components - Lead Content; 2011.
- E. PDI-WH 201 - Water Hammer Arresters; Plumbing and Drainage Institute; 2010.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

2.02 DRAINS

- A. Floor Drain (FD):
 - 1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer.

2.03 CLEANOUTS

- A. Cleanouts at Interior Finished Floor Areas (CO):
 - 1. Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.

2.04 HYDRANTS (HB)

- A. Manufacturers:
 - 1. Jay R. Smith Manufacturing Company; : www.jayrsmith.com.
 - 2. Zurn Industries, LLC; : www.zurn.com.
 - 3. Watts
 - 4. Woodford
- B. Wall Hydrants:
 - 1. ASSE 1019; concealed, freeze resistant, self-draining type with polished bronze wall plate hose thread spout, lockshield and removable key, and integral vacuum breaker.

2.05 WATER HAMMER ARRESTORS

- A. Water Hammer Arrestors:

1. Stainless steel construction, piston type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range 34 to 250 degrees F and maximum 150 psi working pressure.

2.06 MIXING VALVES

- A. Thermostatic Mixing Valves:

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- C. Install floor cleanouts at elevation to accommodate finished floor.
- D. Install approved portable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.

END OF SECTION

SECTION 22 30 00
PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Water heaters.

1.02 REFERENCE STANDARDS

- A. UL 174 - Standard for Household Electric Storage Tank Water Heaters; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.
- B. UL 1453 - Standard for Electric Booster and Commercial Storage Tank Water Heaters; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. Product Data:
 - 1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
 - 2. Provide electrical characteristics and connection requirements.
- B. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- C. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.04 CERTIFICATIONS

- A. Electric Water Heaters: UL listed and labeled to UL 174 or UL 1453.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.06 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for domestic water heaters.

PART 2 PRODUCTS

2.01 COMMERCIAL ELECTRIC WATER HEATERS

- A. Type: Factory-assembled and wired, electric, tankless.
- B. Manufacturers:
 - 1. Stiebel Eltron
 - 2. Rheem
 - 3. EEMAX
- C. Performance: Activation flow; 0.3 GPM or less, Maximum flow at least 2.5 GPM.
- D. Control: Dial or Digital, adjustable temperature range from 85 to 140 degrees F.
- E. Heating Elements: Flange-mounted immersion elements; individual elements sheathed with Incoloy corrosion-resistant metal alloy, rated less than 75 Watts per square inch.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.
- B. Coordinate with plumbing piping and related fuel piping work to achieve operating system.

END OF SECTION

SECTION 22 40 00
PLUMBING FIXTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Water closets.
- B. Urinals.
- C. Lavatories.
- D. Service sinks.
- E. Drinking fountains.

1.02 REFERENCE STANDARDS

- A. ASME A112.6.1M - Supports for Off-the-Floor Plumbing Fixtures for Public Use; The American Society of Mechanical Engineers; 1997 (Reaffirmed 2002).
- B. ASME A112.18.1 - Plumbing Supply Fittings; The American Society of Mechanical Engineers; 2012.
- C. ASME A112.19.2 - Ceramic Plumbing Fixtures; The American Society of Mechanical Engineers; 2013.
- D. NSF 61 - Drinking Water System Components - Health Effects; 2014.
- E. NSF 372 - Drinking Water System Components - Lead Content; 2011.

1.03 SUBMITTALS

- A. Manufacturer's Instructions: Indicate installation methods and procedures.
- B. Maintenance Data: Include fixture trim exploded view and replacement parts lists.

PART 2 PRODUCTS

2.01 GENERAL

- A. Potable Water Systems: Provide plumbing fittings and faucets that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.02 FLUSH VALVE WATER CLOSETS

- A. Water Closets: Stainless Steel, Off Floor, wall hung, siphon jet with elongated bowl and top spud, .
 - 1. Manufacturers:
 - a. Acorn Engineering
 - b. Bradley
 - c. Willoughby Industries
 - 2. Construction
 - a. 16 ga. stainless steel.
 - b. 1-1/2" NPT top flush valve.
 - c. Gasketed back waste outlet
 - d. Satin Finish
 - 3. Seat
 - a. Solid black plastic, hinged, open front, extended back, brass bolts, without cover.
- B. Flush Valves: ASME A112.18.1, diaphragm type, complete with vacuum breaker stops and accessories.
 - 1. Sensor-Operated Type: Solenoid operator, battery powered, infrared sensor and over-ride push button, 1.28 gallon flush.
 - 2. Manufacturers:
 - a. American Standard, Inc; : www.americanstandard-us.com.
 - b. Sloan Valve Company; : www.sloanvalve.com.
 - c. Zurn Industries, Inc; : www.zurn.com.

- C. Water Closet Carriers:
 - 1. ASME A112.6.1M; adjustable cast iron frame, integral drain hub and vent, adjustable spud, lugs for floor and wall attachment, threaded fixture studs with nuts and washers.

2.03 WALL HUNG URINALS

- A. Urinals: Stainless Steel, wall hung, top supply, blowout jet, front mount.
 - 1. Manufacturers:
 - a. Acorn Engineering
 - b. Bradley
 - c. Willoughby Industries
 - 2. Construction
 - a. 16 ga. stainless steel.
 - b. 3/4" NPT top flush valve.
 - c. Satin Finish
- B. Flush Valves: ASME A112.18.1, diaphragm type, complete with vacuum breaker stops and accessories.
 - 1. Sensor-Operated Type: Solenoid operator, battery powered, infrared sensor and over-ride push button.
 - 2. Manufacturers:
 - a. American Standard;
 - b. Sloan Valve Company;
 - c. Zurn Industries, Inc;

2.04 LAVATORIES

- A. Lavatory Manufacturers:
 - 1. Acorn Engineering
 - 2. Bradley
 - 3. Willoughby Industries
- B. 16 ga stainless steel, pre-drilled for faucet.: ASME A112.19.2; 14 by 12 inch minimum, with 3 inch high back, rectangular basin with splash lip, front overflow.
 - 1. Drilling Centers: 4 inch.
- C. Sensor Operated Faucet: Cast brass, chrome plated, deck mounted with sensor located on neck of spout.
 - 1. Spout Style: Standard.
 - 2. Power Supply: Battery, easily replaceable, alkaline or lithium, minimum 200,000 cycles.
 - a. Low battery indicator warning light at 30 days remaining life and continuous light a 2 weeks.
 - 3. Mixing Valve: None, single line for tempered water.
 - 4. Water Supply: 3/8 inch compression connections.
 - 5. Aerator: Vandal resistant, 0.5 GPM, laminar flow device.
 - 6. Finish: Polished chrome.
 - 7. Sensor Operated Faucet Manufacturers:
 - a. American Standard, Inc; : www.americanstandard-us.com.
 - b. Sloan Valve Company; : www.sloanvalve.com.
 - c. Zurn Industries, Inc; : www.zurn.com.
- D. Accessories:
 - 1. Chrome plated 17 gage, 0.0538 inch brass P-trap with clean-out plug and arm with escutcheon.
 - 2. Offset waste with perforated open strainer.
 - 3. Screwdriver stops.
 - 4. Flexible supplies.
 - 5. Carrier:
 - a. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded studs for fixture hanger, bearing plate and studs.

6. Under Sink Protection:
 - a. ADA Compliant stainless steel sheetmetal enclosure to cover all piping, traps, valves, faucet control.

2.05 DRINKING FOUNTAINS

- A. Drinking Fountain Manufacturers:
 1. Elkay Manufacturing Company; : www.elkay.com.
 2. Halsey Taylor; : www.halseytaylor.com.
 3. Haws Corporation; : www.hawscow.com.
- B. Stainless steel, wall mounted, chrome plated brass vandal resistant bubbler, chrome plated brass push button, pneumatic valve. 18"L x 12"W x 6"H
 1. Warm weather use only, domestic water drained during cold weather seasons.

2.06 SERVICE SINKS

- A. Service Sink Manufacturers:
 1. American Standard, Inc; : www.americanstandard-us.com.
 2. FIAT Products.
 3. Acorn Engineering.
- B. Bowl: 24 by 24 by 12 inch high cast terrazzo, floor mounted, with one inch wide shoulders, stainless steel strainer.
- C. Trim: ASME A112.18.1 exposed wall type supply with cross handles, spout wall brace, vacuum breaker, hose end spout, strainers, eccentric adjustable inlets, integral screwdriver stops with covering caps and adjustable threaded wall flanges.
 1. Manufacturers:
 - a. Chicago Faucet
 - b. Delta Faucet
 - c. American Standard
 - d. Sloan Valve Company
 - e. Zurn

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.
- B. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

- A. Install each fixture with trap, easily removable for servicing and cleaning.
- B. Provide chrome plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.
- C. Install components level and plumb.
- D. Install and secure fixtures in place with wall supports and bolts.

3.03 ADJUSTING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.04 CLEANING

- A. Clean plumbing fixtures and equipment.

3.05 PROTECTION

- A. Protect installed products from damage due to subsequent construction operations.
- B. Do not permit use of fixtures by construction personnel.
- C. Repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.

1.02 REFERENCE STANDARDS

- A. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2008.
- B. NEBB (TAB) - Procedural Standard for Testing Adjusting and Balancing of Environmental Systems; National Environmental Balancing Bureau; 2005, Seventh Edition.
- C. SMACNA (TAB) - HVAC Systems Testing, Adjusting, and Balancing; Sheet Metal and Air Conditioning Contractors' National Association; 2002.

1.03 SUBMITTALS

- A. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
 - 1. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
 - 2. Include the following on the title page of each report:
 - a. Name of Testing, Adjusting, and Balancing Agency.
 - b. Address of Testing, Adjusting, and Balancing Agency.
 - c. Telephone number of Testing, Adjusting, and Balancing Agency.
 - d. Project name.
 - e. Project location.
 - f. Project Architect.
 - g. Project Engineer.
 - h. Project Contractor.
 - i. Project altitude.
 - j. Report date.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Perform total system balance in accordance with one of the following:
 - 1. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
 - 2. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.
 - 3. SMACNA (TAB).
- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

3.02 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Duct systems are clean of debris.
 - 3. Fans are rotating correctly.
 - 4. Volume dampers are in place and open.
 - 5. Air outlets are installed and connected.

6. Duct system leakage is minimized.

3.03 ADJUSTMENT TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

3.04 RECORDING AND ADJUSTING

- A. Ensure recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.05 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities.
- B. Measure air quantities at air inlets and outlets.
- C. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- D. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

END OF SECTION

SECTION 23 31 00
HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal ductwork.

1.02 REFERENCE STANDARDS

- A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; 2013.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- C. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association; 2015.
- D. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; Sheet Metal and Air Conditioning Contractors' National Association; 2005.

PART 2 PRODUCTS

2.01 DUCT ASSEMBLIES

- A. Regulatory Requirements: Construct ductwork to NFPA 90A standards.

2.02 MATERIALS

- A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.
- B. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.

2.03 DUCTWORK FABRICATION

- A. Fabricate and support in accordance with SMACNA (DCS) and as indicated.
- B. No variation of duct configuration or size permitted except by written permission. Size round duct installed in place of rectangular ducts in accordance with ASHRAE Handbook - Fundamentals.
- C. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- E. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA (DCS).

2.04 MANUFACTURED DUCTWORK AND FITTINGS

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install, support, and seal ducts in accordance with SMACNA (DCS).
- B. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- C. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.
- D. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

END OF SECTION

SECTION 23 33 00
AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Volume control dampers.

1.02 REFERENCE STANDARDS

- A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association; 2015.
- B. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; Sheet Metal and Air Conditioning Contractors' National Association; 2005.

PART 2 PRODUCTS

2.01 VOLUME CONTROL DAMPERS

- A. Fabricate in accordance with SMACNA (DCS) and as indicated.
- B. Single Blade Dampers: Fabricate for duct sizes up to 6 x 30 inch.
 - 1. Blade: 24 gage, 0.0239 inch, minimum.
- C. Quadrants:
 - 1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). Refer to Section 23 31 00 HVAC Ducts and Casings for duct construction and pressure class.
- B. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.
- C. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

SECTION 23 34 16
CENTRIFUGAL HVAC FANS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Inline centrifugal fans.

1.02 REFERENCE STANDARDS

- A. AMCA 99 - Standards Handbook; Air Movement and Control Association International, Inc.; 2010.
- B. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; Air Movement and Control Association International, Inc.; 2007 (ANSI/AMCA 210, same as ANSI/ASHRAE 51).
- C. AMCA 300 - Reverberant Room Method for Sound Testing of Fans; Air Movement and Control Association International, Inc.; 2014.
- D. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; Air Movement and Control Association International, Inc.; 2014.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fantech.
- B. Continental.
- C. Vortex.

2.02 INLINE FAN

- A. Galvanized steel housing, backward curved impellar blades, speed controllable, thermal overload protection with automatic reset.

2.03 PERFORMANCE REQUIREMENTS

- A. Performance Ratings: Determined in accordance with AMCA 210 and bearing the AMCA Certified Rating Seal.
- B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.
- C. Fabrication: Conform to AMCA 99.
- D. Static and Dynamic Balance: Eliminate vibration or noise transmission to occupied areas.

PART 3 EXECUTION

3.01 INSTALLATION

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

END OF SECTION

SECTION 23 37 00
AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Registers/grilles.

1.02 SUBMITTALS

- A. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Krueger; : www.krueger-hvac.com.
- B. Price Industries; : www.price-hvac.com.
- C. Titus; : www.titus-hvac.com.

2.02 WALL EXHAUST AND RETURN REGISTERS/GRILLES

- A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with spring or other device to set blades, vertical face.
- B. Frame: 1-1/4 inch margin with countersunk screw mounting.
- C. Fabrication: Steel frames and blades, with factory mill finish.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
- C. Install diffusers or grilles to ductwork with air tight connection.
- D. Paint ductwork visible behind air outlets and inlets matte black. Refer to Section 09 90 00.

END OF SECTION

SECTION 26 05 00
BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY OF WORK

- A. Drawings, Bidding Requirements, Contract Forms, Conditions of the Contract and Division 1 General Requirements apply to work of this section.
- B. The work to be done under this specification and the accompanying drawings include the furnishing of all labor, materials, equipment and services necessary for the completion of all electrical work.
- C. The omission of express reference to any parts necessary for or reasonably incidental to a complete installation shall not be construed as releasing the contractor from furnishing such parts.

1.02 DIVISION 26, 27, AND 28 SECTIONS

- A. Requirements of this in this section apply to all work preformed for Divisions 26, 27, and 28.

1.03 RELATED REQUIREMENTS

- A. Section 01 10 00 - Summary: Contract descriptions, description of alterations work, work by others, future work, occupancy conditions, use of site and premises, work sequence.
- B. Section 01 23 00 - Alternates: Descriptions of items, administrative requirements.

1.04 PRICE AND PAYMENT PROCEDURES

- A. Alternates: See Section 01 23 00 - Alternates for work affecting this section.
 - 1. Accepted Alternates, if any, may affect portions of the base bid work.
 - 2. Acceptance Alternates shall include all provisions necessary to construct the Alternates. This work shall include all conduit, cable, grounding, terminations, equipment, and miscellaneous appurtenances as required to make a complete and working installation.
 - 3. Shop drawings shall be submitted for all equipment associated with work to be provided under Alternates specified.

1.05 SYMBOLS, AND ABBREVIATIONS, AND ACRONYMS

- A. Refer to symbols and abbreviations listed on the drawings. Other symbols are in common usage but if uncertainty exists regarding any plan symbols or abbreviations they shall be brought to the attention of the Architect and he shall clarify same.
- B. GFGL: Owner Furnished, Owner Installed.
- C. GFCL: Owner Furnished, Contractor Installed.

1.06 DEFINITIONS

- A. Where the phrase starts "Provide _____", "provide" shall be construed to mean the same as "Furnish and install _____".
- B. Where the phrase "Division 21", "Division 22" or "Division 23" is used on the drawings or in Divisions 26, 27, or 28 of this specification, it shall be the responsibility of this Contractor to determine which Contractor doing work under a Division 21, 22, or 23 specification section is the Contractor being referred to (i.e., plumbing, HVAC, temperature controls, etc.).

1.07 REFERENCE STANDARDS

- A. FM P7825 - Approval Guide; Factory Mutual Research Corporation; current edition.
- B. NFPA 70 - National Electrical Code; National Fire Protection Association; 2014.

1.08 ADMINISTRATIVE REQUIREMENTS

- A. Site Mobilization Meeting: Attend meeting at the Project site prior to Contractor occupancy.
- B. Preconstruction Meeting: Attend preconstruction meeting prior to the start of the work of this section.

1.09 INSPECTION OF SITE

- A. Before submitting a proposal on the work contemplated in this specification and accompanying drawings, each bidder shall examine the site and check as to the means of making connections to services and shall familiarize himself with all the existing conditions and limitations.
- B. No extras will be allowed because of the contractor's misunderstanding as to the amount of work involved or the contractor's lack of knowledge of any site conditions which may affect their work.
- C. Any apparent variance of the plan or specification from the existing conditions at the site shall be called to the attention of the Architect.

1.10 DRAWINGS

- A. The drawings are to scale as noted. The Contractor shall refer to architectural and structural drawings for exact location of partitions, walls, beams, shafts, equipment, etc.
- B. The Contractor, before rough-in facilities or installation of any equipment shall consult all drawings, general, structural, mechanical, finishes, locations of ceiling, structural members, pipes, ducts, recessed lighting fixtures, conduits, etc., which may affect the installation.
- C. Discrepancies discovered before or after work has started shall be brought to the attention of Owner: Architect. Owner reserves the right to require minor changes in the work of any Contractor to eliminate such discrepancies with no change in contract cost.
- D. The plans and specifications are complementary and what is called for in either one shall be as binding as if called for in both.
 - 1. Where a disagreement exists between the plans and specifications, the item or arrangement of better quality, greater quantity or higher cost shall be used.
 - 2. Where a disagreement exists between an item in the specifications and another item in the specifications, the item or arrangement of better quality, greater quantity or higher cost shall be used.
 - 3. Where a disagreement exists between an item on the drawings and another item on the drawings, the item or arrangement of better quality, greater quantity or higher cost shall be used.
- E. Where drawings contain revision clouds, only the work encircled by the revision cloud is included in the contractor's scope of the work for this project.

1.11 COORDINATION

- A. This Contractor shall review drawings and specifications from all divisions for conflicts in work for locations of ducts, piping, sprinkler heads, door hardware schedule for devices, ceiling plans, wall elevations, etc. Discrepancies shall be brought to the attention of the Architect prior to beginning the work.
- B. Coordinate with all sub-contractors for locations of all conduit, cable-tray, lighting, devices, door hardware, occupancy sensors.
- C. Attend Preinstallation and Coordination meetings, if required by individual Section.

1.12 MATERIALS AND WORKMANSHIP

- A. All material and workmanship must be of the best throughout. All material and equipment must be new and must be adequately protected from damage and dirt at all times. The Architect reserves the right to reject any material or workmanship not in accordance with the specifications, either before or after installation.
 - 1. Refer to National Electrical Code 110.12 and NECA-1 for execution of work.
- B. The Contractor will be held responsible for any and all defects in material and workmanship which may appear during guarantee period after the building has been accepted. All such defects must be repaired or defective material replaced by the Contractor at no expense to the Owner.

1.13 GUARANTEE

- A. All electrical work specified in Division 26, 27, 28, or 33 sections shall be guaranteed to be free from defects in materials and installation for a minimum period of one year from the Date of Government Acceptance of the Work. See Division 1 requirements and General Conditions for additional requirements. The Contractor shall repair and/or replace defective work, including materials and labor, discovered during the guarantee period.
- B. See individual specification sections for additional guarantees, which include guarantees that extend beyond one year.
- C. Product Warranties:
 - 1. Product warranty periods begin at Date of Government Acceptance of the Work.
 - a. Product manufacturer "Terms and Conditions" statement for warranty period that begins at "Date of Shipment" will not be accepted.
 - b. This Contractor shall make arrangements with product manufacturers for warranty that periods begin at Date of Government Acceptance of the Work.

1.14 CODES

- A. This Contractor shall comply with all ordinances, laws, regulations and codes applicable to the work involved. This does not relieve the contractor from furnishing and installing work shown or specified which may be beyond the requirements of such ordinances, laws, regulations and codes.
- B. Regular inspections shall be requested by the Contractor as required by any and all regulations. All charges for the inspections by regulating agencies of installations or plans and specifications shall be paid by the Contractor.

1.15 SUBMITTALS

- A. See Section 01 60 00 - Product Requirements for substitutions procedures.
- B. Definitions:
 - 1. Prerequisite Submittals: Submittals that shall be submitted prior to commencement of design, calculations, or study; subsequent submittals, tests, or inspections.
 - 2. Action Submittals: Product data, shop drawings, samples, and similar items for components that are purchased or fabricated.
 - 3. Information Submittals: Contractor and installer qualifications, test agency qualifications, field quality reports, prefunctional checklists, test plans, test reports, and similar items that require review for quality control.
 - 4. Closeout Submittals: Operation and maintenance manuals, as-built drawings, documentation of training, certificates of completion, certificates of compliance by Authority Having Jurisdiction, and similar items required for project documentation.
- C. Prerequisite Submittals:
 - 1. Submit manufacturer qualifications, installer qualifications, and certificates prior to or in conjunction with action submittals for review.
 - 2. Submit delegated design company and personnel qualifications, where indicated in individual sections, prior to commencement of design, calculations, or study.
 - 3. Submit testing agency qualifications, where indicated in individual Sections, prior to preparation of test plans.
 - 4. Submit test plans and prefunctional checklists, where indicated in individual Sections, prior to commencement of tests.
 - a. Submit in accordance with schedule developed as part of the Commissioning Plan.
 - 5. Submit Field Quality Control reports, where indicated in individual Sections, 10 Days prior to Notice of Substantial Completion.
 - 6. Failure to submit prerequisite submittals does not relieve the Contractor from the requirements of meeting the project schedule.
- D. Submittals for Review:
 - 1. Identify Section Number and Section Title for each submittal.

2. Submit items identified in individual sections.
3. Submit each Section Number independently from other Sections.
 - a. Submittals containing multiple Sections in the same submittal may result in the submittal(s) returned to the Contractor for correction and resubmission.
4. Where an individual Section requires more than one identified item for review (i.e. "Shop Drawings", "Product Data", and "Samples"), submit all items concurrently.
 - a. Provide tabbed divider separating each item for review included in the submittal (i.e. "Product Data", "Shop Drawings", and "Warranty").
5. Mark catalog sheets and drawings to indicate specific items submitted and proper identification of equipment by name and/or number, as indicated in the contract documents.
 - a. Failure to properly identify items included in a submittal may result in the submittal(s) returned to the Contractor for correction and resubmission.
6. Failure to follow submittal instructions does not relieve the Contractor from the requirements of meeting the project schedule.

1.16 MOCK-UPS

- A. Construct mockups as indicated in individual Sections.
- B. Locate where directed.
- C. Mock-ups accepted by Owner may remain as part of the Work.

1.17 MAINTENANCE AND OPERATING INSTRUCTIONS

- A. The Contractor shall furnish, without additional expense to the Owner, the services of competent instructors, who will give instruction in the care, adjustment and operation and maintenance of parts of the electrical equipment to the Owner's permanent employees who are to have charge of the equipment.
- B. The amount of instruction to be given will be specified in the respective section.
- C. Instruction shall be given during the regular work week and at a time just prior to the time the equipment is accepted and turned over to the Owner for regular operation.

1.18 OPERATION AND MAINTENANCE MANUAL

- A. This Contractor shall prepare and submit maintenance and operating manuals for all equipment and systems provided by this Contractor.
- B. Submit required information in a three ring binder.
 1. Submit one (1) binder for review prior to final submittal.
 2. Submit three (3) binders for final submittal.
 3. Provide tabbed divider for each Specification Section.
 4. Provide index with Consolidated Maintenance Schedule and each Specification Section identified.
 5. Include Consolidated Maintenance Schedule with tabbed divider after index, before tabbed individual sections.
- C. Provide optical disk (CD or DVD) with information required in individual specification sections.
- D. Maintenance Schedule:
 1. Provide a consolidated maintenance schedule. Indicate item or equipment, maintenance or testing requirement and frequency of maintenance or test. Provide in a table format, refer to sample Consolidated Maintenance Schedule at the end of this Section.
- E. Provide the following for each specification section, where indicated:
 1. Product Data.
 2. Approved shop drawings.
 3. Maintenance Instructions.
 4. Operating Instructions.
 5. Training Outline.
 6. Test Reports.

7. Inspector's reports.
8. Certificates of completion.
9. Warranty information.

1.19 RECORD DRAWINGS

- A. The Contractor shall keep a complete set of all drawings in his job site office for the purposes of showing "As-Built" installation of electrical systems and equipment. This set of drawings shall be used for no other purpose.
- B. Where any material, equipment, or system components are installed differently from that shown on the Architect's drawings, such differences shall be clearly and neatly shown on this set of drawings using ink or indelible pencil.
- C. The change notations shall be kept up-to-date on a daily basis. When requested, this set of drawings shall be transmitted to the Architect, and after the Architect has examined the drawings, the set will be returned to the contractor for further use.
- D. At the completion of the project, the "As-Built" set of drawings shall be turned over to the for review and then shall become the property of the Owner.

1.20 QUALITY ASSURANCE

- A. Testing Agency Qualifications:
 1. The testing organization shall be an independent, third party entity which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers.
 2. Three years documented experience testing products specified in Divisions 26, 27 and 28.
 3. Where indicated in individual Sections:
 - a. InterNational Electrical Testing Association "NETA Accredited Company".
 4. Personnel certified in accordance with ANSI/NETA ETT-2000, Standard for Certification of Electrical Testing Personnel, level III or higher.

1.21 TEMPORARY CONSTRUCTION LIGHTING AND POWER

- A. Temporary Electricity:
 1. Cost: By Owner.
 2. Connect to Owner's existing power service.
 - a. Do not disrupt Owner's need for continuous service.
 - b. Coordinate and schedule all necessary shutdowns with Owner. Schedule all necessary shutdowns 14 days in advance.
 - 1) Include actual time and duration of necessary shutdown in scheduled shutdown request.
 - c. Exercise measures to conserve energy.
 3. Provide temporary electric feeder from existing on-site electrical service at location as directed.
 4. Power Service Characteristics: 480Y/277 volt, 125 ampere, three phase, four wire.
 5. Complement existing power service capacity and characteristics as required.
 6. Provide power outlets for construction operations, with branch wiring and distribution boxes located as required. Provide flexible power cords as required.
 7. Provide feeder switch at source distribution equipment .
 8. Permanent convenience receptacles may be utilized during construction.
 9. Provide adequate distribution equipment, wiring, and outlets to provide single phase branch circuits for power and lighting.
 - a. Provide 20 ampere duplex outlets, single phase circuits for power tools for every 500 sq ft of active work area.
 - b. Provide 20 ampere, single phase branch circuits for lighting.
- B. Temporary Lighting For Construction Purposes:
 1. Provide and maintain lighting for construction operations to achieve a minimum lighting level of 10 footcandles.

2. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.
 3. Maintain lighting and provide routine repairs.
 4. Permanent building lighting may be utilized during construction.
 - a. Replace lamps in permanent fixtures used for construction purposes upon Owner occupancy.
- C. Telecommunications Services:
1. Provide, and maintain telephone service to field office at time of project mobilization.
 2. Telecommunications services shall include:
 - a. Windows-based personal computer dedicated to project telecommunications, with necessary software and laser printer.
 - b. Telephone Land Lines: One line, minimum; one handset per line.
 - c. Email: Account/address reserved for project use.
- D. Refer to Division 1 section for work to be provided by this contractor.

1.22 HOLES THROUGH MASONRY

- A. The Contractor shall provide all holes and openings required for electrical work unless such openings are shown on the architectural and/or structural drawings. The notes on structural drawings are particularly significant when precast and prestressed members are used.
- B. Holes made in existing masonry for raceways or other electrical equipment shall be core drilled.
- C. The Contractor shall be responsible for grouting air-tight any openings adjacent to raceways, etc. to seal against passage of air, smoke or vapors.
- D. The Contractor shall be responsible for providing and disposing of water used in the core drilling operation. Work shall be scheduled and other trades coordinated so that damage will not result from the use of water.

1.23 CLEANING

- A. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.
- B. Contractor shall clear away all debris, surplus materials, etc., resulting from his work or operations, leaving the job and the equipment furnished under any or all contracts in a clean condition.

1.24 COMMISSIONING

- A. See Section 26 08 00 - Commissioning for Electrical for additional requirements.
 1. Complete prefunctional checklists.
 2. Perform functional tests.

1.25 SCHEDULES

- A. Sample Consolidated Maintenance Schedule for Operations and Maintenance Manual:
 1. Table below is a sample representing some typical maintenance items, not representative of actual items included in this project.
- B. Include National Fire Alarm and Signaling Code; 2010 Edition; Tables 14.3.1, 14.4.2.2, and 14.5.5 for fire alarm inspection and testing.

CONSOLIDATED MAINTENANCE SCHEDULE		
EQUIP ITEM	REQUIRED ACTION	FREQUENCY
GROUNDING CONNECTIONS	INSPECT FOR INTEGRITY	12 MONTHS
PANELBOARD CIRCUIT BREAKERS	EXERCISE: CYCLE OFF/ON 5 TIMES.	12 MONTHS
SWITCHBOARD & PANELBOARD FUSIBLE SWITCHES	INSPECT, CLEAN, LUBRICATE	12 MONTHS
ENCLOSED SWITCHES	INSPECT, CLEAN, LUBRICATE	12 MONTHS
LUMINAIRES IN HANGAR	CLEAN LENS WITH MILD DETERGENT, RINSE, DRY.	24 MONTHS
LENSED LUMINAIRES	CLEAN LENS WITH MILD DETERGENT, RINSE, DRY.	36 MONTHS
EMERGENCY LIGHT UNIT EQUIPMENT	OPERATION AND BATTERY TEST.	12 MONTHS
FIRE ALARM COMPONENTS	INSPECT AND TEST PER NFPA 72 TABLES 14.3.1, 14.4.2.2, AND 14.4.5 ON FOLLOWING PAGES.	PER NFPA 72

PART 2 PRODUCTS

2.01 NOT APPLICABLE.

PART 3 EXECUTION

3.01 NOT APPLICABLE.

END OF SECTION

SECTION 26 05 01
MINOR ELECTRICAL DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical demolition.

1.02 RELATED REQUIREMENTS

- A. Section 01 50 00 - Temporary Facilities and Controls.
- B. Section 01 74 19 - Construction Waste Management and Disposal: Recycling.
- C. Section 02 41 00 - Demolition.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Before submitting a proposal on the work contemplated in this specification and accompanying drawings, each bidder shall:
 - 1. Familiarize himself with all the existing conditions and limitations.
 - 2. Examine the site and check as to the means removal and/or relocation of existing conduit, conductors, cable, devices, fixtures, or other equipment as indicated on the drawings; or as required to coordinate and adapt new and existing electrical systems to all other work required in this project.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.
- C. Demolition drawings are based on casual field observation and existing record documents.
 - 1. Report discrepancies to Architect before disturbing existing installation.
- D. Preparation:.

3.02 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings to be removed.
- B. Coordinate utility service outages with utility company and Owner.
- C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
 - 1. Obtain permission from Owner at least 48 hours before partially or completely disabling system.
 - a. Contractor must submit a written request to the Architect for permission of any downtime. Contractor can only proceed with the downtime after receipt of written approval from the Architect.
 - 2. Make temporary connections to maintain service in areas adjacent to work area.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Perform work for removal and disposal of equipment and materials containing toxic substances regulated under the Federal Toxic Substances Control Act (TSCA) in accordance with applicable federal, state, and local regulations. Applicable equipment and materials include, but are not limited to:
 - 1. PCB- and DEHP-containing lighting ballasts.

2. Mercury-containing lamps and tubes, including fluorescent lamps, high intensity discharge (HID), arc lamps, ultra-violet, high pressure sodium, mercury vapor, ignitron tubes, neon, and incandescent.
- B. Removal: Remove demolished material from the Project site.
 1. Demolished material shall become property of the Contractor unless indicated otherwise.
- C. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.
- D. Salvaged equipment: Remove and store. Clean, re-lamp, and reinstall if required, otherwise, turn over to owner at end of project.
- E. Remove, relocate, and extend existing installations to accommodate new construction.
 1. Where circuits are feeding existing components to remain, circuits shall be reworked as necessary to maintain continuity as part of the new work.
- F. Remove abandoned wiring to source of supply.
 1. Trace all existing circuits affected by demolition.
 2. At circuit source, mark all unused circuit breakers and fusible switches remaining after demolition as "Spare".
- G. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
 1. Abandoned conduits that are permitted to remain in place shall be provided with a pull string and label at each end identifying the location of the other end.
- H. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.
- I. Disconnect and remove abandoned panelboards and distribution equipment.
- J. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- K. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- L. Repair adjacent construction and finishes damaged during demolition and extension work.
 1. At construction receiving new finishes, patch and prepare to receive new finishes.
 2. At existing construction not receiving new finishes, patch and provide new finishes to match existing surrounding area.
- M. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.
 1. Provide modifications to assure that circuits or systems wiring shall not pass through outlet or junction boxes which may be rendered inaccessible by changes made to the facility.
- N. Maintain electrical continuity to existing equipment, components, devices, and wiring intended to remain.
- O. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.
- P. Where the reuse of existing conduits, outlets, junction boxes, etc. is permitted, confirm that the associated wiring is continuous from outlet to outlet.
- Q. Connect new work to existing work in a manner that will assure proper raceway grounding throughout in conformance with the National Electrical Code; current edition.

3.04 CLEANING AND REPAIR

- A. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.
- B. Clean and repair existing materials and equipment that remain or that are to be reused.

- C. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.
- D. Luminaires salvaged for reuse: Remove luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts and broken electrical parts.
- E. Replace damaged parts of equipment and luminaires damaged during demolition, salvage, storage, and construction.

END OF SECTION

SECTION 26 05 19
LOW VOLTAGE POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wire and cable for 600 volts and less.
- B. Single conductor building wire.
- C. Metal-clad cable.
- D. Wiring connectors.
- E. Electrical tape.
- F. Heat shrink tubing.
- G. Oxide inhibiting compound.
- H. Wire pulling lubricant.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 34 - Conduit.
- B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013.
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2011.
- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010 (Reapproved 2014).
- D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2014).
- E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2010.
- F. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes; 2013.
- G. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- H. NECA 120 - Standard for Installing Armored Cable (AC) and Metal-Clad Cable (MC); National Electrical Contractors Association; 2012 (NECA/NACMA 102).
- I. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; National Electrical Manufacturers Association; 2009 (ANSI/NEMA WC 70/ICEA S-95-658).
- J. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; International Electrical Testing Association; 2013 (ANSI/NETA ATS).
- K. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
- M. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
- N. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
- O. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
- P. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.

- Q. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.
- R. UL 1569 - Metal-Clad Cables; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
 - 3. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
- B. Closeout Submittals:
 - 1. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.
 - 2. Project Record Documents: Record actual locations of components and circuits #6 AWG and larger.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.07 FIELD CONDITIONS

- A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

1.08 SEQUENCING AND SCHEDULING

- A. Coordination: Coordinate layout and installation of cable with other installations.
 - 1. Revise locations and elevations from those indicated as required to suit field conditions and as approved by the Contracting Officer.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
- C. Concealed Dry Interior Locations: Use only building wire in raceway.
- D. Exposed Dry Interior Locations: Use only building wire in raceway.
- E. Wet or Damp Interior Locations: Use only building wire with Type THWN insulation in raceway.
- F. Exterior Above Grade Locations: Use only building wire with Type THWN insulation in raceway.
- G. Underground Installations:
 - 1. Underground feeders: Use only building wire with Type XHHW-2 insulation in raceway.

2. Underground branch circuits: Use only building wire with Type XHHW-2 insulation in raceway.
- H. Nonmetallic-sheathed cable is not permitted.
- I. Underground feeder and branch-circuit cable is not permitted.
- J. Service entrance cable is not permitted.
- K. Armored cable is not permitted.
- L. Metal-clad cable is permitted only as follows:
 1. Where not otherwise restricted, may be used:
 - a. Where concealed above accessible ceilings for final connections from junction boxes to a single luminaire.
 - 1) Maximum Length: 6 feet.
 - b. Pre-wired factory cable with plug connectors for master/satellite lighting fixture pairs.
 - c. Metal-clad cable is prohibited for all other installations.

2.02 CONDUCTOR AND CABLE MANUFACTURERS

- A. Cerro Wire LLC: www.cerrowire.com.
- B. Encore Wire Corporation: www.encorewire.com.
- C. Southwire Company: www.southwire.com.
- D. Houston Wire and Cable: www.houwire.com.
- E. General Cable: www.generalcable.com.
- F. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- D. Comply with NEMA WC 70.
- E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- G. Conductor Material:
 1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
 2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B 787M unless otherwise indicated.
 3. Tinned Copper Conductors: Comply with ASTM B33.
- H. Minimum Conductor Size:
 1. Branch Circuits: 12 AWG.
 - a. Exceptions:
 - 1) Underground Circuits: 10 AWG.
 - 2) 20 A, 120 V circuits greater than 60 feet and less than 100 feet: 10 AWG, for voltage drop.
 - 3) 20 A, 120 V circuits greater than 100 feet and less than 150 feet: 8 AWG, for voltage drop.
 - 4) 20 A, 120 V circuits greater than 150 feet: 6 AWG, for voltage drop.
- I. Conductor Color Coding:
 1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
 2. Color Coding Method: Integrally colored insulation.

- a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
- 3. Color Code:
 - a. 240/120 V, 1 Phase, 3 Wire System:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Shared Neutral/Grounded: White.
 - 4) Dedicated Neutral/Grounded: White with colored tracer in braid, same color as phase conductor.
 - 5) Switch Leg: Pink.
 - b. Equipment Ground, All Systems: Green.
 - c. Travelers for 3-Way and 4-Way Switching: Pink.

2.04 SINGLE CONDUCTOR BUILDING WIRE

- A. Description: Single conductor insulated wire.
- B. Conductor Stranding:
 - 1. Feeders and Branch Circuits:
 - a. Size 10 AWG and Smaller: Stranded.
 - b. Size 8 AWG and Larger: Stranded.
 - 2. Control Circuits: Stranded.
- C. Insulation Voltage Rating: 600 Volts.
- D. Insulation:
 - 1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
 - a. Installed Underground: Type XHHW-2.

2.05 METAL-CLAD CABLE

- A. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.
- B. Conductor Stranding:
 - 1. Size 10 AWG and Smaller: Solid.
 - 2. Size 8 AWG and Larger: Stranded.
- C. Insulation Voltage Rating: 600 V.
- D. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.
- E. Grounding: Full-size integral equipment grounding conductor.
- F. Armor: Steel, interlocked tape.

2.06 WIRING CONNECTORS

- A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
- B. Wiring Connectors for Splices and Taps:
 - 1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
 - 2. Copper Conductors Size 6 AWG to Size 4 AWG: Use mechanical connectors or compression connectors.
 - 3. Copper Conductors Size 3 AWG and Larger: Use Power Distribution Blocks:
 - a. Copper Conductors Power Distribution Blocks secured inside enclosure:
 - b. Withstand rating: Not less than fault current ampere interrupting capacity of upstream overcurrent protective device.
 - c. Manufacturers:
 - 1) Bussmann.
 - 2) Ferraz Shawmut.
 - 3) Ilco.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

- C. Wiring Connectors for Terminations:
 - 1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
 - 2. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
 - 3. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
 - 4. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
 - 5. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
- D. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
- E. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.
- F. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
- G. Mechanical Connectors: Provide bolted type or set-screw type.
- H. Compression Connectors: Provide circumferential type or hex type crimp configuration.
- I. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.

2.07 WIRING ACCESSORIES

- A. Electrical Tape:
 - 1. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
 - 2. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
 - 3. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.
 - 4. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.
 - 5. Varnished Cambric Electrical Tape: Cotton cambric fabric tape, with or without adhesive, oil-primed and coated with high-grade insulating varnish; minimum thickness of 7 mil; suitable for continuous temperature environment up to 221 degrees F.
 - 6. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.
- B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.
- C. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
- D. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that interior of building has been protected from weather.

- B. Verify that work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that field measurements are as shown on the drawings.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03 INSTALLATION

- A. Circuiting Requirements:
 - 1. Unless dimensioned, circuit routing indicated is diagrammatic.
 - 2. When circuit destination is indicated and routing is not shown, determine exact routing required.
 - 3. Arrange circuiting to minimize splices.
 - 4. Include circuit lengths required to install connected devices within 10 ft of location shown.
 - 5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
 - 6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
 - 7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are shown as separate, combining them together in a single raceway is not permitted.
- B. The use of multi-wire branch circuits serving multiple loads with a common neutral is permitted only for individual utilization equipment that is provided with a disconnecting means that simultaneously disconnects all ungrounded conductors.
- C. Install products in accordance with manufacturer's instructions.
- D. Use fish tape with marked 12 inch increments to provide conduit length data. Install minimum conductor size adjusted for voltage drop.
- E. Install conductors and cable in a neat and workmanlike manner in accordance with NECA 1.
- F. Install metal-clad cable (Type MC) in accordance with NECA 120.
- G. Installation in Raceway:
 - 1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
 - 2. Pull all conductors and cables together into raceway at same time.
 - 3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
 - 4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.
- H. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- I. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
- J. Terminate cables using suitable fittings.
 - 1. Metal-Clad Cable (Type MC):
 - a. Use listed fittings.
 - b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
- K. Install conductors with a minimum of 8 inches of slack at each outlet.
- L. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

- M. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- N. Make wiring connections using specified wiring connectors.
 - 1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
 - 2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
 - 3. Do not remove conductor strands to facilitate insertion into connector.
 - 4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
 - 5. Terminations for Fine-Strand Conductors: Terminate with tin-plated aluminum-bodied compression connectors only.
 - 6. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 - 7. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- O. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
 - 1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.
 - b. For taped connections likely to require re-entering, including motor leads, first apply varnished cambric electrical tape, followed by adequate amount of rubber splicing electrical tape, followed by outer covering of vinyl insulating electrical tape.
 - 2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
 - b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
 - 3. Wet Locations: Use heat shrink tubing.
- P. Insulate ends of spare conductors using vinyl insulating electrical tape.
- Q. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.
- R. Identify conductors and cables in accordance with Section 26 05 53 Identification for Electrical Systems.
- S. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Perform inspection, testing, and adjusting in accordance with Section 01 40 00 Quality Requirements.
- C. Inspect and test in accordance with NETA ATS, except Section 4.
- D. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is not required. The resistance test for parallel conductors listed as optional is not required.
- E. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.
- D. Ground rod electrodes.
- E. Grounding and bonding components.

1.02 RELATED REQUIREMENTS

- A. Section 03 2000 - Concrete Reinforcing.
- B. Section 03 3000 - Cast-in-Place Concrete.
- C. Section 26 05 19 - Low Voltage Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
- D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. IEEE 81 - Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System; Institute of Electrical and Electronic Engineers; 2012.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; National Electrical Manufacturers Association; 2007.
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; International Electrical Testing Association; 2013 (ANSI/NETA ATS).
- E. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify exact locations of underground metal water service pipe entrances to building.
 - 2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
 - 3. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.05 SUBMITTALS

- A. Submit all product data, samples, manufacturer's instructions, and installer qualifications concurrently.
- B. Prerequisite Submittals:
 - 1. Submit testing agency qualifications 14 prior to performing field quality control tests.
- C. Action Submittals:
 - 1. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.

- a. Include each component specified in this section.
 - b. Include exothermic weld kits.
- D. Information Submittals:
 - 1. Construction Documentation:
 - a. Inform Architect of completion of below grade connections 7 days prior to cover.
 - b. Submit digital photographs of each below grade connections prior to cover.
 - 2. Testing Agency Qualifications and personnel certifications.
 - 3. Field quality control test reports.
 - a. Indicate overall resistance to ground and resistance of each electrode.
 - b. Indicate compliance with the performance requirements.
- E. Closeout Submittals:
 - 1. Project Record Documents: Record actual locations of grounding electrode system components and connections.
 - 2. Operation and Maintenance Manual:
 - a. Test Reports: Include field quality control test reports.
 - b. Maintenance Schedule: Include equipment maintenance or testing requirement and frequency of maintenance or test in consolidated maintenance schedule table.
 - 1) Inspection frequency for accessible connections: 12 months.
 - c. Maintenance Data:
 - 1) Include recommended maintenance procedures.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Testing Agency Qualifications:
 - 1. The testing organization shall be an independent, third party entity which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers.
 - 2. Three years documented experience testing products specified in this section .

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

- A. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
- C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- D. Grounding System Resistance:
 - 1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect. Precipitation within the previous 48 hours does not constitute normally dry conditions.
 - 2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
- E. Grounding Electrode System:
 - 1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
 - a. Provide continuous grounding electrode conductors without splice or joint.
 - b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
 - 2. Metal Underground Water Pipe(s):
 - a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet

- at an accessible location not more than 5 feet from the point of entrance to the building.
 - b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
 - c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
- 3. Concrete-Encased Electrode:
 - a. Provide connection to concrete-encased electrode consisting of not less than 20 feet of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
- 4. Ground Rod Electrode(s):
 - a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.
 - b. Space electrodes not less than 6.0 M (20 feet) from each other and any other ground electrode.
- 5. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
- F. Service-Supplied System Grounding:
 - 1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
 - 2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.
- G. Bonding and Equipment Grounding:
 - 1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
 - 2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
 - 3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
 - 4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
 - 5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
 - 6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
 - 7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
 - a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.

2.02 GROUNDING AND BONDING COMPONENTS

- A. General Requirements:
 - 1. Provide products listed, classified, and labeled as suitable for the purpose intended.
 - 2. Provide products listed and labeled as complying with UL 467 where applicable.
- B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 05 26 Grounding and Bonding for Electrical Systems:
 - 1. Use insulated copper conductors unless otherwise indicated.
 - a. Exceptions:

- 1) Use bare copper conductors where installed underground in direct contact with earth.
- 2) Use bare copper conductors where directly encased in concrete (not in raceway).
2. Grounding Electrode Conductor Size: As indicated on Drawings, not less than #6 AWG.
- C. Connectors for Grounding and Bonding:
 1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
 2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
 3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
 4. Mechanical and Compression Connector Material: Bronze.
 5. Exothermic Connections:
 - a. Provide in kit form and selected per manufacturer's written instructions for specific types, sizes and combinations of conductors and connected items.
 - b. Use metal alloy weld material as recommended by manufacturer for use on material to be exothermically connected.
 - c. Manufacturers - Exothermic Welded Connections:
 - 1) Cadweld, a brand of Erico International Corporation: www.erico.com.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.

2.03 ELECTRODES

- A. Ground Rod Electrodes:
 1. Comply with NEMA GR 1.
 2. Material: Copper-bonded (copper-clad) steel.
 3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.
 4. Manufacturers:
 - a. Erico International Corporation: www.erico.com.
 - b. Harger Lightning & Grounding: www.harger.com.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 ACCESSORIES

- A. Grounding Lugs: All lugs used on grounding of manholes and transformers, including medium/high voltage cable shields, are to be compression type.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install grounding and bonding system components in a neat and workmanlike manner in accordance with NECA 1.
- C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.
- D. Install ground electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground.
- E. Make grounding and bonding connections using specified connectors.
 1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
 2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.

3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
 4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- F. Identify grounding and bonding system components in accordance with Section 26 05 53 Identification for Electrical Systems.
 - G. Provide grounding electrode conductor and connect to reinforcing steel in foundation footing where indicated. Bond steel together.
 - H. Bond metal piping systems to ground.
 1. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding-clamp connectors.
 - I. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

3.02 CONNECTIONS

- A. General: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
- B. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections. Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. Moisture Protection: Where insulated grounding conductors are connected to grounding rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Perform inspection, testing, and adjusting in accordance with Section 01 40 00.
- C. Inspect and test in accordance with NETA ATS except Section 4.
- D. Perform inspections and tests listed in NETA ATS, Section 7.13.
- E. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
- F. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.
- G. Test ground resistance at each rod, plate, and pipe electrode (before interconnection to other electrodes), the entire ground rod-ground cable counterpoise system before it is bonded to concrete encased electrode or building steel.
- H. Test Procedures:
 1. Test with a D.C. three-point earth ground resistance tester in accordance with IEEE 81.
 2. Measure ground resistance without the soil being moistened by any means other than natural precipitation.
 3. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Support and attachment components for equipment, conduit, cable, boxes, and other electrical work.

1.02 RELATED REQUIREMENTS

- A. Section 26 0534 - Conduit: Additional support and attachment requirements for conduits.
- B. Section 26 0537 - Boxes: Additional support and attachment requirements for boxes.

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- C. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 30 00 Cast-in-Place Concrete.

1.05 QUALITY ASSURANCE

- A. Comply with NFPA 70.

PART 2 PRODUCTS

2.01 COMPLY WITH APPLICABLE BUILDING CODE.

2.02 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
- B. Anchors and Fasteners:
 - 1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
 - 2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
 - 3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the static design load to be supported plus 200 pounds. Include consideration for vibration, equipment operation, and shock loads where applicable.
 - 4. Concrete Structural Elements: Use precast inserts, expansion anchors, or preset inserts.

5. Do not use products for applications other than as permitted by NFPA 70 and product listing.
6. Steel Structural Elements: Use beam clamps, steel spring clips, steel ramset fasteners, or welded fasteners.
7. Concrete Surfaces: Use self-drilling anchors or expansion anchors.
8. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
 - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
 - b. Outdoor and Damp or Wet Indoor Locations: Use stainless steel or approved equivalent unless otherwise indicated.
 - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
9. Wood Elements: Use wood screws.
 - a. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- C. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
 1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
 2. Conduit Clamps: Bolted type unless otherwise indicated.
- D. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.
- E. Formed Steel Channel:
 1. Product:
 - a. Material: Steel, except as otherwise indicated, protected from corrosion with zinc coating or with treatment of equivalent corrosion resistance using approved alternative finish or inherent material characteristics.
 - b. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel, except as otherwise indicated.
 - c. Steel channel supports have 9/16-inch diameter holes at a maximum of 8 inches o.c., in at least 1 surface.
 - d. Fittings and accessories mate and match with channels and are from the same manufacturer.
- F. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
 1. Comply with MFMA-4.
- G. Hanger Rods: 3/8-inch diameter or larger threaded steel, except as otherwise indicated.
 1. Channel (Strut) Used as Raceway (only where specifically indicated): Listed and labeled as complying with UL 5B.
 2. Channel Material:
 - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
 3. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
- H. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install hangers and supports as required to adequately and securely support electrical system components, in a neat and workmanlike manner, as specified in NECA 1.
 1. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
- B. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- C. In wet and damp locations use steel channel supports to stand cabinets and panelboards 1 inch off wall.

- D. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
- E. Spare Capacity: Size supports for multiple conduits so capacity can be increased by a 25 percent minimum in the future.
- F. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
- G. Miscellaneous Supports: Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other except where components are mounted directly to structural features of adequate strength.
- H. Anchors and Fasteners:
 - 1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
 - 2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
 - 3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
 - 4. Hollow Masonry: Use toggle bolts.
 - 5. Wood: Use wood screws.
 - 6. Powder-actuated fasteners are not permitted.
 - 7. Hammer-driven anchors and fasteners are not permitted.
 - 8. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - a. Comply with MFMA-4.
 - b. Channel Material: Use galvanized steel.
 - c. Manufacturer: Same as manufacturer of metal channel (strut) framing system.
 - 9. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.

3.02 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.
- D. Install products in accordance with manufacturer's instructions.
- E. Install support and attachment components in a neat and workmanlike manner in accordance with NECA 1.
- F. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- G. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- H. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- I. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- J. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- K. Equipment Support and Attachment:
 - 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
 - 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 - 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 - 4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

- L. Conduit Support and Attachment: Also comply with Section 26 05 34 Conduit.
- M. Box Support and Attachment: Also comply with Section 26 05 37 Boxes.
- N. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- O. Secure fasteners according to manufacturer's recommended torque settings.
- P. Remove temporary supports.

END OF SECTION

SECTION 26 05 34

CONDUIT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. Intermediate metal conduit (IMC).
- C. PVC-coated galvanized steel rigid metal conduit (RMC).
- D. Flexible metal conduit (FMC).
- E. Liquidtight flexible metal conduit (LFMC).
- F. Electrical metallic tubing (EMT).
- G. Rigid polyvinyl chloride (PVC) conduit.
- H. Conduit fittings.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 26 05 37 - Boxes.
- D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 21 00 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conduits.
- F. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.

1.03 DEFINITIONS

- A. Wet Location: A location in which water or other liquid can drip, splash, or flow on or against electrical equipment.
- B. Damp Location: An exterior or interior location that is normally or periodically subject to condensation of moisture in, on, or adjacent to, electrical equipment, and includes partially protected locations.
- C. Inaccessible Spaces: Inside permanent walls and ceilings, completely enclosed without access.
- D. Accessible Spaces: Spaces above accessible ceiling tile, spaces with access panels, accessible void spaces, accessible attic spaces.
- E. Finished Spaces: Rooms or spaces with painted or otherwise finished surfaces, intended for regular use by occupants.
 - 1. Spaces are considered finished spaces unless defined as unfinished.
- F. Unfinished Spaces: Mechanical rooms, shop spaces, bulk storage, shell space for future construction.

1.04 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2005.
- B. ANSI C80.3 - American National Standard for Steel Electrical Metallic Tubing (EMT); 2005.
- C. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit (EIMC); 2005.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); National Electrical Contractors Association; 2013.

- F. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); National Electrical Contractors Association; 2003.
- G. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; National Electrical Manufacturers Association; 2012 (ANSI/NEMA FB 1).
- H. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit; National Electrical Manufacturers Association; 2005.
- I. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; National Electrical Manufacturers Association; 2013.
- J. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; National Electrical Manufacturers Association; 2015.
- K. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.
- M. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
- N. UL 360 - Liquid-Tight Flexible Steel Conduit; Current Edition, Including All Revisions.
- O. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
- P. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
- Q. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.
- R. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
 - 4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
 - 5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.06 SUBMITTALS

- A. Closeout Submittals:
 - 1. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 2 inch (53 mm) trade size and larger.

1.07 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.

- B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.
- C. Underground:
1. Under Slab on Grade: Use rigid PVC conduit.
 2. Exterior, Direct-Buried: Use rigid PVC conduit.
 - a. Within 5 Feet from Foundation Wall: Use galvanized rigid steel metal conduit or PVC-coated galvanized rigid steel metal conduit.
 3. Exterior, Embedded Within Concrete: Use rigid PVC conduit.
 4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from underground.
 5. Where rigid polyvinyl (PVC) conduit is provided, use galvanized steel rigid metal conduit elbows for bends.
 6. Where rigid polyvinyl (PVC) conduit is provided under vehicle driving areas: Use Schedule 80.
 7. Where steel conduit is installed in direct contact with earth where soil has a resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience, use corrosion protection tape to provide supplementary corrosion protection or use PVC-coated galvanized steel rigid metal conduit.
- D. Embedded Within Concrete:
1. Within Slab on Grade (within structural slabs only where approved by Structural Engineer): Use rigid PVC conduit.
 2. Within Slab Above Ground: Not permitted.
 3. Maximum Size Conduit Within Slab: 3/4 inch; 1/2 inch for conduits crossing each other.
 4. Within Concrete Walls Above Ground: Use rigid PVC conduit.
 5. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from concrete.
 6. Where rigid polyvinyl (PVC) conduit is provided, use galvanized steel rigid metal conduit elbows for bends.
- E. Concealed Within Masonry Walls: Use electrical metallic tubing (EMT).
- F. Concealed Within Hollow Stud Walls: Use electrical metallic tubing (EMT).
- G. Concealed Above Accessible Ceilings: Use electrical metallic tubing (EMT).
- H. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
- I. Exposed, Interior Unfinished Spaces, Not Subject to Physical Damage: Use electrical metallic tubing (EMT).
- J. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit.
1. Locations subject to physical damage include, but are not limited to:
 - a. Where exposed below 8 feet, except within electrical and communication rooms or closets.
- K. Exposed, Exterior: Use galvanized steel rigid metal conduit or PVC-coated galvanized steel rigid metal conduit.
- L. Corrosive Locations Above Ground: Use PVC-coated galvanized steel rigid metal conduit.
- M. Connections to Vibrating Equipment:
1. Dry Locations: Use flexible metal conduit.
 2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
 3. Maximum Length: 6 feet unless otherwise indicated.
 4. Vibrating equipment includes, but is not limited to:
 - a. Transformers.
 - b. Motors.

2.02 CONDUIT REQUIREMENTS

- A. Electrical Service Conduits: Also comply with Section 26 21 00 Low-Voltage Electrical Service Entrance.
- B. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Minimum Conduit Size, Unless Otherwise Indicated:
 - 1. Power Branch Circuits: 1/2 inch (16 mm) trade size.
 - 2. Power Branch Circuit Homeruns: 3/4 inch (21 mm) trade size.
 - 3. Control Circuits: 1/2 inch (16 mm) trade size.
 - 4. Flexible Connections to Luminaires: 1/2 inch (16 mm) trade size.
- E. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
 - 1. Allied Tube & Conduit: www.alliedeg.com.
 - 2. Republic Conduit: www.republic-conduit.com.
 - 3. Wheatland Tube Company: www.wheatland.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- C. Fittings:
 - 1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Material: Use steel or malleable iron.
 - 3. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.04 INTERMEDIATE METAL CONDUIT (IMC)

- A. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.
- B. Fittings:
 - 1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Hazardous Location Boundaries: Use conduit seal fittings.
 - 3. Material: Use steel or malleable iron.
 - 4. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.05 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.
- B. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil.
- C. PVC-Coated Fittings:
 - 1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
 - 2. Non-Hazardous Locations: Use fittings listed and labeled as complying with UL 514B.
 - 3. Material: Use steel or malleable iron.
 - 4. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil.
- D. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil.

2.06 FLEXIBLE METAL CONDUIT (FMC)

- A. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.
- B. Fittings:
 - 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Material: Use steel or malleable iron.

2.07 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- B. Fittings:
 - 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Material: Use steel or malleable iron.

2.08 ELECTRICAL METALLIC TUBING (EMT)

- A. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
- B. Fittings:
 - 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - a. Provide identified insulating fittings/bushings providing a smoothly rounded insulating surface at all conduit terminations to protect conductors.
 - 2. Material: Use steel or malleable iron.
 - 3. Connectors and Couplings: Use compression (gland) or set-screw type.
 - a. Do not use indenter type connectors and couplings.

2.09 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

- A. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.
- B. Fittings:
 - 1. Manufacturer: Same as manufacturer of conduit to be connected.
 - 2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on drawings.
- B. Verify that mounting surfaces are ready to receive conduits.
- C. Verify that conditions are satisfactory for installation prior to starting work.
- D. Verify routing and termination locations of conduit prior to rough-in.
- E. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in a neat and workmanlike manner in accordance with NECA 1.
- C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
- D. Install intermediate metal conduit (IMC) in accordance with NECA 101.

- E. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by the manufacturer.
- F. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.
- G. Install liquidtight flexible metallic conduit (LFMC) in accordance with NECA 111.
- H. Conduit Routing:
 - 1. Unless dimensioned, conduit routing indicated is diagrammatic.
 - 2. When conduit destination is indicated and routing is not shown, determine exact routing required.
 - 3. Conceal all conduits unless specifically indicated to be exposed.
 - 4. Conduits in the following areas may be exposed, unless otherwise indicated:
 - a. Electrical rooms.
 - b. Mechanical equipment rooms.
 - 5. Unless otherwise approved, do not route conduits exposed:
 - a. Across floors.
 - b. Across roofs.
 - c. Across building exterior surfaces.
 - 6. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
 - 7. Arrange conduit to maintain adequate headroom, clearances, and access.
 - 8. Arrange conduit to provide no more than the equivalent of three 90 degree bends between pull points.
 - 9. Arrange conduit to provide no more than 150 feet between pull points.
 - 10. Use conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one shot bender to fabricate bends in metal conduit larger than 2 inch size.
 - 11. Arrange supports to prevent misalignment during wiring installation.
 - 12. Route conduits above water and drain piping where possible.
 - 13. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
 - 14. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
 - 15. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
 - a. Heaters.
 - b. Hot water piping.
- I. Conduit Support:
 - 1. Secure and support conduits in accordance with NFPA 70 and Section 26 05 29 Hangers and Supports for Electrical Systems using suitable supports and methods approved by the authority having jurisdiction.
 - 2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
 - 3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
 - 4. Use conduit strap to support single surface-mounted conduit.
 - a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
 - 5. Use of spring steel conduit clips for support of conduits is not permitted.
 - 6. Use of wire for support of conduits is not permitted.
 - 7. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with the most stringent requirements.
- J. Connections and Terminations:
 - 1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.

2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
 3. Use suitable adapters where required to transition from one type of conduit to another.
 4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
 5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
 6. Where spare conduits stub up through concrete floors and are not terminated in a box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.
 7. Secure joints and connections to provide maximum mechanical strength and electrical continuity.
- K. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
 2. Make penetrations perpendicular to surfaces unless otherwise indicated.
 3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
 4. Conceal bends for conduit risers emerging above ground.
 5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
 6. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
 7. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.
- L. Underground Installation:
1. Provide trenching and backfilling in accordance with Section 31 23 16.13.
 2. Minimum Cover, Unless Otherwise Indicated or Required:
 - a. Underground, Exterior: 24 inches.
 - b. Under Slab on Grade: 12 inches to bottom of slab.
 3. Provide underground warning tape in accordance with Section 26 05 53 along entire conduit length for service entrance where not concrete-encased.
- M. Embedment Within Structural Concrete Slabs (only where approved by Structural Engineer):
1. Install conduits within middle one third of slab thickness.
 2. Secure conduits to prevent floating or movement during pouring of concrete.
- N. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
 2. Where conduits are subject to earth movement by settlement or frost.
- O. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
1. Where conduits pass from outdoors into conditioned interior spaces.
 2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
- P. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.
- Q. Provide grounding and bonding in accordance with Section 26 05 26.
- R. Identify conduits in accordance with Section 26 05 53.

3.03 PROTECTION

- A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

3.04 INTERFACE WITH OTHER PRODUCTS

- A. Route conduit through roof openings for piping and ductwork wherever possible. Where separate roofing penetration is required, coordinate location and installation method with roofing installation. Do not void the roof warranty.

END OF SECTION

SECTION 26 05 37

BOXES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.
- B. In-ground boxes.
- C. Underground pull box enclosures.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- B. Section 26 05 34 - Conduit:
 - 1. Conduit bodies and other fittings.
 - 2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 27 16 - Electrical Cabinets and Enclosures.
- E. Section 26 27 26 - Wiring Devices:
 - 1. Wall plates.
 - 2. Additional requirements for locating boxes for wiring devices.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; National Electrical Contractors Association; 2010.
- C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; National Electrical Manufacturers Association; 2012 (ANSI/NEMA FB 1).
- D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; National Electrical Manufacturers Association; 2013 (ANSI/NEMA OS 1).
- E. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. SCTE 77 - Specification for Underground Enclosure Integrity; Society of Cable Telecommunications Engineers; 2013 (ANSI/SCTE 77).
- G. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
 - 4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
 - 5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.

6. Coordinate the work with other trades to preserve insulation integrity.
7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. Closeout Submittals:
 1. Project Record Documents: Record actual locations for outlet and device boxes, pull boxes, cabinets and enclosures, floor boxes, and underground boxes/enclosures.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

PART 2 PRODUCTS

2.01 BOXES

- A. General Requirements:
 1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
 2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
 3. Provide products listed, classified, and labeled as suitable for the purpose intended.
 4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
 5. Provide grounding terminals within boxes where equipment grounding conductors terminate.
- B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
 1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
 2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
 3. Use cast iron boxes or cast aluminum boxes where exposed galvanized steel rigid metal conduit or exposed intermediate metal conduit (IMC) is used.
 4. Use suitable concrete type boxes where flush-mounted in concrete.
 5. Use suitable masonry type boxes where flush-mounted in masonry walls.
 6. Use raised covers suitable for the type of wall construction and device configuration where required.
 7. Use shallow boxes where required by the type of wall construction.
 8. Do not use "through-wall" boxes designed for access from both sides of wall.
 9. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
 10. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
 11. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
 12. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes.
 13. Minimum Box Size, Unless Otherwise Indicated:
 - a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 2-1/8 inch deep (100 by 54 mm) trade size.
 - b. Ceiling Outlets: 4 inch octagonal or square by 2-1/8 inch deep (100 by 54 mm) trade size.
 14. Wall Plates: Comply with Section 26 27 26.
 15. Manufacturers:

- a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com.
 - b. Hubbell Incorporated; Bell Products: www.hubbell-rtb.com.
 - c. Hubbell Incorporated; RACO Products: www.hubbell-rtb.com.
 - d. Thomas & Betts Corporation: www.tnb.com.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Cabinets and Enclosures: See Section 26 27 16.
- D. In-Ground Boxes:
 - 1. Description: In-Ground Cast Metal Box 305 x 305 mm (12 x 12 inch) and larger: NEMA 250, Type 4; flat-flanged, in-ground junction box:
 - a. Material: Galvanized cast iron.
 - b. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.
 - c. Material: Galvanized cast iron.
 - d. Cover: Smooth cover with neoprene gasket and stainless steel cover screws.
 - e. Cover Legend: "ELECTRIC".
 - f. Cable Entrance: Pre-cut 6 x 6 inch cable entrance at center bottom of each side.
 - g. Cover: Glass fiber weatherproof cover with nonskid finish.
- E. Underground Pull Box Enclosures:
 - 1. Description: In-ground, stackable open bottom boxes furnished with flush, non-skid covers with legend indicating type of service and stainless steel tamper resistant cover bolts.
 - 2. Cover Legends:
 - a. LV ELECTRIC for low voltage electrical systems, 600 volts and less.
 - b. COMMUNICATIONS for telecommunications systems.
 - 3. Size: As indicated on drawings.
 - 4. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 12 inches.
 - 5. Applications:
 - a. Sidewalks and Landscaped Areas Subject Only to Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77, Tier 8 load rating.
 - b. Do not use polymer concrete enclosures in areas subject to deliberate vehicular traffic.
 - 6. Polymer Concrete Underground Pull Box Enclosures: Comply with SCTE 77.
 - a. Manufacturers:
 - 1) Hubbell Incorporated; Quazite Products: www.hubbellpowersystems.com.
 - 2) Oldcastle Precast, Inc: www.oldcastleprecast.com.
 - 3) Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on drawings.
- B. Verify that mounting surfaces are ready to receive boxes.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.

- E. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
- F. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.
- G. Box Locations:
 - 1. Locate boxes to be accessible.
 - 2. Unless dimensioned, box locations indicated are approximate.
 - 3. Locate boxes as required for devices installed under other sections or by others.
 - a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 26 27 26.
 - 4. Locate boxes so that wall plates do not span different building finishes.
 - 5. Locate boxes so that wall plates do not cross masonry joints.
 - 6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
 - 7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
 - 8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches horizontal separation.
 - 9. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
 - a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
 - b. Do not install flush-mounted boxes with area larger than 16 square inches or such that the total aggregate area of openings exceeds 100 square inches for any 100 square feet of wall area.
 - 10. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 05 34.
 - 11. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
 - a. Concealed above accessible suspended ceilings.
 - b. Within joists in areas with no ceiling.
 - c. Electrical rooms.
 - d. Mechanical equipment rooms.
- H. Box Supports:
 - 1. Secure and support boxes in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
 - 2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
 - 3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
 - 4. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.
- I. Install boxes plumb and level.
- J. Flush-Mounted Boxes:
 - 1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
 - 2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.

3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.
- K. Install boxes as required to preserve insulation integrity.
- L. Underground Pull Box Enclosures:
 1. Install enclosure on gravel base, minimum 6 inches deep.
 2. Mount enclosures located in landscaped areas with top at 1 inch above finished grade.
 3. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.
- M. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- N. Close unused box openings.
- O. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- P. Provide grounding and bonding in accordance with Section 26 05 26.
- Q. Identify boxes in accordance with Section 26 05 53.

3.03 CLEANING

- A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.04 PROTECTION

- A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Underground warning tape.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 19 - Low Voltage Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
- B. Section 26 05 73 - Overcurrent Protective Device Coordination Study: Arc flash hazard warning labels.

1.03 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
- B. Sequencing:
 - 1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
 - 2. Do not install identification products until final surface finishes and painting are complete.

1.05 SUBMITTALS

- A. Submit all product data, shop drawings, and samples concurrently.
- B. Action Submittals:
 - 1. Product Data: Provide manufacturer's standard catalog pages and data sheets for:
 - a. Cable and Wire Markers.
 - b. Underground Warning Tape.
 - 2. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.
 - 3. Samples:
 - a. Identification Nameplates: One of each type and color specified.
 - b. Identification Labels: One of each type and color specified.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.07 FIELD CONDITIONS

- A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

- A. Identification for Equipment:
 - 1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
 - a. Panelboards:

- 1) Equipment identification nameplate:
 - (a) Include equipment identification name.
 - (b) Include voltage and phase.
 - (c) Include ampere interrupting capacity (AIC) or short circuit current rating (SCCR).
 - (d) Include power source and circuit number. Include location when not within sight of equipment.
- 2) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
- 3) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces.
- 4) For power distribution panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Identify spares and spaces.
- b. Enclosed switches, circuit breakers, and motor controllers:
 - 1) Equipment identification nameplate:
 - (a) Include equipment identification name. Match identification for load(s) served. Include location when not within sight of equipment.
(1) Example: EF-1 EXHAUST FAN - PENTHOUSE EXTERIOR
 - (b) Include voltage and phase.
 - (c) Include power source and circuit number. Include location.
- c. Time Switches:
 - 1) Identify load(s) served and associated circuits controlled. Include location.
- d. Enclosed Contactors:
 - 1) Equipment identification nameplate:
 - (a) Include equipment identification name.
 - (b) Identify load(s) and associated circuits controlled. Include location.
2. Service Equipment:
 - a. Use identification nameplate to identify each service disconnecting means.
 - b. Use identification nameplate at each piece of service equipment to identify the available fault current and the date calculations were performed.
3. Use identification label on inside of door at each fused switch to identify required NEMA fuse class and size.
4. Arc Flash Hazard Warning Labels: Comply with Section 26 05 73.
- B. Identification for Conductors and Cables:
 1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 05 19.
 2. Use identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment.
 3. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
 - a. At each source and load connection.
 - b. Within boxes.
 4. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.
 5. Use underground warning tape to identify direct buried cables.
- C. Identification for Boxes:
 1. Use identification labels to identify circuits enclosed.
 - a. For exposed boxes in public areas, provide identification on inside face of cover.
- D. Identification for Devices:
 1. Use identification label to identify serving branch circuit for receptacles.
 2. Use identification label to identify receptacles protected by upstream GFI protection, where permitted.
 3. Use identification label to identify individual wall switches where indicated.

2.02 IDENTIFICATION NAMEPLATES AND LABELS

- A. Identification Nameplates:
 - 1. Materials:
 - a. Indoor Clean, Dry Locations: Use plastic nameplates.
 - b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
 - 2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
 - 3. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
 - 4. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
 - 5. Text height: 3/16 inches minimum.
 - 6. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.
- B. Identification Labels:
 - 1. Manufacturers:
 - a. Brady Corporation: www.bradyid.com.
 - b. Brother International Corporation: www.brother-usa.com.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
 - a. Use only for indoor locations.
 - 3. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.
- C. Format for Equipment Identification:
 - 1. Minimum Size: 1 inch by 2.5 inches.
 - 2. Legend:
 - a. Equipment designation or other approved description.
 - b. Other information as indicated.
 - 3. Text: All capitalized unless otherwise indicated.
 - 4. Minimum Text Height:
 - a. Equipment Designation: 1/2 inch.
 - b. Other Information: 1/4 inch.
 - 5. Color:
 - a. Normal Power System: Black text on white background.
- D. Format for General Information and Operating Instructions:
 - 1. Minimum Size: 1 inch by 2.5 inches.
 - 2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
 - 3. Text: All capitalized unless otherwise indicated.
 - 4. Minimum Text Height: 1/4 inch.
 - 5. Color: Black text on white background unless otherwise indicated.
- E. Format for Receptacle Identification:
 - 1. Minimum Size: 1/4 inch by 1.5 inches.
 - 2. Legend: Power source and circuit number or other designation indicated.
 - a. Include voltage and phase for other than 120 V, single phase circuits.
 - 3. Text: All capitalized unless otherwise indicated.
 - 4. Minimum Text Height: 1/8 inch.
 - 5. Color: White text on black background.
- F. Format for Control Device Identification:

1. Minimum Size: 1/4 inch by 1.5 inches.
2. Legend: Load controlled or other designation indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/8 inch.
5. Color: White text on black background.

2.03 WIRE AND CABLE MARKERS

- A. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.
- B. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- C. Legend: Power source and circuit number or other designation indicated.
- D. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
- E. Minimum Text Height: 1/8 inch.
- F. Color: Black text on white background unless otherwise indicated.

2.04 UNDERGROUND WARNING TAPE

- A. Materials: Use foil-backed detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
- B. Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.
- C. Legend: Type of service, continuously repeated over full length of tape.
- D. Color:
 1. Tape for Buried Power Lines: Black text on red background.
 2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

PART 3 EXECUTION

3.01 PREPARATION

- A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
 1. Surface-Mounted Equipment: Enclosure front.
 2. Flush-Mounted Equipment: Inside of equipment door.
 3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
 4. Elevated Equipment: Legible from the floor or working platform.
 5. Branch Devices: Adjacent to device.
 6. Interior Components: Legible from the point of access.
 7. Boxes: Outside face of cover.
 8. Conductors and Cables: Legible from the point of access.
 9. Devices: Outside face of cover.
- C. Install identification products centered, level, and parallel with lines of item being identified.
- D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using stainless steel screws.
 1. Do not use adhesives except where substrate can not be penetrated.
- E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

- F. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.
- G. Secure rigid signs using stainless steel screws.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION

SECTION 26 05 73
OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY
AND ARC FLASH ASSESSMENT

PART 1 GENERAL

1.01 SCOPE

- A. The electrical contractor shall retain qualified services to perform a short circuit/coordination study and arc flash hazard assessment.
- B. The study shall be performed, stamped and signed by a registered professional engineer licensed in the State in which the Project is located. Credentials of the individual(s) performing the study and background of the firm shall be submitted to the Engineer for approval prior to start of the work.
- C. The firm performing the study should demonstrate capability and experience to provide assistance during start up as required.
- D. The studies shall be submitted to the Design Engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment for manufacture.
- E. No less than two scenarios shall be included in the study:
 - 1. High level short circuit conditions that may occur during connection to the utility source.
 - 2. Low level short circuit conditions that may occur during connection to an alternate utility source.
- F. Short Circuit Study: Normal system connections and those which result in maximum fault conditions shall be adequately covered in the study. The studies shall include:
 - 1. All portions of the electrical distribution system from the normal power source or sources down to and including each bus in the distribution system.
 - 2. All devices down to largest branch circuit and largest feeder circuit breaker in each motor control center, and main breaker in branch panelboards.
 - 3. All multimotor and combination-load refrigeration equipment that has a protective device rated greater than 60 amperes.
 - 4. All motor controllers; except those rated less than 2 horsepower at 300 volts or less.
- G. Coordination study and Analysis shall include normal and alternate systems. The studies shall include:
 - 1. All devices down to largest branch circuit and largest feeder circuit breaker in each motor control center, and main breaker in branch panelboards.
 - a. Include enclosed circuit breakers and enclosed switches that function as overcurrent protective devices for panelboard mains.
 - 2. All ground fault protection of equipment.
- H. Arc Flash Assessment: Normal and emergency/alternate system connections; and those that result in maximum arc flash conditions. The studies shall include:
 - 1. All portions of the normal electrical distribution system from the electrical service equipment devices down to largest branch circuit and largest feeder circuit breaker in each motor control center, and main breaker in branch panelboards.
 - a. Include enclosed circuit breakers and enclosed switches that function as overcurrent protective devices for panelboard mains.
 - 2. All portions of the electrical distribution system from the emergency/alternate power source or sources down to and including the smallest adjustable trip circuit breaker in the distribution system.
 - 3. All devices that provide overcurrent protection for multimotor and combination load refrigeration equipment that has a protective device rated greater than 60 amperes.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 53 - Identification for Electrical Systems: Additional requirements for arc flash hazard warning labels.

- B. Section 26 24 16 - Panelboards.

1.03 REFERENCE STANDARDS

- A. IEEE 242 - IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems; 2001.
- B. IEEE 399 - IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis; 1997.
- C. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; International Electrical Testing Association; 2013 (ANSI/NETA ATS).
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work to provide equipment and associated protective devices complying with criteria for selection and adjustment, as determined by studies to be performed.
 - 2. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Submit study reports prior to or concurrent with product submittals.
 - 2. Do not order equipment until matching study reports and product submittals have both been evaluated by Architect.

1.05 SUBMITTALS

- A. Failure to follow submittal instructions does not relieve the Contractor from the requirements of meeting the project schedule.
- B. Evaluation of electrical equipment product data submittals by Architect will not commence until acceptable preliminary studies in sufficient detail to ensure that device selection will be adequate have been submitted.
- C. Information Submittals:
 - 1. Qualifications of firm performing the study.
 - 2. Study reports, stamped or sealed and signed by study preparer.
 - 3. Personnel Qualifications: Submit qualifications of individual(s) who will perform the work for approval prior to commencement of the studies. Submit within 30 days of award of contract.
- D. Action Submittals:
 - 1. Study Report - General: Submit protective device studies as specified, prior to submission of product data submittals or ordering or fabrication of protective devices.
 - a. Evaluation of product data submittals by Architect will not commence until acceptable preliminary studies in sufficient detail to ensure that device selection will be adequate have been submitted.
 - b. Equipment submittals received prior to submittal of acceptable studies will be rejected without review.
 - c. Include stamp or seal and signature of preparing engineer.
 - 2. Draft Report: Submit a draft of the study to Engineer for review prior to delivery of the study to the Owner. Submit draft report in conjunction with equipment submittals. The report shall include:
 - a. Descriptions, purpose, and scope of the study.
 - b. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties, and commentary regarding same.
 - c. Fault current calculations including a definition of terms and guide for interpretation of computer printout.
 - d. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same

- e. Complete one-line diagram with fault current trip setting shall be included with submittal.
- f. Arc flash hazard tabulations indicating hazard class and personnel protective equipment.
- g. Include color printouts of arc flash hazard warning labels; paper hard copy or PDF electronic file format.
- h. Include all files prepared using software packages, on optical disk (CD-ROM or DVD), with file name cross-references to specific pieces of equipment and systems. Include all libraries necessary for the reviewer to open and review settings.
- 3. Final Report: Provide studies in conjunction with Record Documents submittals to verify equipment ratings required. The results of the power system study shall be summarized in a final report. Six (6) bound copies of the final report shall be submitted. The report shall include the following sections:
 - a. All items included in draft report, with all additions or changes as required by the reviewer.
 - 1) Include updated files prepared using software packages, on optical disk (CD-ROM or DVD).
 - b. Field study findings.
 - c. Include stamp or seal and signature of preparing engineer.
- E. Closeout Submittals:
 - 1. Project Record Documents: Revise studies as required to reflect as-built conditions.
 - a. Submit not less than 60 days prior to final inspection of electrical system.
 - b. Include hard copies with operation and maintenance data submittals.
 - c. Include all files prepared using software packages, on optical disk (CD-ROM or DVD), with file name cross-references to specific pieces of equipment and systems.

1.06 DATA COLLECTION FOR THE STUDY

- A. Contractor Responsibility: Provide all project-related data needed by study preparer, including equipment, wire sizes, insulation types, conduit types, and actual circuit lengths, and provide to study preparer.
 - 1. Obtain information on existing power distribution equipment.
 - 2. Obtain information from utility company.
 - 3. Obtain information on relevant Owner provided power distribution equipment.
- B. Owner's Responsibility: Provide data on relevant Owner power distribution equipment to Contractor.

1.07 PROTECTIVE DEVICE STUDY

- A. Analyze the specific electrical and utilization equipment (according to NEC definition), the actual protective devices to be used, and the actual feeder lengths to be installed.
 - 1. Primary Source, for Purposes of Studies: Utility company primary protective devices.
 - 2. Study Methodology: Comply with requirements and recommendations of NFPA 70, IEEE 399, and IEEE 242.
 - 3. Report: State the methodology, assumptions, base per unit quantities selected, and rationale employed in making each type of calculation; identify computer software package(s) used.
- B. One-Line Diagrams: Prepare schematic drawing of electrical distribution system, with all electrical equipment and wiring to be protected by the protective devices; identify nodes on the diagrams for reference on report that includes:
 - 1. Calculated fault impedance, X/R ratios, utility contribution, and short circuit values (asymmetric and symmetric) at the main switchboard bus and all downstream devices containing protective devices.
 - 2. Breaker and fuse ratings.
 - 3. Transformer kVA and voltage ratings, percent impedance, X/R ratios, and wiring connections.
 - 4. Identification of each bus, with voltage.

5. Conduit materials, feeder sizes, actual lengths, and X/R ratios.
- C. Short Circuit Study: Calculate the fault impedance to determine available 3-phase short circuit and ground fault currents at each bus and piece of equipment during normal conditions, alternate operations, emergency power conditions, and other operations that could result in maximum fault conditions.
1. Include fault currents at supply switchgear lineup, unit substation primary and secondary terminals, low voltage switchgear lineup, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboard, and other significant locations throughout the system.
 2. Show fault currents available at key points in the system down to a fault current of 7,000 A at 480 V and 208 V.
 3. Provide a ground fault current study for the same system areas, including the associated zero sequence impedance data. Include in tabulations fault impedance, X to R ratios, asymmetry factors, motor contribution, short circuit KVA, and symmetrical and asymmetrical fault currents.
 4. Show transformer full load and 150, 400, or 600 percent currents, transformer magnetizing inrush, ANSI transformer withstand parameters, and significant symmetrical and asymmetrical fault currents. Terminate device characteristic curves at a point reflecting the maximum symmetrical and asymmetrical fault current to which the device is exposed.
 5. Include source combinations for present and future supply circuits, large motors, or generators.
 6. Include motor contributions in determining the momentary and interrupting ratings of the protective devices.
 - a. Utilize equipment load data for the study obtained by the Contractor from the contract documents.
 7. Primary Fault Level Assumptions at utility primary connection:
 - a. Analyze for assumed infinite bus at utility connection.
 - b. Obtain source impedance data and power company system characteristics from utility company.
 8. Report: Include all pertinent data used in calculations and for each device include:
 - a. Device identification.
 - b. Operating voltage.
 - c. Protective device.
 - d. Device rating.
 - e. Calculated short circuit current, asymmetrical and symmetrical, and ground fault current.
- D. Coordination Study: Perform an organized time-current analysis of each protective device in series from the individual device back to the primary source, under normal conditions, alternate operations, and emergency power conditions.
1. For motor control circuits, show the MCC full-load current plus symmetrical and asymmetrical of the largest motor starting current to ensure protective devices will not trip major or group operation.
 2. Graphically illustrate that adequate time separation exists between series devices, including upstream primary device.
 3. Plot the specific time-current characteristics of each protective device graphically indicating the coordination proposed for the system, centered on conventional, full-size, log-log forms.
 - a. Organize plots so that all upstream devices are clearly depicted on one sheet.
 4. Also show the following on curve plot sheets:
 - a. Device identification: Type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings.
 - b. Voltage and current transformer ratios for curves.
 - c. 3-phase and 1-phase ANSI damage curves for each transformer.

- d. No-damage, melting, and clearing curves for fuses. Include manufacturing tolerance and damage bands in plotted fuse characteristics.
 - e. Cable damage curves.
 - f. Transformer inrush points.
 - g. Maximum short circuit cutoff point.
 - h. Simple one-line diagram with title for the portion of the system that each curve plot illustrates.
 - i. Software report for each curve plot, labeled for identification.
- E. Analysis: Determine ratings and settings of protective devices to minimize damage caused by a fault and so that the protective device closest to the fault will open first.
 - 1. Required Ratings and Settings: Derive required ratings and settings of protective devices in consideration of upstream protective device settings and optimize system to ensure selective coordination.
 - 2. Evaluate proper operation of the ground relays in 4-wire distributions with more than one main service circuit breaker, or when generators are provided, and discuss the neutral grounds and ground fault current flows during a neutral to ground fault.
 - 3. Separate medium-voltage relay characteristic curves from curves for other devices by at least a 0.4-second time margin.
 - 4. Provide settings for chiller motor starters or obtain from the mechanical contractor, include in the study package, and comment.
 - 5. Identify any equipment that is underrated as specified.
 - a. Notify the Engineer in writing of circuit protective devices not properly rated for fault conditions
 - 6. Identify specified protective devices that will not achieve required protection or coordination and cannot be field adjusted to do so, and for which adequate devices would involve a change to the contract sum.
 - 7. In all cases where adequate protection or coordination cannot be achieved at no extra cost to Owner, provide a discussion of alternatives and logical compromises for best achievable coordination.
- F. Protective Device Rating and Setting Chart: Summarize in tabular format the required characteristics for each protective device based on the analysis; include:
 - 1. Device identification.
 - 2. Relay CT ratios, tap, time dial, and instantaneous pickup.
 - 3. Circuit breaker sensor rating, long-time, short-time, and instantaneous settings, and time bands.
 - 4. Fuse rating and type.
 - 5. Ground fault pickup and time delay.
 - a. Include all adjustable settings for ground fault protective devices.
 - 6. Input level and expected response time at two test points that are compatible with commonly available test equipment and the ratings of the protective device.
 - 7. Highlight all devices that as furnished by Contractor will not achieve required protection.

1.08 ARC FLASH HAZARD ASSESSMENT

- A. As part of the short circuit and coordination study, arc flash hazard study shall be included.
- B. Determine and document all possible utility and generator/emergency sources that are capable of being connected to each piece of electrical gear. Calculations shall be based on highest possible source connection.
- C. Calculations to conform to IEEE 1584a 2004 - Guide for Arc Flash Hazard Calculations standards. All incident energy units shall be calculated in calories per square centimeter.
- D. Provide recommended boundary zones and personal protective equipment (PPE) based on the calculated incident energy and requirements of NFPA 70E-2003 for each piece of electrical gear.

1.09 QUALITY ASSURANCE

- A. Study Preparer Qualifications: Professional electrical engineer licensed in the State in which the Project is located and with minimum five years experience in the preparation of studies of similar type and complexity using specified computer software.
- B. Study Preparer Qualifications:
 - 1. Company Qualifications: The firm performing the study should be currently involved in high- and low-voltage power system evaluation, regularly engaged in short circuit and coordination studies, with at least 5 years experience in power system analysis.
 - 2. Study Preparer Qualifications: Qualified engineer of switchgear manufacturer; or approved professional engineer.
 - a. Professional electrical engineer licensed in the State in which the Project is located.
 - b. Minimum 5 years experience in preparation of studies of similar type and magnitude.
 - c. Familiar with the software analysis products specified.
- C. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.
 - 1. Acceptable Software Products:
 - a. SKM Systems Analysis, Inc: www.skm.com.
- D. Contractor Responsibilities:
 - 1. Provide all project-related data needed by study preparer, including equipment, wire sizes, insulation types, conduit types, and actual circuit lengths.
 - 2. Obtain all project-related data needed by study preparer from utility company, other Contractors and subcontractors, and Owner. Typical data includes but is not limited to:
 - a. Utility primary voltage, transformer kVA and impedance, and X/R ratios.
 - b. Motors and other utilization equipment connected to the electrical distribution system, including existing components.
 - c. Motor controllers, including variable-frequency controllers.
- E. Owner's Responsibility: Provide data on relevant Owner power distribution equipment.

PART 2 PRODUCTS


2.01 PROTECTIVE DEVICES


- A. Provide protective devices of ratings and settings as required so that the protective device closest to the fault will open first.
- B. In addition to requirements specified elsewhere, provide overcurrent protective devices having ratings and settings in accordance with results of this analysis.

2.02 LABELS

- A. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
 - 1. Minimum Size: 4 by 6 inches.
 - 2. Legend: Provide custom legend in accordance with NFPA 70E based on equipment-specific data:
 - a. Include orange header that reads "WARNING" where calculated incident energy is less than 40 calories per square cm.
 - 1) Include the text "Arc Flash and Shock Hazard; Appropriate PPE Required" beneath header.
 - b. Include red header that reads "DANGER" where calculated incident energy is 40 calories per square cm or greater.
 - 1) Include the text "NO SAFE PPE EXISTS ENERGIZED WORK PROHIBITED" beneath header.
 - c. Include the following information:
 - 1) Available fault current: Initial RMS 3 Phase bolted fault.

- (a) Worst case scenario (High Isc).
 - 2) Arc flash protection boundary.
 - 3) Incident energy: Minimum arc rating.
 - 4) Hazard/risk category.
 - 5) PPE (personnel protective equipment) requirements.
 - 6) Nominal voltage.
 - 7) Shock hazard boundaries:
 - (a) Limited approach boundary.
 - (b) Restricted approach boundary.
 - (c) Prohibited approach boundary.
 - 8) Equipment identification.
 - 9) Date calculations were performed.
3. Sample Labels:

 DANGER	
NO SAFE PPE EXISTS ENERGIZED WORK PROHIBITED	
FLASH PROTECTION Flash Hazard at 457 mm Min. Arc Rating: 47 cal/cm ² Flash Protection Boundary: 4290 mm Glove Class: 00 Clothing Category: Dangerous! REFER TO NFPA 70E AND/OR APPLICABLE SAFE WORK PROCEDURES.	SHOCK PROTECTION Shock Hazard when cover is removed 208 VAC Limited Approach 1067 mm Restricted Approach Avoid Contact Prohibited Approach Avoid Contact <hr/> Bolted Fault 39.36 kA
Bus: MAIN SWBD Prot: MAIN FU SEPT, 2010	

 WARNING	
Arc Flash and Shock Hazard Appropriate PPE Required	
FLASH PROTECTION Flash Hazard at 457 mm Min. Arc Rating: 0.25 cal/cm ² Flash Protection Boundary: 175 mm Glove Class: 00 Clothing Category: Category 0 REFER TO NFPA 70E AND/OR APPLICABLE SAFE WORK PROCEDURES.	SHOCK PROTECTION Shock Hazard when cover is removed 208 VAC Limited Approach 1067 mm Restricted Approach Avoid Contact Prohibited Approach Avoid Contact <hr/> Bolted Fault 28.24 kA
Bus: MDP-EQ Prot: MAIN SWBD-FU1-MDP-EQ SEPT, 2010	

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install arc flash warning labels in accordance with Section 26 05 53.

3.02 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Adjust equipment and protective devices for compliance with studies and recommended settings.
- D. Notify Architect of any conflicts with or deviations from studies. Obtain direction before proceeding.

3.03 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.

END OF SECTION

SECTION 26 08 00
COMMISSIONING OF ELECTRICAL

PART 1 GENERAL

1.01 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.
- B. The OPR and BOD documentation are included by reference for information only.
 - 1. OPR: Owner's Project Requirements.
 - 2. BOD: Basis of Design.

1.02 SUMMARY

- A. This section covers the Contractor's responsibilities for commissioning; each subcontractor or installer responsible for the installation of a particular system or equipment item to be commissioned is responsible for the commissioning activities relating to that system or equipment item.
- B. Other electrical system testing is required under other Division 26 Specification Sections. National Electrical Installation Standards (NEIS) NECA 90-2004, "Recommended Practice for Commissioning Building Electrical Systems", 27th Volume of the NEIS Series, provides additional guidance for the commissioning of electrical systems.
- C. Commissioning requires the participation of the Contractor to ensure that all systems are operating in a manner consistent with the Contract Documents. General Commissioning requirements and coordination are detailed in Division 01. Division 26 shall be familiar with all parts of Division 01 and the Commissioning Plan issued by the Contractor and shall execute all Commissioning responsibilities assigned to them in the Contract Documents and include the cost of Commissioning in the Contract price.
- D. The Commissioning Authority (CA) directs and coordinates all commissioning activities and provides Prefunctional Checklists and Functional Test Procedures for Contractor's use.
- E. The following Electrical Systems are to be commissioned, including commissioning activities for the following specific items:
 - 1. Sweep and Scheduled Lighting Controls.
 - 2. Lighting Control Devices.
 - 3. Electrical Power Distribution Systems:
 - a. Grounding Electrode Systems.
- F. The Prefunctional Checklist and Functional Test requirements specified in this section are in addition to, not a substitute for, inspection or testing specified in other sections.

1.03 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 09 19 - Enclosed Contactors.
- C. Section 26 09 23 - Lighting Control Devices.

1.04 DEFINITIONS

- A. Commissioning: A systematic process confirming that building systems have been installed, properly started, and consistently operated in strict accordance with the Contract Documents, that all systems are complete and functioning in accordance with the Contract Documents at that all systems are complete and functioning in accordance with the Contract Documents at Substantial Completion, and that Contractor has provided Owner adequate system documentation and training. Commissioning includes deferred and/or seasonal tests as approved by Owner.
- B. Commissioning Plan: Document prepared by Contractor and approved by Owner that provides the structure, schedule, and coordination plan for the Commissioning process from the

construction phase through the warranty period. The Commissioning Plan must satisfy the Owner's test requirements.

- C. Commissioning Team: Working group made up of representative(s) from the Architect/Engineer (A/E), Contractor, Lighting Controls System provider, Engine Generator provider, Fire Alarm System equipment provider, Mass Notification System equipment provider, specialty manufacturers and suppliers, Testing Agencies, and Owner. Contractor will provide ad-hoc representation of Subcontractors on the Commissioning Team as required for implementation of the Commissioning Plan.
- D. Deferred Tests: Functional Performance or Integrated System Tests performed after Substantial Completion due to partial occupancy, partial equipment acceptance, seasonal requirements, design, or other Site conditions that prohibit the test from being performed prior to Substantial Completion.
- E. Deficiency: Condition of a component, piece of equipment or system that is not in compliance with Contract Documents.
- F. Factory Testing: Testing of equipment at the factory, by factory personnel with Owner's representative present if deemed necessary by Owner.
- G. Functional Performance Test (FPT): Test of dynamic function and operation of equipment and systems executed by Contractor. Systems are tested under various modes, such as low electrical loads, high loads, component failures, unoccupied, varying outside available daylight, life safety conditions, power failure, etc. Systems are run through all specified sequences of operation. Components are verified to be responding in accordance with Contract Documents. Functional Performance Tests are executed after start-ups and Prefunctional Checklists are complete.
- H. Functional Performance Test Procedures: Commissioning protocols and detailed test procedures and instructions in tabular and script-type format that fully describe system configuration and steps required to determine if the system is performing and functioning properly. Contractor prepares these procedures to document Functional Performance Tests.
- I. Integrated System Test: Test of dynamic function and operation of multiple systems. Integrated System Tests are tested under various modes, such as fire alarm and emergency situations, life safety conditions, power failure, etc. Systems are integrally operated through all specified sequences of operation. Components are verified to be responding in accordance with Contract Documents. Integrated System Tests are executed after Functional Performance Tests are complete and prior to Substantial Completion. Integrated System Tests provide verification that the integrated systems will properly function according to the Contract Documents.
- J. Integrated System Test Procedures: Commissioning protocols and detailed test procedures and instructions in tabular and script-type format that fully describe system configurations and steps required to determine if the interacting systems are performing and functioning properly. Contractor prepares these procedures to document Integrated System Tests.
- K. Prefunctional Checklist: A list of static inspections and material or component tests that verify proper installation of equipment (e.g., belt tension, oil levels, labels affixed, gages in place, sensors calibrated, etc.). The word Prefunctional refers to before Functional tests. Prefunctional Checklists must include the manufacturer's Start-up checklist(s). Contractor shall sign Prefunctional Checklists as complete and submit with the Request for Start-up/Functional Performance Test Form.
- L. Start-up: The activities where equipment is initially energized, tested, and operated. Start-up is completed prior to Functional Performance Tests.
- M. Test Requirements: Requirements specifying what systems, modes and functions, etc. must be tested. Test requirements are not detailed test procedures. Test requirements and acceptance criteria are specified in the Contract Documents.

1.05 SUBMITTALS

- A. Updated Submittals: Keep the Commissioning Authority informed of all changes to control system documentation made during programming and setup; revise and resubmit when substantial changes are made.
- B. Prefunctional Submittals:
 - 1. Contractor shall prepare Prefunctional Checklists and Functional Performance Test (FPT) procedures and execute and document results. All Prefunctional Checklists and tests must be documented using specific, procedural forms in Microsoft Word or Excel software developed for that purpose. Prior to testing, Contractor shall submit those forms to the Owner for review and approval.
 - 2. DRAFT Prefunctional Checklists and Functional Test Procedures for Electrical Systems: Detailed written plan indicating the procedures to be followed to test, checkout and adjust the control systems prior to full system Functional Testing; include at least the following for each type of system controlled:
 - a. System name.
 - b. Testing Agency Qualifications and personnel certifications.
 - c. List of equipment and devices.
 - d. Step-by-step procedures for testing each component after installation, including:
 - 1) Process of verifying proper hardware and wiring installation.
 - 2) Process of downloading programs to control equipment and verifying that they are addressed correctly.
 - 3) Process of performing operational checks of each controlled component.
 - 4) Plan and process for calibrating devices and sensors.
 - 5) Description of the expected field adjustments for controls should control responses fall outside of expected values.
 - e. Description of the instrumentation required for testing.
 - f. Indicate what tests on what systems should be completed prior to system startup using the control system for adjustments. Coordinate with the Commissioning Authority, product manufacturer's authorized representative, and Testing Agency for this determination.
 - 3. Draft Training Plan, include:
 - a. Follow the format consistent with ASHRAE Guideline 1 (for HVAC&R Training).
 - b. Control system manufacturer's recommended training.
 - c. Demonstration and instruction on function and overrides of any local packaged controls not controlled by the control system.
 - 4. COMPLETED Prefunctional Checklists.
- C. Functional Performance Submittals:
 - 1. Startup Reports, Functional Performance Test results, and Trend Logs: Submit for approval of Commissioning Authority.
- D. Closeout Submittals:
 - 1. Operation and Maintenance Manuals:
 - a. See Section 01 78 00 for additional requirements.
 - b. Add design intent documentation furnished by Architect to manuals prior to submission to Owner.
 - c. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.
 - d. Commissioning Authority will add commissioning records to manuals after submission to Owner.
 - 2. Project Record Documents: See Section 01 78 00 for additional requirements.
 - a. Submit updated version of control and measurement systems documentation, for inclusion with operation and maintenance data.
 - 3. Training Manuals:

- a. Provide three extra copies of the controls training manuals in a separate manual from the O&M manuals.
- b. Include optical discs (CD or DVD) of manufacturer's training materials.
- c. Include optical disk (DVD) containing videos of training sessions.

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

- A. Provide all standard testing equipment required to perform startup and initial checkout and required functional performance testing; unless otherwise noted such testing equipment will NOT become the property of Owner.
- B. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.
- C. A testing laboratory must have calibrated test equipment within the previous twelve (12) months. Calibration shall be NIST traceable. Contractor must calibrate test equipment and instruments according to manufacturer's recommended intervals and whenever the test equipment is dropped or damaged. Calibration tags must be affixed to the test equipment or certificates readily available.

PART 3 EXECUTION

3.01 PREPARATION

- A. Cooperate with the Commissioning Authority in development of the Prefunctional Checklists and Functional Test Procedures.
- B. Furnish additional information requested by the Commissioning Authority.
- C. Prepare a preliminary schedule for each system equipment start-up and testing, adjusting, and completion for use by the Commissioning Authority; update the schedule as appropriate.
- D. Notify the Commissioning Authority when startup of each piece of equipment and testing will occur; when commissioning activities not yet performed or not yet scheduled will delay construction notify ahead of time and be proactive in seeing that the Commissioning Authority has the scheduling information needed to efficiently execute the commissioning process.
- E. Put all electrical, communications, and electronic safety and security equipment and systems into operation and continue operation during each working day of testing, adjusting, and commissioning, as required.
- F. Construction Phase:
 - 1. In each purchase order or subcontract that is written for changes in scope, include the following requirements for submittal data, Commissioning documentation, testing assistance, Operating and Maintenance (O&M) data, and training, as a minimum.
 - 2. Attend Pre-Commissioning Meeting(s), Pre-Installation Meeting(s), and other Project meetings scheduled by the Contractor to facilitate the Commissioning process.
 - 3. Provide manufacturer's data sheets and shop drawing submittals of equipment.
 - 4. Provide additional requested documentation to the Contractor, prior to O&M manual submittals, for development of Prefunctional Checklist and Functional Performance Tests procedures.
 - a. Typically, this will include detailed manufacturer's installation and Start-up, operating, troubleshooting and maintenance procedures, full details of any Owner-contracted tests, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified.
 - b. In addition, the installation, Start-up, and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Contractor.
 - c. This information and data request may be made prior to normal submittals.

5. With input from the equipment Providers and A/E, Clarify the operation and control of commissioned equipment in areas where the Specifications, control drawings, or equipment documentation are not sufficient for writing detailed test procedures.
 6. Prepare the specific Functional Performance Test procedures specified in this section.
 - a. Ensure that Functional Performance Test procedures address feasibility, safety, and equipment protection and provide necessary written alarm limits to be used during the tests.
 7. During the Start-up and initial checkout process, execute and document related portions of the Prefunctional Checklists for all commissioned equipment.
 8. Perform and clearly document all completed Prefunctional Checklists and Start-up procedures. Provide a copy to the Owner prior to the Functional Performance Test.
 9. Address current A/E and Owner punch list items before Functional Performance Tests. Lighting controls tests and adjustments shall be completed with discrepancies and problems remedied before Functional Performance Tests of the respective lighting controls related systems are executed.
 10. Provide skilled technicians to execute starting of equipment and to assist in execution of Functional Performance Tests. Ensure that they are available and present during the agreed-upon schedules and for a sufficient duration to complete the necessary tests, adjustments, and problem solving.
 11. Correct deficiencies (differences between specified and observed performance) as interpreted by the Owner's Project Manager and A/E and retest the system and equipment.
 12. Compile all Commissioning records and documentation to be included in a Commissioning and Closeout Manual.
 13. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.
 14. During construction, maintain as-built marked-up Drawings and Specifications of all Contract Documents and Contractor-generated coordination Drawings. Update after completion of Commissioning activities (include deferred tests). The as-built drawings and specifications shall be delivered to the Owner both in electronic format and hard copies as required by the Owner
 15. Provide training of the Owner's operating personnel as specified.
 16. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.
- G. Warranty Phase:
1. Execute seasonal or deferred tests, witnessed by the Owner, according to the
 - a. Complete deferred tests as part of this Contract during the Warranty Period. Schedule this activity with Owner. Perform tests, document and correct deficiencies. Owner may observe the tests and review and approve test documentation and deficiency corrections.
 - b. If any check or test cannot be completed prior to Substantial Completion due to the building structure, required occupancy condition, or other condition, execution of such test may be delayed to later in the Warranty Period, upon approval of the Owner. Contractor shall reschedule and conduct these unforeseen deferred tests in the same manner as deferred tests.
 2. Correct deficiencies and make necessary adjustments to O&M manuals, Commissioning documentation, and as-built drawings for applicable issues identified in any seasonal testing.

3.02 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installation shall be in accordance with manufacturer's published recommendations.

3.03 INSPECTING AND TESTING - GENERAL

- A. Submit startup plans, startup reports, and Prefunctional Checklists for each item of equipment or other assembly to be commissioned.
- B. Perform the Functional Tests directed by the Commissioning Authority for each item of equipment or other assembly to be commissioned.
- C. Coordination Between Testing Parties:
 - 1. Factory Start-ups: Factory Start-ups are specified for certain systems and equipment. Factory Start-ups generally are Start-up related activities that will be reviewed and checked prior to Functional Performance Tests (FPT). All costs associated with factory Start-ups shall be included with the contract price unless otherwise noted. Notify the Commissioning Team of the factory Start-up schedule and coordinate these factory Start-ups with witnessing parties.
 - 2. Independent Testing Agencies: Independent tests are specified for certain systems and equipment. Independent tests generally are Functional Performance Tests (FPT) that verify systems and equipment respond in accordance with Contract Documents. Functional Performance Tests are executed after start-ups and Prefunctional Checklists are complete. Notify the Commissioning Team of the independent testing schedule and coordinate these independent tests with witnessing parties.
 - 3. The Commissioning Team members may witness Factory Start-ups and Functional Performance Tests at their discretion.
- D. Provide two-way radios for use during the testing.
- E. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions.
- F. Tests will be performed using design conditions whenever possible.
- G. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the Commissioning Agent and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- H. The Commissioning Agent may direct that set points be altered when simulating conditions is not practical.
- I. If tests cannot be completed because of a deficiency outside the scope of the Electrical system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.04 ELECTRICAL SYSTEMS, SUBSYSTEMS, AND EQUIPMENT FUNCTIONAL TESTING

- A. Equipment Testing and Acceptance Procedures:
 - 1. Testing and acceptance procedures indicated in this section are minimum requirements. Testing requirements specified in individual Division 26, 27, and 28 sections that exceed the minimum requirements of this section shall be required.
 - 2. Provide submittals, test data, inspector record, test instrument information, and test agency certifications to the Commissioning Agent.
- B. Where InterNational Electrical Testing Association (NETA) standards for acceptance Inspection and Test Procedures are referenced in this section or in individual Division 26, 27, and 28 sections, the NETA standards shall prevail, and are required.
- C. Lighting Controls Testing and Acceptance Procedures:
 - 1. Sweep and Scheduled Lighting Controls.
 - 2. Lighting Control Devices.

- D. Electrical Power Distribution Testing and Acceptance Procedures: Provide technicians, infrared cameras, instrumentation, tools and equipment to test performance of designated systems and devices at the direction of the Commissioning Agent.
 - 1. Grounding Electrode System:
 - a. Test with D.C. three-point earth ground resistance tester, fall of potential method.
 - b. Test each grounding electrode independently prior to interconnection to other electrodes.
 - c. Test in appropriate seasonal weather conditions at maximum precipitation levels as specified in Section 26 05 26.
- E. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.

3.05 DEMONSTRATION AND TRAINING

- A. Demonstrate operation and maintenance of lighting control system to Owner' personnel; if during any demonstration, the system fails to perform in accordance with the information included in the O&M manual, stop demonstration, repair or adjust, and repeat demonstration. Demonstrations may be combined with training sessions if appropriate.
- B. These demonstrations are in addition to, and not a substitute for, Prefunctional Checklists and demonstrations to the Commissioning Authority during Functional Testing.
- C. Provide hands-on training of Owner's designated personnel on operation and maintenance of the electrical systems, communications systems, electronic safety and security systems, and all equipment items indicated to be commissioned. Provide the following minimum durations of training:
- D. Provide the services of manufacturer representatives to assist instructors where necessary.

END OF SECTION

SECTION 26 08 20
ELECTRICAL PREFUNCTIONAL CHECKLISTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical Prefunctional Checklist forms.

1.02 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.
- B. The OPR, BOD, and Commissioning Plan Documentation documentation are included by reference for information only.
 - 1. OPR: Owner's Project Requirements.
 - 2. BOD: Basis of Design.

1.03 SUMMARY

- A. See Section 26 08 00 - Commissioning of Electrical for Contractor's responsibilities for Functional Tests.
- B. This section includes the Prefunctional Checklist forms and procedures for the Contractor's use.
- C. Other electrical system checks are required under other Division 26, 27, and 28 Specification Sections. National Electrical Installation Standards (NEIS) NECA 90-2004, "Recommended Practice for Commissioning Building Electrical Systems", 27th Volume of the NEIS Series, provides additional guidance for the commissioning of electrical systems.
- D. Commissioning requires the participation of the Contractor to ensure that all systems are operating in a manner consistent with the Contract Documents. General Commissioning requirements and coordination are detailed in Division 01. Division 26 shall be familiar with all parts of Division 01 and the Commissioning Plan issued by the Contractor and shall execute all Commissioning responsibilities assigned to them in the Contract Documents and include the cost of Commissioning in the Contract price.
- E. The Commissioning Authority (CA) directs and coordinates all commissioning activities and provides Prefunctional Checklists and Functional Test Procedures for Contractor's use.
- F. The Prefunctional Checklist requirements included in this section are in addition to, not a substitute for, inspection or testing specified in other sections.

1.04 RELATED REQUIREMENTS

- A. Section 26 08 00 - Commissioning of Electrical.

1.05 REFERENCE STANDARDS

- A. National Electrical Installation Standards (NEIS) NECA 90-2009; Commissioning Building Electrical Systems.

1.06 DEFINITIONS

- A. Prefunctional Checklist: A list of static inspections and material or component tests that verify proper installation of equipment (e.g., torque values, connections correct, grounding complete, labels affixed, sensors calibrated, etc.). The word Prefunctional refers to before Functional tests. Prefunctional Checklists must include the manufacturer's Start-up checklist(s). Contractor shall sign Prefunctional Checklists as complete and submit with the Request for Start-up/Functional Performance Test Form.

1.07 SUBMITTALS

- A. Refer to Section 26 08 00 - Commissioning of Electrical for submittal procedures of COMPLETED Prefunctional Checklists.

PART 2 PRODUCTS

2.01 EQUIPMENT AND TOOLS

- A. Provide all standard equipment and tools required to perform startup and initial checkout; unless otherwise noted such testing equipment will NOT become the property of Owner.

PART 3 EXECUTION

3.01 PREPARATION

- A. Cooperate with the Commissioning Authority in development of the Prefunctional Checklists.
- B. Furnish additional information requested by the Commissioning Authority.

3.02 INSPECTION AND CHECKOUT - GENERAL

- A. Submit startup plans, startup reports, and Prefunctional Checklists for each item of equipment or other assembly to be commissioned.

3.03 PREFUNCTIONAL CHECKLISTS

- A. This section contains Prefunctional Checklists in a form format (PC).
- B. Prefunctional Checklists for control system components will require a signed and dated certification that all system programming is complete as required to accomplish the requirements of the Contract Documents and the detailed Sequences of Operation documentation submittal.
- C. The checklists contain items for Division 26 contractors to perform. On each checklist, a column is provided that should be filled out by the Contractor assigning responsibility for that line item to a trade. Those executing the checklists are only responsible to perform items that apply to the specific application at hand. These checklists do not take the place of the manufacturer's recommended checkout and start-up procedures or report. Some checklist procedures may be redundant of some checkout procedures that will be documented on typical factory field checkout sheets. Double documenting is required in those cases
- D. Refer to Section 26 08 00 for additional requirements regarding prefunctional checklists, startup and initial checkout. Items that do not apply should be noted along with the reasons on the form. If this form is not used for documenting, one of similar rigor and clarity shall be used. Contractors assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off. "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. A/E = architect/engineer, All = all contractors, CA = commissioning authority, CC = controls contractor, EC = electrical contractor, GC = general contractor, MC = mechanical contractor, SC = sheet metal contractor, TAB = test and balance contractor.
- E. Number each Prefunctional Checklist form sequentially; i.e: PC-E01-01, PC-E01-02, PC-E02-01, PC-E02-02, etc.
- F. Index of Prefunctional Checklists
 - PC-E03 Grounding Electrode System
 - PC-E06 Lighting Sweep
 - PC-E08 Lighting Control Devices
- G. Prefunctional Checklist Forms:

**PREFUNCTIONAL CHECKLIST
GROUNDING ELECTRODE SYSTEM**

PC-E03-_____ System ID#s (Indicate Main Service, Generator, or Derived System):

Components included: Grounding Electrodes, Conductors, Connections.

1. Submittal / Approvals

Submittal. The above equipment and systems integral to them are complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This prefunctional checklist is submitted for approval, subject to an attached list of outstanding items yet to be completed. A Statement of Correction will be submitted upon completion of any outstanding areas. None of the outstanding items preclude safe and reliable functional tests being performed.

_____ Mechanical Contractor	_____ Date	_____ Fire Protection Contractor	_____ Date
_____ Electrical Contractor	_____ Date	_____ Concrete Contractor	_____ Date
_____ Plumbing Contractor	_____ Date	_____ General Contractor	_____ Date

Prefunctional checklist items are to be completed as part of startup & initial checkout, preparatory to functional testing.

- a. This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.
- b. Items that do not apply shall be noted with the reasons on this form (N/A = not applicable, BO = by others).
- c. Items that require actual description/values shall be completed with actual description/values recorded.
- d. If this form is not used for documenting, one of similar rigor shall be used.
- e. Contractors assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.
- f. "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. A/E = architect/engineer, All = all contractors, CA = commissioning authority, CPC = cast-in-place concrete contractor, FPC = fire protection contractor, EC = electrical contractor, GC = general contractor, MC = mechanical contractor, PLC = plumbing contractor, ____ = _____.

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

_____ Commissioning Authority	_____ Date	_____ Owner's Representative	_____ Date
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2. Requested documentation submitted

System ID (Grounded System) --->			Contr.	Notes
Manufacturer's data sheets				
Manufacturer's instructions				
Digital photos of concrete-encased electrodes				
Test plan				

Documentation complete as per contract documents..... ☐ YES ☐ NO

3. Model verification [Contr = _____]

1 = as specified, 2 = as submitted, 3 = as installed. Check if Okay. Enter note number if deficient.

System ID --->			Contr.	Notes
Made Electrode Manufacturer				
Mechanical Connector Manufacturer				
Weld Kit Manufacturer				
Ground Bar Manufacturer				
Electrode type 1 - water pipe (Y/N)				
Conductor size for type 1 electrode				
Termination method for type 1				
Electrode type 2 - building steel structure (Y/N)				
Conductor size for type 2 electrode				
Termination method for type 2				
Electrode type 3 - concrete encased (Y/N - Size)				
Conductor size for type 3 electrode				
Termination method for type 3				
Electrode type 4 - ground ring (Y/N - Size)				
Termination method for type 4				

The equipment installed matches the specifications for given trade ... ☐ YES ☐ NO

4. Installation Checks

Check	System ID --->			Contr.	Notes
Items Below Ground					
General appearance good, no apparent damage, free of corrosion					
Connections complete in accordance with Grounding Diagram and specifications					
Ground rods are located no less than 20 feet apart from each other and any other electrode					
Ground rod(s) accessible in ground well(s)					
Underground splices exothermic weld quality is acceptable.					
Internal foundation ground connections are correct, exothermic weld quality is acceptable.					
Ground ring is installed at proper burial depth					
Conductors below ground are bare copper					
Items Above Ground					
Main bonding jumper is bonded to grounded system neutral					
General appearance good, no apparent damage, free of corrosion					
Connections complete in accordance with Grounding Diagram and specifications					
Conductors are installed in PVC conduit where required for physical protection					
Conductors that pass through metal raceways or enclosures are bonded to raceway or enclosure at both ends					
Splices are exothermic weld or irreversible compression type.					
Torque values at mechanical connectors in accordance with manufacturer's published data, or per NETA Table 100.12 (note if table is used)					
Compression-applied connectors match cable, indented properly					
Color coding is green or bare copper					

The checklist items of Part 4 are successfully completed for given trade ☐ YES ☐ NO

5. **Operational Checks** (These augment mfr's list. This is not the functional performance testing)

Check	System ID --->			Contr.	Notes
Prior to interconnecting individual electrodes, measure resistance to earth for each electrode (ground electrode resistance check)					
After interconnecting individual electrodes, measure system resistance to ground (grounded system resistance check)					
Prior to energizing derived system, measure resistance to neutral (ground-neutral resistance check)					

The checklist items of Part 5 are successfully completed for given trade ☐ YES ☐ NO

-- END OF GROUNDING ELECTRODE SYSTEM PC CHECKLIST --

PREFUNCTIONAL CHECKLIST

LIGHTING SWEEP

PC-E06-_____ SWEEP AND SCHEDULED LIGHTING CONTROLS:

Components included: Controllers, Timing Devices, Photocells, and Contactors.
Associated Checklists: Daylight and Dimming Controls, Lighting Control Devices, and Emergency Lighting.

1. Submittal / Approvals

Submittal. The above equipment and systems integral to them are complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This prefunctional checklist is submitted for approval, subject to an attached list of outstanding items yet to be completed. A Statement of Correction will be submitted upon completion of any outstanding areas. None of the outstanding items preclude safe and reliable functional tests being performed.

_____ Mechanical Contractor	_____ Date	_____ Controls Contractor	_____ Date
_____ Electrical Contractor	_____ Date	_____ _____	_____ Date
_____ _____	_____ Date	_____ General Contractor	_____ Date

Prefunctional checklist items are to be completed as part of startup & initial checkout, preparatory to functional testing.

- This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.
- Items that do not apply shall be noted with the reasons on this form (N/A = not applicable, BO = by others).
- Items that require actual description/values shall be completed with actual description/values recorded.
- If this form is not used for documenting, one of similar rigor shall be used.
- Contractors assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.
- "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. A/E = architect/engineer, All = all contractors, CA = commissioning authority, CC = controls contractor, EC = electrical contractor, GC = general contractor, MC = mechanical contractor, _____ = _____.

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

_____ Commissioning Authority	_____ Date	_____ Owner's Representative	_____ Date
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2. Requested documentation submitted

Sweep Controller Component ID --->			Contr.	Notes
Manufacturer's data sheets				
Manufacturer's specifications and features				
Manufacturer's instructions				
List of loads and zones each relay or contactor controls attached*				
Contact number for additional assistance attached*				
Current written list of sweep schedules for all zones attached*				
Programming instructions attached*				
Controller warranty (in submittals)				
Written instructions for tenants in using the local overrides and a description of the areas they control				
A/E ASHRAE 90.1 Lighting Compliance Documentation Form				
Test plan				

*Attached = attached to the controller panel door or if PC controlled, in documentation manual.

Documentation complete as per contract documents..... ☐ YES ☐ NO

3. Model verification [Contr = _____]

1 = as specified, 2 = as submitted, 3 = as installed. Check if Okay. Enter note number if deficient.

Sweep Controller Component Type --->			Contr.	Notes
Manufacturer Brand and Model				
Firmware Revision				
Software Revision				
Photocell Sensor Manufacturer and Model				
Time Control Switch Manufacturer and Model				
Contactor Manufacturer and Model				
Sweep Controller Type (Y/N): <input type="checkbox"/> Part of BMS <input type="checkbox"/> Separate Hardware/Software System <input type="checkbox"/> Stand-Alone Controllers (quantity) <input type="checkbox"/> Stand-Alone Integrated Into BMS				
Type of System (Y/N): <input type="checkbox"/> Sweeps Lights Off Until Morning <input type="checkbox"/> Sweeps Lights Off Dawn to Dusk <input type="checkbox"/> Override Timers for Zones to be Turned On Any light can be turned on by: <input type="checkbox"/> Standard Switch <input type="checkbox"/> Phone Call Within Building				

The equipment installed matches the specifications for given trade ... ☐ YES ☐ NO

4. Installation Checks

Check	Component Tag --->			Contr.	Notes
General appearance good, no apparent damage					
Connections complete in accordance with plans, specifications, and manufacturer's instructions					
Check tightness of electrical connections					
Verify operation of loads controlled					
Verify nameplates and labels are affixed					
Record passwords					
Verify components are installed per manufacturer's instructions.					
Verify unit is fused in accordance with manufacturer's instructions.					
Verify all operating parameters are set: Photocell adjustments, time controls, software configuration.					

The checklist items of Part 4 are successfully completed for given trade ☐ YES ☐ NO

5. Operational Checks (These augment mfr's list. This is not the functional performance testing)

Check	Component Tag --->			Contr.	Notes
Programming capabilities via keypad or BMS interface. Verify by running through the current program and schedules (programming check)					
Back-up power supply (automatically recharged) that will retain program for ___ weeks without power. Verify by viewing specifications and battery pack (standby check)					
Lockable controller enclosure or room with key or code-only access for programming and total override or access is in a restricted PC program (security check)					
The controlling time clock is reading the appropriate time.					
Override duration set to not more than 2 hours.					
Each override energizes no more than 5000 sf of floor area					

The checklist items of Part 5 are successfully completed for given trade ☐ YES ☐ NO

-- END OF LIGHTING SWEEP PC CHECKLIST --

**PREFUNCTIONAL CHECKLIST
LIGHTING CONTROL DEVICES**

PC-E08-_____ LIGHTING CONTROLS:

Components included: Lighting Control Devices, Power Packs, and Relays.
Associated Checklists: Lighting Sweep and Daylighting and Dimming Controls.

1. Submittal / Approvals

Submittal. The above equipment and systems integral to them are complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This prefunctional checklist is submitted for approval, subject to an attached list of outstanding items yet to be completed. A Statement of Correction will be submitted upon completion of any outstanding areas. None of the outstanding items preclude safe and reliable functional tests being performed.

_____ Mechanical Contractor	_____ Date	_____ Controls Contractor	_____ Date
_____ Electrical Contractor	_____ Date	_____ _____	_____ Date
_____ _____	_____ Date	_____ General Contractor	_____ Date

Prefunctional checklist items are to be completed as part of startup & initial checkout, preparatory to functional testing.

- a. This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.
- b. Items that do not apply shall be noted with the reasons on this form (N/A = not applicable, BO = by others).
- c. Items that require actual description/values shall be completed with actual description/values recorded.
- d. If this form is not used for documenting, one of similar rigor shall be used.
- e. Contractors assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.
- f. "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. A/E = architect/engineer, All = all contractors, CA = commissioning authority, CC = controls contractor, EC = electrical contractor, GC = general contractor, MC = mechanical contractor, _____ = _____.

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

_____ Commissioning Authority	_____ Date	_____ Owner's Representative	_____ Date
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2. Requested documentation submitted

Control Component ID --->			Contr.	Notes
Manufacturer's data sheets				
Manufacturer's wiring diagrams				
Manufacturer's instructions				
Manufacturer's layout of devices				
Preinstallation meeting attendance list				
Contact number for additional assistance attached*				
Manufacturer's warranty (in submittals)				
A/E ASHRAE 90.1 Lighting Compliance Documentation Form				
Test plan				

*Attached = attached to the controller panel door or if PC controlled, in documentation manual.

Documentation complete as per contract documents..... ☐ YES ☐ NO

3. Model verification [Contr = _____]

1 = as specified, 2 = as submitted, 3 = as installed. Check if Okay. Enter note number if deficient.

Control Component Type --->			Contr.	Notes
Occupancy/Vacancy Sensor Manufacturer and Models				
Outdoor Motion Sensor Manufacturer and Model				
In-Wall Interval Timer Manufacturer and Model				
Keypad Control Manufacturer and Model				
Outdoor Motion Sensor Manufacturer and Model				
Firmware Revision				
Software Revision				

The equipment installed matches the specifications for given trade ... ☐ YES ☐ NO

4. Installation Checks

Check	Control Component Type --->			Contr.	Notes
General appearance good, no apparent damage					
Connections complete in accordance with plans, specifications, and manufacturer's instructions					
Check tightness of electrical connections					
Verify sensor locations, in accordance with layout provided by lighting control manufacturer as part of sensor layout and tuning services					
Verify components are installed per manufacturer's instructions					
Verify labels for intended operation features are installed					
Verify all operating parameters are set: Light sensor adjustments, time controls, software configuration.					
Verify nameplates are affixed					
Record passwords					

The checklist items of Part 4 are successfully completed for given trade ☐ YES ☐ NO

5. Operational Checks (These augment mfr's list. This is not the functional performance testing)

Check	Control Component Type --->			Contr.	Notes
Programming capabilities via keypad or BMS interface. Verify by running through the current program and schedules (programming check)					
Back-up power supply (automatically recharged) that will retain program for ___ weeks without power. Verify by viewing specifications and battery pack (standby check)					
Lockable controller enclosure or room with key or code-only access for programming and total override or access is in a restricted PC program (security check)					
Verify control of each space complies with the indicated Sequence of Operation (operation check)					
Verify manual override controls function as intended (override check)					

The checklist items of Part 5 are successfully completed for given trade ☐ YES ☐ NO

-- END OF LIGHTING CONTROL DEVICES PC CHECKLIST --

END OF SECTION

SECTION 26 08 30
ELECTRICAL FUNCTIONAL TESTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical Functional Test forms.

1.02 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.
- B. The OPR, BOD, and Commissioning Plan Documentation documentation are included by reference for information only.
 - 1. OPR: Owner's Project Requirements.
 - 2. BOD: Basis of Design.

1.03 SUMMARY

- A. See Section 26 08 00 - Commissioning of Electrical for Contractor's responsibilities for Functional Tests.
- B. This section includes the Functional Test forms and procedures for the Contractor's use.
- C. Other electrical system testing is required under other Division 26, 27, and 28 Specification Sections. National Electrical Installation Standards (NEIS) NECA 90-2004, "Recommended Practice for Commissioning Building Electrical Systems", 27th Volume of the NEIS Series, provides additional guidance for the commissioning of electrical systems.
- D. Commissioning requires the participation of the Contractor to ensure that all systems are operating in a manner consistent with the Contract Documents. General Commissioning requirements and coordination are detailed in Division 01. Division 26 shall be familiar with all parts of Division 01 and the Commissioning Plan issued by the Contractor and shall execute all Commissioning responsibilities assigned to them in the Contract Documents and include the cost of Commissioning in the Contract price.
- E. The Commissioning Authority (CA) directs and coordinates all commissioning activities and provides Prefunctional Checklists and Functional Test Procedures for Contractor's use.
- F. The Functional Test requirements included in this section are in addition to, not a substitute for, inspection or testing specified in other sections.

1.04 RELATED REQUIREMENTS

- A. Section 26 08 00 - Commissioning of Electrical.

1.05 REFERENCE STANDARDS

- A. National Electrical Installation Standards (NEIS) NECA 90-2009; Commissioning Building Electrical Systems.
- B. ASHRAE 90.1 - Lighting Compliance Documentation; 2007.

1.06 DEFINITIONS

- A. See Section 26 08 00 - Commissioning of Electrical for definitions.

1.07 SUBMITTALS

- A. Updated Submittals: Keep the Commissioning Authority informed of all changes to control system documentation made during programming and setup; revise and resubmit when substantial changes are made.
- B. Prerequisite Submittals:
 - 1. Refer to Section 26 08 00 - Commissioning of Electrical for submittal procedures of COMPLETED Prefunctional Checklists.

2. Contractor shall submit COMPLETED Prefunctional Checklists and Functional Performance Test (FPT) procedures. Prior to testing, Contractor shall submit those forms to the Owner for review and approval.
 3. Functional Test Procedures for Electrical Systems: Detailed written plan indicating the procedures to be followed to test, checkout and adjust the control systems prior to full system Functional Testing.
- C. Functional Performance Submittals:
1. Refer to Section 26 08 00 - Commissioning of Electrical for submittal procedures of COMPLETED Functional Tests.
 2. Startup Reports, Functional Performance Test results, and Trend Logs: Submit for approval of Commissioning Authority.

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

- A. Provide all standard testing equipment required to perform startup and initial checkout and required functional performance testing; unless otherwise noted such testing equipment will NOT become the property of Owner.
- B. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.
- C. A testing laboratory must have calibrated test equipment within the previous twelve (12) months. Calibration shall be NIST traceable. Contractor must calibrate test equipment and instruments according to manufacturer's recommended intervals and whenever the test equipment is dropped or damaged. Calibration tags must be affixed to the test equipment or certificates readily available.

PART 3 EXECUTION

3.01 PREPARATION

- A. Cooperate with the Commissioning Authority in development of the Functional Test Procedures.
- B. Furnish additional information requested by the Commissioning Authority.

3.02 INSPECTING AND TESTING - GENERAL

- A. Submit startup plans, startup reports, and Prefunctional Checklists for each item of equipment or other assembly to be commissioned.
- B. Perform the Functional Tests directed by the Commissioning Authority for each item of equipment or other assembly to be commissioned.
 1. Refer to Section 26 08 00 - Commissioning of Electrical for Functional Tests (FT or FPT) procedures and requirements.

3.03 FUNCTIONAL TESTS

- A. This section contains sample Functional performance Test procedures in a form format (FT).
- B. The FT procedures displayed in a form format here are intended to provide the Subcontractors and CA with an example of a format and an indication of the rigor of the required testing and documentation for various equipment types. They were not developed for this project. Other forms and formats are acceptable if they comply with the rigor, clarity and intent of all the commissioning specifications. The CA will use the functional testing requirements in Section 26 08 00 for developing site-specific functional test procedures and forms for this project. For illustrative purposes, sequences of operation associated with a few pieces of the equipment for which tests are included are also provided.
- C. Number each Functional Test form sequentially; i.e: FT-E01-01, FT-E01-02, FT-E02-01, FT-E02-02, etc.
- D. Index of Functional Tests
 - FT-E03 Grounding Electrode System
 - FT-E06 Lighting Sweep
 - FT-E08 Lighting Control Devices
- E. Functional Test Forms:

**FUNCTIONAL TEST
GROUNDING ELECTRODE SYSTEM**

FT-E03-_____ GROUNDED SYSTEM ID TAG:

Components included: Grounding Electrodes, Grounding Electrode Conductors, Mechanical Connectors, and Exothermic Welds.
Associated Functional Tests: None.

1. Participants

<u>Party</u>	<u>Organization</u>	<u>Participation</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Party filling out form and witnessing testing: _____

Date of test: _____

2. Prerequisite Checklist

- a. ☐ All ground termination connections are complete, correct, and torqued properly.

_____	_____
Electrical Contractor Signature	Date

- b. ☐ All A/E punchlist items for this equipment corrected.
c. ☐ Test requirements and Test Plan attached.
d. ☐ Manufacturer's published torque values attached.
e. ☐ NETA Table 100.12 torque values attached.

3. Sensor Calibration Checks: Check the sensors listed below for calibration and adequate location. This is a sampling check of calibrations done during prefunctional checklisting.
---NONE---

4. Device Calibration Checks: Check the devices listed below for calibration.

a. ☐ NIST 4-pin soil resistivity tester calibration certificate is current. Attach certificate.
b. ☐ NIST 3-point earth ground resistance tester calibration certificate is current. Attach certificate.

5. Verification of Prefunctional Checklists:

- a. Misc. site checks of the prefunctional checklist and startup reports completed successfully. Pass? ☐ Yes ☐ No
b. ☐ Connections complete and in accordance with Grounding Diagram.
c. ☐ Irreversible compression-applied connectors match cable, indented properly.
d. ☐ Corrosion inhibiting compound used where appropriate.

6. Functional Testing Record:

Proceed. No. & Spec. Seq. ID (1)	Req ID No. (2)	Test Procedure (3) (including special conditions)	Expected and Actual Response (4) [Write response in blank space]	Pass Y/N & Note																		
1		<u>Torque Values:</u> Check the tightness of terminations at mechanical connectors.	Torque values should match manufacturer's published data. <u>Connection:</u> <table><thead><tr><th></th><th><u>Target</u></th><th><u>Actual</u></th></tr></thead><tbody><tr><td>Gnd Bar</td><td>_____</td><td>_____</td></tr><tr><td>Water Pipe</td><td>_____</td><td>_____</td></tr><tr><td>Equip Lug</td><td>_____</td><td>_____</td></tr><tr><td>_____</td><td>_____</td><td>_____</td></tr><tr><td>_____</td><td>_____</td><td>_____</td></tr></tbody></table>		<u>Target</u>	<u>Actual</u>	Gnd Bar	_____	_____	Water Pipe	_____	_____	Equip Lug	_____	_____	_____	_____	_____	_____	_____	_____	
	<u>Target</u>	<u>Actual</u>																				
Gnd Bar	_____	_____																				
Water Pipe	_____	_____																				
Equip Lug	_____	_____																				
_____	_____	_____																				
_____	_____	_____																				
2		<u>Soil Resistivity Test:</u> Perform soil resistivity test at locations where made electrodes will be installed. <u>Procedure:</u> 1. 4-pin Wenner Method, linear fall-of-potential in accordance with ANSI/IEEE 81. 2. Record Results.	Soil resistivity should be less than 20,000 ohm-centimeters. <u>Soil Resistivity:</u> <table><tbody><tr><td>_____</td><td>Ohm-cm</td></tr></tbody></table>	_____	Ohm-cm																	
_____	Ohm-cm																					
3		<u>Electrode System Resistance Test:</u> Perform resistance test on grounding electrode system with respect to ground. <u>Procedure:</u> 1. 3-point fall-of-potential method in accordance with ANSI/IEEE 81. 2. Record results and identify deficiencies. * Investigate values greater than 5 ohms in accordance with ANSI/IEEE 142. 3. Retest after deficiencies have been corrected, record results.	Electrode System resistance value should not be greater than 5 ohms. <table><thead><tr><th><u>Target</u></th><th><u>Actual</u></th></tr></thead><tbody><tr><td>5 Ohms</td><td>_____</td></tr></tbody></table>	<u>Target</u>	<u>Actual</u>	5 Ohms	_____															
<u>Target</u>	<u>Actual</u>																					
5 Ohms	_____																					

Proceed. No. & Spec. Seq. ID (1)	Req ID No. (2)	Test Procedure (3) (including special conditions)	Expected and Actual Response (4) [Write response in blank space]	Pass Y/N & Note
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4	<p><u>Electrode Resistance Test:</u> Perform resistance test on each electrode connection with respect to ground.</p> <p><u>Procedure:</u></p> <ol style="list-style-type: none">1. 3-point fall-of-potential method in accordance with ANSI/IEEE 81.2. Record results and identify deficiencies. * Investigate values deviate more than 50% from the lowest value.3. Retest after deficiencies have been corrected, record results.	<p>Individual Electrode resistance at each electrode connection should not deviate more than 50% from the lowest value.</p> <table><thead><tr><th><u>Electrode</u></th><th><u>Resistance Ohms</u></th></tr></thead><tbody><tr><td>Rod 1</td><td>_____</td></tr><tr><td>Rod 2</td><td>_____</td></tr><tr><td>Rod 3</td><td>_____</td></tr><tr><td>Water Pipe</td><td>_____</td></tr><tr><td>Encased</td><td>_____</td></tr><tr><td>Steel Struct</td><td>_____</td></tr></tbody></table>	<u>Electrode</u>	<u>Resistance Ohms</u>	Rod 1	_____	Rod 2	_____	Rod 3	_____	Water Pipe	_____	Encased	_____	Steel Struct	_____
<u>Electrode</u>	<u>Resistance Ohms</u>															
Rod 1	_____															
Rod 2	_____															
Rod 3	_____															
Water Pipe	_____															
Encased	_____															
Steel Struct	_____															
5	<p><u>Neutral Bonding Jumper:</u> Perform resistance test of neutral-ground connections.</p> <p><u>Procedure:</u></p> <ol style="list-style-type: none">1. Measure point-to-point resistance of neutral connection to ground.2. Record results and identify deficiencies. * Investigate resistance value greater than 0.1 ohm.3. Retest after deficiencies have been corrected, record results.	<p>Neutral bus resistance to ground should be less than 0.1 ohm.</p> <p><u>Neutral Resistance:</u></p> <table><thead><tr><th></th><th><u>Reference</u></th><th><u>Actual</u></th></tr></thead><tbody><tr><td>Jumper</td><td>0.1 Ohm</td><td>_____</td></tr></tbody></table>		<u>Reference</u>	<u>Actual</u>	Jumper	0.1 Ohm	_____								
	<u>Reference</u>	<u>Actual</u>														
Jumper	0.1 Ohm	_____														

Record Foot Notes:

- (1) Sequences of operation specified in Contract Documents (attached).
- (2) Mode or function ID being tested, per testing requirements section of the project Specifications.
- (3) Step-by-step procedures for manual testing, trend logging or data-logger monitoring.
- (4) Include tolerances for a passing condition.

-- END OF GROUNDING ELECTRODE SYSTEM TEST --

**FUNCTIONAL TEST
LIGHTING SWEEP**

FT-E06-_____ SWEEP AND SCHEDULED LIGHTING CONTROLS:

Components included: Controllers, Timing Devices, and Photocells.

Associated Functional Tests: Daylight and Dimming Controls and Lighting Control Devices.

1. Participants

<u>Party</u>	<u>Organization</u>	<u>Participation</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Party filling out form and witnessing testing: _____

Date of test: _____

2. Prerequisite Checklist

- a. ☐ All sensor and control connections are complete, correct, and reporting properly.
- b. ☐ All control system functions for this and all interlocking systems are programmed and operable per contract documents, including final setpoints, schedules, debugging and fine tuning of photo-cell parameters.

Electrical Contractor Signature Date

- c. ☐ All A/E punchlist items for this equipment corrected.
- d. ☐ Test requirements and Test Plan attached.
- e. ☐ Manufacturer's operating instructions attached.
- f. ☐ A/E ASHRAE 90.1 Lighting Compliance Documentation Form attached.

3. Sensor Calibration Checks: Check the sensors listed below for calibration and adequate location. This is a sampling check of calibrations done during prefunctional checklisting.
---NONE---

4. Device Calibration Checks: Check the devices listed below for calibration.
---NONE---

5. Verification of Prefunctional Checklists:

- a. Misc. site checks of the prefunctional checklist and startup reports completed successfully. Pass? ☐ Yes ☐ No
- b. ☐ Connections complete and in accordance with manufacturer's instructions.
- c. ☐ Software is installed and configured properly.
- d. ☐ Sensors, overrides, and timing devices operate properly.

6. Functional Testing Record: Verify actual sweep and override operation of each controller.

Schedule of Sweeps (hour of day)

Day Type and Sweep No.	Zone 1 ID: _____	Zone 2 ID: _____	Zone 3 ID: _____	Zone 4 ID: _____	Zone 5 ID: _____
	Relay or Contactor ID: _____	Relay or Contactor ID: _____	Relay or Contactor ID: _____	Relay or Contactor ID: _____	Relay or Contactor ID: _____
Weekdays Schd 1					
Weekdays Schd 2					
Weekdays Schd 3					
-- Add as Needed --					
Saturday Schd 1					
Saturday Schd 2					
Saturday Schd 3					
-- Add as Needed --					
Sunday Schd 1					
Sunday Schd 2					
Sunday Schd 3					
-- Add as Needed --					
Fixtures/Rooms excluded from sweep (Qty/Room No.)					
Sweep Verification Type (Sequence 1)					
No. of Local Override Switches (actual / specified)	/	/	/	/	/
No. of Override Switches Tested (Sequence 3)					

Proceed. No. & Spec. Seq. ID (1)	Req ID No. (2)	Test Procedure (3) (including special conditions)	Expected and Actual Response (4) [Write response in blank space]	Pass Y/N & Note

1	<p><u>Sweep Operation Test:</u> Verify that lights turn on and off at scheduled times, and in response to natural daylight.</p> <p><u>Procedure:</u></p> <p>1. 50% of the zones with a minimum of 2 zones per controller or relay must be verified by turning on at least 25% of the lights in the zone and witnessing an actual sweep. The remainder of the zones must have the programming of their schedules verified.</p> <p><u>In the table above, enter all of the following codes that apply:</u></p> <p>0 not verified. S verified Schedule in keypad or BMS display. W verified operation by Witnessing a sweeping off of the lights at a special schedules time. D verified operation by witnessing lights turn on at Dusk, off at Dawn. F witnessed sweep, but sweep Failed to function properly. Refer to comments. -----</p> <p>2. Retest after deficiencies have been corrected, record results</p>	<p>Lights should turn on and off at designated times.</p> <p><u>Exterior Lights:</u></p> <table> <tr> <th></th> <th><u>Target</u></th> <th><u>Actual</u></th> </tr> <tr> <td>Building</td> <td>_____</td> <td>_____</td> </tr> <tr> <td>Site</td> <td>_____</td> <td>_____</td> </tr> </table> <p><u>Weekday Interior Lights</u></p> <table> <tr> <th></th> <th><u>Target</u></th> <th><u>Actual</u></th> </tr> <tr> <td>Sched 1</td> <td>_____</td> <td>_____</td> </tr> <tr> <td>Sched 2</td> <td>_____</td> <td>_____</td> </tr> <tr> <td>Sched 3</td> <td>_____</td> <td>_____</td> </tr> </table> <p><u>Saturday Interior Lights</u></p> <table> <tr> <th></th> <th><u>Target</u></th> <th><u>Actual</u></th> </tr> <tr> <td>Sched 1</td> <td>_____</td> <td>_____</td> </tr> <tr> <td>Sched 2</td> <td>_____</td> <td>_____</td> </tr> <tr> <td>Sched 3</td> <td>_____</td> <td>_____</td> </tr> </table> <p><u>Sunday Interior Lights</u></p> <table> <tr> <th></th> <th><u>Target</u></th> <th><u>Actual</u></th> </tr> <tr> <td>Sched 1</td> <td>_____</td> <td>_____</td> </tr> <tr> <td>Sched 2</td> <td>_____</td> <td>_____</td> </tr> <tr> <td>Sched 3</td> <td>_____</td> <td>_____</td> </tr> </table>		<u>Target</u>	<u>Actual</u>	Building	_____	_____	Site	_____	_____		<u>Target</u>	<u>Actual</u>	Sched 1	_____	_____	Sched 2	_____	_____	Sched 3	_____	_____		<u>Target</u>	<u>Actual</u>	Sched 1	_____	_____	Sched 2	_____	_____	Sched 3	_____	_____		<u>Target</u>	<u>Actual</u>	Sched 1	_____	_____	Sched 2	_____	_____	Sched 3	_____	_____
	<u>Target</u>	<u>Actual</u>																																													
Building	_____	_____																																													
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Sched 1	_____	_____																																													
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Sched 1	_____	_____																																													
Sched 2	_____	_____																																													
Sched 3	_____	_____																																													

Proceed. No. & Spec. Seq. ID (1)	Req ID No. (2)	Test Procedure (3) (including special conditions)	Expected and Actual Response (4) [Write response in blank space]	Pass Y/N & Note
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2		<p><u>Overrides Test:</u> Confirm overrides operate correctly.</p> <p><u>Procedure:</u></p> <ol style="list-style-type: none"> 1. 25% of the local override switches with a minimum of 4 overrides must be verified by turning the override switches on after a sweep and seeing the lights turn back on. 2. 100% of the remainder of the switches should be sight verified to be in place. 3. For each Zone, enter the number of override switches where functionality was actually witnessed. 4. Verify that the local override only controls the specified zone. 5. Record results and identify deficiencies. 6. Retest after deficiencies have been corrected, record results. 	Overrides should turn on lights for maximum of 2 hours.	
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Record Foot Notes:

- (1) Sequences of operation specified in Contract Documents (attached).
- (2) Mode or function ID being tested, per testing requirements section of the project Specifications.
- (3) Step-by-step procedures for manual testing, trend logging or data-logger monitoring.
- (4) Include tolerances for a passing condition.

-- END OF LIGHTING SWEEP TEST --

FUNCTIONAL TEST
LIGHTING CONTROL DEVICES
FT-E08-_____ AUTOMATIC AND MANUAL LIGHTING CONTROLS:

Components included: Controllers, Lighting Control Devices, and Relays.
Associated Functional Tests: Lighting Sweep and Daylight and Dimming Controls.

1. Participants

<u>Party</u>	<u>Organization</u>	<u>Participation</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Party filling out form and witnessing testing: _____

Date of test: _____

2. Prerequisite Checklist

- a. ☐ All sensor and control connections are complete, correct, and reporting properly.
- b. ☐ All control system functions for this and all interlocking systems are programmed and operable per contract documents, including final setpoints, schedules, debugging and fine tuning of occupancy sensor parameters

Electrical Contractor Signature

Date

- c. ☐ All A/E punchlist items for this equipment corrected.
- d. ☐ Test requirements and Test Plan attached.
- e. ☐ Manufacturer's operating instructions attached.
- f. ☐ A/E ASHRAE 90.1 Lighting Compliance Documentation Form attached.

3. Sensor Calibration Checks: Check the sensors listed below for calibration and adequate location. This is a sampling check of calibrations done during prefunctional checklisting.
---NONE---

4. Device Calibration Checks: Check the devices listed below for calibration.
---NONE---

5. Verification of Prefunctional Checklists:

- a. Misc. site checks of the prefunctional checklist and startup reports completed successfully. Pass? ☐ Yes ☐ No
- b. ☐ Connections complete and in accordance with manufacturer's instructions.
- c. ☐ Software is installed and configured properly.
- d. ☐ Sensors, manual dimmers, and timing devices operate properly.

- # LIGHTING CONTROL DEVICES TEST REPORT

Test Report Codes: In the table above, enter all of the following codes that apply:

- (1) OS = Occupancy Sensor, VS = Vacancy Sensor, MS = outdoor Motion Sensor
- (2) K = Keypad control, T = interval Timer, S = manual override Switch.
- (3) A = Automatic on - automatic off, M = Manual on - automatic off, O = Override.
- (4) B = Automatic step on - manual full on - automatic off.

Proceed. No. & Spec. Seq. ID (1)	Req ID No. (2)	Test Procedure (3) (including special conditions)	Expected and Actual Response (4) [Write response in blank space]	Pass Y/N & Note
1		<p><u>Automatic On - Automatic Off Operation Test:</u> Verify that lights automatically turn on and off correctly.</p> <p><u>Procedure:</u></p> <ol style="list-style-type: none"> 1. Refer to plans and specifications at designated time delay. 2. Automatic On Response: Verify lights automatically turn on within 2 feet of entry into space. 3. False on response: Verify lights do not turn on in response to air movement or activity in adjacent room or space. 4. Automatic Off Response: Verify lights automatically turn off at designated time delay. 5. False Off Response: Verify lights do not turn off during typical occupant activity in designated room or space. 6. Record results in Lighting Control Devices Test Report, above. <ul style="list-style-type: none"> * Investigate deviation from intended response. * Automatic off within 5 minutes greater than target are acceptable. 7. Retest after deficiencies have been corrected, record results in revised table. 	<p>Lights should automatically turn on within 2 feet of personnel entry into room or space.</p> <p>Lights should not automatically turn on from cross traffic or activity in adjacent room or space.</p> <p>Lights should automatically turn off at designated off delay times.</p> <p>Lights should not automatically turn off when occupant(s) are using room or space as intended.</p>	

Proceed. No. & Spec. Seq. ID (1)	Req ID No. (2)	Test Procedure (3) (including special conditions)	Expected and Actual Response (4) [Write response in blank space]	Pass Y/N & Note
---	-------------------	--	---	-----------------------

2		<p><u>Manual On - Automatic Off Operation Test:</u> Verify that lights automatically turn off correctly, and manual on operation is required.</p> <p><u>Procedure:</u></p> <ol style="list-style-type: none"> 1. Refer to plans and specifications for designated time delay. 2. Manual On Response: Verify lights require manual switch operation to turn on. 3. False on response: Verify lights do not turn on in response to air movement or activity in adjacent room or space. 4. Automatic Off Response: Verify lights automatically turn off at designated time delay. 5. False Off Response: Verify lights do not turn off during typical occupant activity in designated room or space. 6. Record results in Lighting Control Devices Test Report, above. <ul style="list-style-type: none"> * Investigate deviation from intended response. * Automatic off within 5 minutes greater than target are acceptable. 5. Retest after deficiencies have been corrected, record results in revised table. 	<p>Lights should not automatically turn on, requires manual switch operation to turn on.</p> <p>Lights should not automatically turn on from cross traffic or activity in adjacent room or space.</p> <p>Lights should automatically turn off at designated off delay times.</p> <p>Lights should not automatically turn off when occupant(s) are using room or space as intended.</p>	
---	--	--	--	--

Proceed. No. & Spec. Seq. ID (1)	Req ID No. (2)	Test Procedure (3) (including special conditions)	Expected and Actual Response (4) [Write response in blank space]	Pass Y/N & Note
----------------------------------	----------------	---	--	-----------------

3		<p><u>Automatic Step On - Manual Full On - Automatic Off Operation Test:</u> Verify that lights turn on and off correctly.</p> <p><u>Procedure:</u></p> <ol style="list-style-type: none"> 1. Refer to plans and specifications at designated time delay. 2. Automatic Step On Response: Verify lights automatically turn on to first step within 2 feet of entry into space. 3. Manual Full On Response: Verify lights require manual operation to maximum light output. 4. False on response: Verify lights do not turn on in response to air movement or activity in adjacent room or space. 5. Automatic Off Response: Verify lights automatically turn off at designated time delay. 6. False Off Response: Verify lights do not turn off during typical occupant activity in designated room or space. 7. Manual Off Response: Confirm lights can be manually turned off regardless of automatic sensor operation. 8. Record results in Lighting Control Devices Test Report, above. <ul style="list-style-type: none"> * Investigate deviation from intended response. * Automatic off within 5 minutes greater than target are acceptable. 9. Retest after deficiencies have been corrected, record results in revised table. 	<p>Lights should automatically turn on to first step light output within 2 feet of personnel entry into room or space.</p> <p>Lights should require manual on to achieve maximum light output.</p> <p>Lights should not automatically turn on from cross traffic or activity in adjacent room or space.</p> <p>Lights should automatically turn off at designated off delay times.</p> <p>Lights should not automatically turn off when occupant(s) are using room or space as intended.</p> <p>Lighting controls should revert to automatic operation when sensors indicate space has been unoccupied for designated time period</p>	
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Proceed. No. & Spec. Seq. ID (1)	Req ID No. (2)	Test Procedure (3) (including special conditions)	Expected and Actual Response (4) [Write response in blank space]	Pass Y/N & Note

4		<p><u>Override Operation Test:</u> Confirm overrides operate correctly.</p> <p><u>Procedure:</u></p> <ol style="list-style-type: none"> 1. Confirm lights can be manually turned off regardless of automatic sensor operation. 2. Confirm space reverts to automatic operation upon automatic shutoff time delay expiration. 3. Verify that the local override only controls the specified zone. 4. Record results and identify deficiencies. 5. Retest after deficiencies have been corrected, record results. 	<p>Light switches should turn lights off regardless of automatic sensor input.</p> <p>Lighting controls should revert to automatic operation when sensors indicate space has been unoccupied for designated time period.</p>	
5		<p><u>Manual Dimmer Operation Test:</u> Confirm manual dimmer switches operate correctly.</p> <p><u>Procedure:</u></p> <ol style="list-style-type: none"> 1. Confirm manual dimmer ramps lights up/down at specified fade rates. 2. Record results and identify deficiencies. 3. Retest after deficiencies have been corrected, record results 	<p>Overrides should ramp lights up/down at specified fade rates.</p>	

Record Foot Notes:

- (1) Sequences of operation specified in Contract Documents (attached).
- (2) Mode or function ID being tested, per testing requirements section of the project Specifications.
- (3) Step-by-step procedures for manual testing, trend logging or data-logger monitoring.
- (4) Include tolerances for a passing condition.

-- END OF LIGHTING CONTROLS DEVICES TEST --

END OF SECTION

SECTION 26 09 16
ELECTRIC CONTROLS AND RELAYS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pushbutton and selector switches.
- B. Control stations and panels.
- C. Relays and time-delay relays.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

- A. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; National Electrical Manufacturers Association; 2000 (R2005), with errata, 2008.

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Provide for each component showing electrical characteristics and connection requirements.
- B. Closeout Submittals:
 - 1. Project Record Documents: Record actual locations of devices.
 - 2. Operation and Maintenance Manual:
 - a. Include Operation Data: Instructions on how to make field adjustments.
 - b. Include Maintenance Data: Maintenance and repair procedures.
 - c. Include Warranty Information.

PART 2 PRODUCTS

2.01 COMPONENTS

- A. Control Switches and Stations:
 - 1. Contacts: NEMA ICS 2, Form Z.
 - 2. Contact Ratings: NEMA ICS 2, A150.
 - 3. Selector Switch Operators: Two position rotary selector switch.
 - 4. Pushbutton Operator: Unguarded type.
 - 5. Control Stations: Standard duty oiltight type pushbutton station.
- B. Solid-State Relays: NEMA ICS 2.
 - 1. Contacts: NEMA ICS 2, Form Z.
 - 2. Contact Ratings: NEMA ICS 2, Class A150.
 - 3. Coil Voltage: 120 volts, 60 Hz, AC.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install individual relays and time-delay relays in enclosures.
- C. Make electrical wiring interconnections as indicated.

END OF SECTION

SECTION 26 09 19
ENCLOSED CONTACTORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Lighting contactors.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; National Electrical Manufacturers Association; 2000 (R2005), with errata, 2008.
- B. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices; National Electrical Manufacturers Association; 2000 (R2010).
- C. NEMA ICS 6 - Industrial Control and Systems: Enclosures; National Electrical Manufacturers Association; 1993 (R2011).

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Provide dimensions, size, voltage ratings and current ratings.
- B. Closeout Submittals:
 - 1. Project Record Documents: Record actual installed locations of contactors
 - 2. Operation and Maintenance Manual:
 - a. Include approved shop drawings and product data.
 - b. Maintenance Data: Include instructions for replacing and maintaining coil and contacts.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Allen-Bradley/Rockwell Automation: ab.rockwellautomation.com.
- B. Eaton Corporation: www.eaton.com.
- C. General Electric Company: www.geindustrial.com.
- D. Schneider Electric; Square D Products: www.schneider-electric.us.

2.02 LIGHTING CONTACTORS

- A. Description: NEMA ICS 2, magnetic lighting contactor.
- B. Configuration: Electrically held.
- C. Coil operating voltage: 120 volts, 60 Hertz.
- D. Poles: As required to match circuit configuration and control function. Refer to Schedules on Drawings.
- E. Contact Rating: Match branch circuit overcurrent protection, considering derating for continuous loads.
- F. Enclosure: NEMA ICS 6, Type 1.
- G. Accessories:
 - 1. Selector Switch: ON/OFF.
 - 2. Indicating Light: RED.

2.03 ACCESSORIES

- A. Cover Mounted Pilot Devices: NEMA ICS 5, standard type.
- B. Indicating Lights: Transformer, LED type.
- C. Selector Switches: Rotary type.
- D. Control Power Transformers: 120 volt secondary, 50 VA minimum, in each enclosed contactor. Provide fused primary and secondary, and bond unfused leg of secondary to enclosure.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install enclosed contactors where indicated, in accordance with manufacturer's instructions.
- B. Install enclosed contactors plumb. Provide supports in accordance with Section 26 05 29.
- C. Identify enclosed contactors in accordance with Section 26 05 53.

END OF SECTION

SECTION 26 09 23
LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Occupancy/Vacancy sensors.
- B. Time switches.
- C. Outdoor photo sensors.
- D. Accessory Switches.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 37 - Boxes.
- B. Section 26 08 00 - Commissioning of Electrical.
- C. Section 26 27 26 - Wiring Devices: Devices for manual control of lighting, including wall switches, wall dimmers, fan speed controllers, and wall plates.
- D. Section 26 51 10 - Luminaires.

1.03 REFERENCE STANDARDS

- A. ASHRAE 90.1-2010 - Energy Standard for Buildings Except Low-Rise Residential Buildings: Lighting.
- B. ABBREVIATIONS:
 - 1. BAS: Building Automation System.
 - 2. AV: Audio Visual.
 - 3. RF: Radio Frequency.
 - 4. CT: Current Transformer.
- C. ANSI C136.10 - American National Standard for Roadway and Area Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing; 2010.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association; 2014.
- F. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 508 - Industrial Control Equipment.
- H. UL 773 - Plug-in Locking Type Photocontrols for Use with Area Lighting; Current Edition, Including All Revisions.
- I. UL 916 - Energy Management Equipment; Current Edition, Including All Revisions.
- J. UL 917 - Clock-Operated Switches; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. This project includes commissioning of Electrical systems. Refer to Section 26 08 00 for the Contractor commissioning responsibilities.
- B. Preinstallation Meeting:
 - 1. Manufacturer's Representative(s) of Lighting Control Devices to coordinate a meeting of the installing Contractor, Owner, representatives for network lighting controls, lighting, and professional audio-video systems manufacturers. Include any designers and contractors for any other direct digital control system designed to interact with product of this Section.
 - a. Discuss interconnection and interoperability of other equipment with lighting management software.

- C. Coordination:
 - 1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.
 - 3. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.
- D. Sequencing:
 - 1. Do not install lighting control devices until final surface finishes and painting are complete.

1.05 SUBMITTALS

- A. Submit all product data, shop drawings, samples, and manufacturer's instructions concurrently.
- B. Prerequisite Submittals:
 - 1. Submit all manufacturer's qualifications, installer qualifications, and testing agency qualifications prior to or concurrent with product data and shop drawings.
 - 2. Submit training plan prior to commencement of training.
- C. Action Submittals:
 - 1. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
 - a. Occupancy Sensors: Include detailed motion detection coverage range diagrams.
 - b. Remote Keypad Controls: Include schedule of devices:
 - 1) Room number where device is installed.
 - 2) Keypad configuration, indicating quantity of buttons and function of each button.
 - 2. Shop Drawings:
 - a. Layout Drawings: Provide floor plans with manufacturer's actual layout of occupancy sensors and light level sensors. Submit drawings at the same scale as the Architect's project drawings.
 - 1) Occupancy Sensors: Indicate location, model number, and orientation of each occupancy sensor and associated system component.
 - 2) Daylighting Controls: Indicate location, model number, and orientation of each photo sensor and associated system component.
- D. Information Submittals:
 - 1. Testing agency qualifications.
 - 2. Prefunctional Checklists, Tests and Startup, refer to Section 26 08 00 - Commissioning of Electrical.
 - 3. Field Quality Control Reports.
 - 4. Training Plan:
 - a. Indicate proposed date(s) of training and demonstration.
 - b. Include outline of demonstration and training session(s).
- E. Closeout Submittals:
 - 1. Operation and Maintenance Manual:
 - a. Operation and Maintenance Data: Include detailed information on device programming and setup.
 - b. Include approved Shop Drawings and Product Data.
 - c. Include Sequence of Operation, identifying operation for each room or space.
 - d. Include manufacturer's maintenance information.
 - e. Include startup and test reports.
 - f. Include Documentation of Training:
 - 1) Date, attendance roster. and outline of training.
 - 2) Video of training session on DVD.
 - 3) Manufacturers operating procedures on DVD.

2. Project Record Documents: Record actual installed locations and settings for lighting control devices.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Testing Agency Qualifications:
 1. The testing organization shall be an independent, third party entity which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers.
 2. Three years documented experience testing products specified in this section.

1.07 PRE-INSTALLATION MEETING

- A. Convene one week prior to commencing work of this section.
 1. Provide and arrange a pre-installation meeting with a factory authorized representative at the Owner's facility to verify placement of sensors and installation criteria.

1.08 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide three year manufacturer warranty for all occupancy sensors.
- C. Provide three year manufacturer warranty for utility grade locking receptacle-mounted outdoor photo controls.
- D. Provide three year manufacturer warranty for all daylighting controls.
- E. Manufacturer's "Terms and Conditions" stating that warranty period begins at date of shipment is prohibited. Provide extended warranty for time period indicated that begins at date of Substantial Completion.
- F. Manufacturer's Extended Support Service: Extended telephone support: Unlimited period.

PART 2 PRODUCTS

2.01 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.
- C. Products for Switching of Electronic Fluorescent Ballasts: Tested and rated to be suitable for peak inrush currents specified in NEMA 410.

2.02 OCCUPANCY/VACANCY SENSORS

- A. Manufacturers:
 1. WattStopper: www.wattstopper.com.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
 3. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.
- B. All Occupancy Sensors:
 1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
 2. Sensor Technology:
 - a. Passive Infrared (PIR) Occupancy Sensors: Designed to detect occupancy by sensing movement of thermal energy between zones.

- b. Ultrasonic Occupancy Sensors: Designed to detect occupancy by sensing frequency shifts in emitted and reflected inaudible sound waves.
 - c. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic technologies.
 - d. Acoustic Technology: Not permitted.
- 3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
- 4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.
- 5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
- 6. Passive Infrared Lens Field of View: Field customizable by addition of factory masking material, adjustment of integral blinders, or similar means to block motion detection in selected areas.
- 7. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
- 8. Sensitivity: Field adjustable.
- 9. Adaptive Technology: Not permitted.
- 10. Compatibility:
 - a. Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, LED lighting with electronic drivers, and fractional motor loads, with no minimum load requirements.
- 11. Load Rating for Line Voltage Occupancy Sensors:
 - a. Incandescent Load: Not less than 800 W.
 - b. Fluorescent or LED Load: Not less than 800 W at 120 V ac and 1,200 W at 277 V ac.
 - c. Motor Load: Not less than 1/6 HP.
- 12. Isolated Relay for Low Voltage Occupancy Sensors: SPDT dry contacts, ratings as required for interface with system indicated.
- C. Ceiling Mounted Occupancy/Vacancy Sensors:
 - 1. All Ceiling Mounted Occupancy/Vacancy Sensors:
 - a. Description: Low profile occupancy sensors designed for ceiling installation.
 - b. Unless otherwise indicated or required to control the load indicated on the drawings, provide line voltage units, low voltage units, or digital units as indicated in schedule on Drawings.
 - c. Provide field selectable setting for disabling LED motion detector visual indicator.
 - d. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.
 - 1) Occupancy Sensor: Automatic on, automatic off.
 - 2) Vacancy Sensor: Manual on, automatic off.
 - e. Finish: White.
 - 1) Off-white product is prohibited.
 - 2. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
 - a. Extended Range Sensors: Capable of detecting motion within an area of 1000 at a mounting height of 9 feet, with a field of view of 360 degrees.
 - 1) Low Voltage Sensor: Interfaces with power pack and relays for circuit control.
 - 2) Digital Sensor: Interfaces with digital lighting management room controllers.
 - 3) Products:
 - (a) Low voltage sensor: Wattstopper DT-300-U.
- D. Power Packs for Low Voltage Occupancy Sensors:
 - 1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.

2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on the drawings.
3. Input Supply Voltage: Dual rated for 120/277 V ac.
4. Load Rating:
 - a. Fluorescent Load: Not less than 20 A.
 - b. LED Load: Not less than 20 A.
 - c. Motor Load: Not less than 1 HP.

2.03 TIME SWITCHES

- A. Manufacturers:
 1. Intermatic, Inc: www.intermatic.com.
 2. Paragon, a brand of Invensys Controls: www.invensyscontrols.com.
 3. Tork, a division of NSI Industries LLC: www.tork.com.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Digital Electronic Time Switches:
 1. Description: Factory-assembled solid state programmable controller with LCD display, listed and labeled as complying with UL 916 or UL 917.
 2. Program Capability:
 - a. 7-Day Time Switches: Single channel, capable of different schedule for each day of the week with additional holiday schedule available to override normal schedule for selected days.
 3. Schedule Capacity: Not less than 16 programmable on/off operations.
 4. Provide automatic daylight savings time and leap year compensation.
 5. Provide power outage backup to retain programming and maintain clock.
 6. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
 7. Input Supply Voltage: As indicated on the drawings.
 8. Output Switch Configuration: As required to control the load indicated on the drawings.
 9. Output Switch Contact Ratings:
 - a. Resistive Load: Not less than 30 A at 120-277 V ac.
 - b. Inductive Load: Not less than 30 A at 120-277 V ac.
 - c. Ballast Load: Not less than 20 A at 120 V ac or 6 A at 277 V ac.
 10. Provide lockable enclosure; environmental type per NEMA 250 as specified for the following installation locations:

2.04 OUTDOOR PHOTO CONTROLS

- A. Manufacturers:
 1. Intermatic, Inc: www.intermatic.com.
 2. Paragon, a brand of Invensys Controls: www.invensyscontrols.com.
 3. Tork, a division of NSI Industries LLC: www.tork.com.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Locking Receptacle-Mounted Outdoor Photo Controls
 1. Description: Plug-in locking type photo control unit complying with ANSI C136.10 for mounting on a compatible receptacle, listed and labeled as complying with UL 773.
 2. Housing: Weatherproof, impact resistant UV stabilized polypropylene, color to be selected.
 3. Photo Sensor: Cadmium sulfide.
 4. Light Level Activation: 1 to 3 footcandles turn-on and 1.5 to 1 turn-off to turn-on ratio with instant turn-on and delayed turn-off.
 5. Voltage: As required to control the load indicated on the drawings.
 6. Failure Mode: Fails to the on position.
 7. Load Rating: As required to control the load indicated on the drawings.
 8. Surge Protection: 160 joule metal oxide varistor.
 9. Provide the following accessories where indicated or as required to complete installation:

- a. Receptacle: Complying with ANSI C136.10.
- b. Mounting Bracket.
- c. Shorting Cap: Suitable for replacing locking photo control to complete circuit.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.
- F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.
- G. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 26 05 37 as required for installation of lighting control devices provided under this section.
- C. Install lighting control devices in accordance with manufacturer's instructions.
- D. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- E. Install lighting control devices plumb and level, and held securely in place.
 - 1. Provide support from structure or clips fastened to ceiling grid.
 - 2. Installation in ceiling tile without support indicated is prohibited.
- F. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 26 27 26.
- G. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- H. Occupancy Sensor Locations:
 - 1. Locate all occupancy sensors a minimum of 4 feet from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.
- I. Outdoor Photo Control Locations:
 - 1. Where possible, locate outdoor photo controls with photo sensor facing north. If north facing photo sensor is not possible, install with photo sensor facing east, west, or down.
 - 2. Locate outdoor photo controls so that photo sensors do not face artificial light sources, including light sources controlled by the photo control itself.
- J. Install outdoor photo controls so that connections are weatherproof. Do not install photo controls with conduit stem facing up in order to prevent infiltration of water into the photo control.
- K. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near the sensor location.

- L. Where indicated, install separate compatible wall switches for manual control interface with lighting control devices or associated power packs.
- M. Identification: Install "Sensor Controlled" labels at outlets controlled by Plug Load Controllers.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Contractors' tests shall be scheduled and documented in accordance with the commissioning requirements.
- C. Testing Agency: Engage a qualified testing agency to evaluate lighting control devices and perform tests and inspections.
- D. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- E. Inspect each lighting control device for damage and defects.
- F. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.
- G. Test time switches to verify proper operation.
- H. Test outdoor photo controls to verify proper operation, including time delays where applicable.
- I. Provide a report in table format including each room or space that has occupancy sensors and/or light level sensors installed. Indicate the following for each space:
 - 1. Date of test or inspection.
 - 2. Room Number and Room Name.
 - 3. Sensor Types.
 - 4. Sequence of Operation for the control of each space.
 - 5. Verification that the control of each space complies with the Sequence of Operation.
 - 6. Quantity and Type of each device installed.
 - 7. Test Reports for each device.
 - 8. Light Level Sensors, indicate the following:
 - a. Light level at which the lights turn on.
 - b. Light level at which the lights turn off.
 - c. Location of light level readings.
 - d. Time delay settings.
 - 9. Occupancy Sensors, indicate the following:
 - a. Verification that sensors are adjusted for complete coverage of space.
 - b. Time delay settings.
- J. Correct wiring deficiencies and replace damaged or defective lighting control devices.

3.04 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.
- C. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.
- D. Adjust time switch settings to achieve desired operation schedule as indicated in Lighting Controls Sequence of Operations on Drawings. Record settings in written report to be included with submittals.
- E. Adjust external sliding shields on outdoor photo controls under optimum lighting conditions to achieve desired turn-on and turn-off activation as indicated or as directed by Architect.

3.05 COMMISSIONING

- A. See Section 26 08 00 - Commissioning for Electrical for additional requirements.
 - 1. Complete prefunctional checklists.
 - 2. Perform functional tests: Field Tests specified in this section.
- B. System functional performance testing is part of the Commissioning Process. Functional performance testing shall be performed by the Contractor under direction of the CxA. The CxA will witness and document the functional performance testing.

3.06 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.
- B. Training of the Owner's operation and maintenance personnel is required in cooperation with the Owner's Representative. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with the Owner's Representative after submission and approval of formal training plans.
- C. Demonstration: Demonstrate proper operation of lighting control devices to Architect, and correct deficiencies or make adjustments as directed.
- D. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours of training.
 - 3. Instructor: Manufacturer's authorized service representative.
 - 4. Location: At project site.
 - 5. Provide video of training session.

END OF SECTION

SECTION 26 21 00
LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical service requirements.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 24 16 - Panelboards: Service entrance equipment.
- E. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.

1.03 DEFINITIONS

- A. Service Point: The point of connection between the facilities of the serving utility and the premises wiring as defined in NFPA 70, and as designated by the Utility Company.

1.04 REFERENCE STANDARDS

- A. IEEE C2 - National Electrical Safety Code; Institute of Electrical and Electronic Engineers; 2012.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- C. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. No later than two weeks following date of the Agreement, notify Utility Company of anticipated date of service.
- B. Coordination:
 - 1. Verify the following with Utility Company representative:
 - a. Utility Company requirements, including division of responsibility.
 - b. Exact location and details of utility point of connection.
 - c. Utility easement requirements.
 - d. Utility Company charges associated with providing service.
 - 2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for electrical service and associated equipment.
 - 3. Coordinate arrangement of service entrance equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 4. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- C. Arrange for Utility Company to provide permanent electrical service. Prepare and submit documentation required by Utility Company.
- D. Utility Company charges associated with providing permanent service to be paid by Owner.
- E. Preinstallation Meeting: Convene one week prior to commencing work of this section to review service requirements and details with Utility Company representative.
- F. Scheduling:
 - 1. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.06 QUALITY ASSURANCE

- A. Comply with the following:
 - 1. IEEE C2 (National Electrical Safety Code).

2. NFPA 70 (National Electrical Code).
3. The requirements of the Utility Company.

PART 2 PRODUCTS

2.01 ELECTRICAL SERVICE REQUIREMENTS

- A. Provide new electrical service consisting of all required conduits, conductors, equipment, metering provisions, supports, accessories, etc. as necessary for connection between Utility Company point of supply and service entrance equipment.
- B. Electrical Service Characteristics:
 1. Service Type: Underground.
 2. Service Voltage: 240/120 V, 1 phase, 60 Hz.
- C. Utility Company: Minnesota Power.
- D. Division of Responsibility:
 1. Pole-Mounted Utility Transformers:
 - a. Utility Poles: Furnished and installed by Utility Company.
 - b. Transformers: Furnished and installed by Utility Company.
 - c. Transformer Grounding Provisions: Furnished and installed by Utility Company.
 - d. Primary: Furnished and installed by Utility Company.
 - e. Secondary - Underground Service:
 - 1) Conduits: Furnished and installed by Contractor.
 - 2) Conductors: Furnished and installed by Utility Company (Service Point at service entrance equipment).
 2. Terminations at Service Point: Provided by Utility Company.
 3. Metering Provisions:
 - a. Meter Bases: Furnished and installed by Contractor per Utility Company requirements.
- E. Products Furnished by Contractor: Comply with Utility Company requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on drawings.
- B. Verify that ratings and configurations of service entrance equipment are consistent with the indicated requirements.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Verify and mark locations of existing underground utilities.

3.03 INSTALLATION

- A. Install products in accordance with manufacturer's instructions and Utility Company requirements.
- B. Perform work in a neat and workmanlike manner in accordance with NECA 1.
- C. Arrange equipment to provide minimum clearances and required maintenance access.
- D. Provide required trenching and backfilling in accordance with Section 31 23 16.13.
- E. Provide required support and attachment components in accordance with Section 26 05 29.
- F. Provide grounding and bonding for service entrance equipment in accordance with Section 26 05 26.
- G. Identify service entrance equipment, including main service disconnect(s) in accordance with Section 26 05 53.

END OF SECTION

SECTION 26 24 16
PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Lighting and appliance panelboards.
- B. Overcurrent protective devices for panelboards.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 05 73 - Overcurrent Protective Device Coordination Study: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

1.03 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; Federal Specification; Revision E, 2013.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- C. NECA 407 - Standard for Installing and Maintaining Panelboards; National Electrical Contractors Association; 2009.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- E. NEMA PB 1 - Panelboards; National Electrical Manufacturers Association; 2011.
- F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less; National Electrical Manufacturers Association; 2013 (ANSI/NEMA PB 1.1).
- G. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; International Electrical Testing Association; 2013 (ANSI/NETA ATS).
- H. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- K. UL 67 - Panelboards; Current Edition, Including All Revisions.
- L. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- M. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.
- N. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.

3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. Action Submittals:
 1. Submit Product Data and Shop Drawings in conjunction with Overcurrent Protective Device Coordination Study and Arc Flash Assessment to verify equipment ratings required. Submittals received without concurrent submittal of Section 26 05 73 may be rejected without review.
 2. Submit all product data, shop drawings, and samples concurrently.
 3. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
 4. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 - a. Circuit arrangement has been designed by the engineer for optimum phase balance; rearrangement by equipment provider is prohibited.
- B. Information Submittals:
 1. Field Quality Control Test Reports.
 - a. Test procedures used.
 - b. Test results that comply with requirements.
 - c. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- C. Closeout Submittals:
 1. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.
 2. Operation and Maintenance Manual:
 - a. Include approved shop drawings and product data.
 - b. Test Reports: Include field quality control test reports.
 - c. Maintenance Schedule: Include equipment maintenance or testing requirement and frequency of maintenance or test in consolidated maintenance schedule table. Refer to Section 26 05 00 - Basic Electrical Requirements for maintenance schedule table requirements.
 - 1) Include exercise requirements for circuit breakers.
 - d. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
 - e. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - f. Time-current coordination curves for each type and rating of main overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
 - 1) Include coordination curves for each feeder overcurrent protective device for panelboards with main lugs only.
 - g. Documentation of Training:
 - 1) Include date, attendance roster, and outline of training session.
 - 2) Include video of training session.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. See Section 01 60 00 - Product Requirements, for additional provisions.

2. Panelboard Keys: Two of each different key.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 1.1 and trained in electrical safety as required by NFPA 70E.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Eaton Corporation: www.eaton.com.
- B. General Electric Company: www.geindustrial.com.
- C. Schneider Electric; Square D Products: www.schneider-electric.us.
- D. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Source Limitations: Furnish panelboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 PANELBOARDS - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 1. Altitude: Less than 6,600 feet.
 2. Ambient Temperature:
 - a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.
- C. Short Circuit Current Rating:
 1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
 2. Listed series ratings are not acceptable.
- D. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- E. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- F. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
- G. Bussing: Sized in accordance with UL 67 temperature rise requirements.
 1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
 2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
- H. Conductor Terminations: Suitable for use with the conductors to be installed.
- I. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R.

2. Boxes: Galvanized steel unless otherwise indicated.
 - a. Provide wiring gutters sized to accommodate the conductors to be installed.
 - b. Provide painted steel boxes for surface-mounted panelboards where indicated, finish to match fronts.
3. Fronts:
 - a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
 - b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
 - c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.
4. Lockable Doors: All locks keyed alike unless otherwise indicated.
- J. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
- K. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.
- L. Load centers are not acceptable.
- M. Provide the following features and accessories where indicated or where required to complete installation:
 1. Feed-through lugs.
 2. Sub-feed lugs.

2.03 LIGHTING AND APPLIANCE PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:
 1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
 1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
 2. Phase and Neutral Bus Material: Copper.
 3. Ground Bus Material: Copper.
- D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.
- E. Main circuit breaker: Branch mounted device prohibited except where specifically indicated in Schedules on Drawings.
- F. Enclosures:
 1. Provide surface-mounted or flush-mounted enclosures as indicated.
 2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
 3. Provide clear plastic circuit directory holder mounted on inside of door.

2.04 OVERCURRENT PROTECTIVE DEVICES

- A. Molded Case Circuit Breakers:
 1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
 2. Interrupting Capacity:
 - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated.

- b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
- 3. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.
 - b. Provide compression lugs where indicated.
 - c. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
- 4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
- 5. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
- 6. Provide the following circuit breaker types where indicated:
 - a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
 - b. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.
 - c. 100 Percent Rated Circuit Breakers: Listed for application within the panelboard where installed at 100 percent of the continuous current rating.
- 7. Provide listed switching duty rated circuit breakers with SWD marking for all branch circuits serving fluorescent lighting.
- 8. Do not use tandem circuit breakers.
- 9. Do not use handle ties in lieu of multi-pole circuit breakers.
- 10. Provide the following features and accessories where indicated or where required to complete installation:

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive panelboards.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Verify that field measurements are as indicated on shop drawings.

3.03 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install panelboards securely, in a neat and workmanlike manner in accordance with NECA 1 (general workmanship), NECA 407 (panelboards), and NEMA PB 1.1.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required supports in accordance with Section 26 05 29.
- E. Install panelboards plumb.
- F. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.
- G. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.
- H. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.
- I. Provide minimum of six spare 1 inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.
- J. Provide grounding and bonding in accordance with Section 26 05 26.

- K. Install all field-installed branch devices, components, and accessories.
- L. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- M. Provide filler plates to cover unused spaces in panelboards.
- N. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated.
- O. Identify panelboards in accordance with Section 26 05 53.
- P. Provide arc flash hazard labels under the provisions of Section 26 05 53.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Perform Tests and Inspections:
- C. Tests and Inspections:
 - 1. Perform inspection, testing, and adjusting in accordance with Section 01 40 00.
 - 2. Inspect and test in accordance with NETA ATS, except Section 4.
 - 3. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than 100 amperes. Tests listed as optional are not required.
 - 4. Test GFCI circuit breakers to verify proper operation.
 - 5. Correct deficiencies and replace damaged or defective panelboards or associated components.
- D. Prepare Test and Inspection Reports:
 - 1. Provide a cover sheet listing all deficient items. Correct deficiencies and repeat tests for deficient items. Provide new test report for each panelboard containing a deficient item.
 - 2. Provide certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
 - 3. Provide test reports for each panelboard feeder indicating balance of phase loads. Indicate the following:
 - a. Date of test or inspection.
 - b. Deficiency and corrective action taken.
 - c. Repeat test/verification for each panelboard containing a deficient item.

3.05 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Adjust alignment of panelboard fronts.
- C. Adjust circuit breaker trip and time delay settings to values indicated in Overcurrent Protective Device Coordination Study. Refer to Section 26 05 73.
- D. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes:
 - 1. Measure as directed during period of normal system loading.
 - 2. Tolerance: Difference exceeding 20 percent between phase loads within a panelboard is not acceptable.
 - 3. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disruption of critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 - 4. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.

3.06 CLEANING

- A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

- A. Manufacturer's Services: Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust and operate panelboards.
- B. Demonstration and Training: Train Owners's personnel to adjust, operate, and maintain panelboards, overcurrent protective devices, and accessories.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours of training.
 - 3. Location: At project site.
 - 4. Provide video of training session.

END OF SECTION

SECTION 26 27 16
ELECTRICAL CABINETS AND ENCLOSURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Hinged cover enclosures.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 37 - Boxes.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.

1.03 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 ENCLOSURE MANUFACTURERS

- A. Hoffman, a division of Pentair: <http://www.hoffmanonline.com>.
- B. Cooper B-Line, a division of Cooper Industries: www.cooperindustries.com.
- C. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 HINGED COVER ENCLOSURES

- A. Construction: NEMA 250, Type 1 steel enclosure.
- B. Covers: Continuous hinge, held closed by flush latch operable by screwdriver.
- C. Enclosure Finish: Manufacturer's standard enamel.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install securely, in a neat and workmanlike manner, as specified in NECA 1.
- B. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner under the provisions of Section 26 05 29.

3.02 CLEANING

- A. Remove dirt and debris from enclosure.
- B. Clean finishes and touch up damage.

END OF SECTION

SECTION 26 27 17
EQUIPMENT WIRING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical connections to equipment.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 19 - Low Voltage Power Conductors and Cables.
- B. Section 26 05 34 - Conduit.
- C. Section 26 05 37 - Boxes.
- D. Section 26 27 26 - Wiring Devices.

1.03 REFERENCE STANDARDS

- A. NEMA WD 1 - General Color Requirements for Wiring Devices; National Electrical Manufacturers Association; 1999 (R 2010).
- B. NEMA WD 6 - Wiring Devices - Dimensional Requirements; National Electrical Manufacturers Association; 2012.
- C. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
 - 2. Determine connection locations and requirements.
- B. Sequencing:
 - 1. Obtain coordination requirements prior to rough-in for equipment.
 - 2. Install rough-in of electrical connections before installation of equipment is required.
 - 3. Make electrical connections before required start-up of equipment.

1.05 SUBMITTALS

- A. Action Submittals:
 - 1. Consolidated Table: Provide information in table format indicating each Equipment Designation and Name; Cord Type/Size; Device Configuration.
 - 2. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.
- B. Closeout Submittals:
 - 1. Operation and Maintenance Manual:
 - a. Include approved Consolidated Table.
 - b. Include approved Product Data.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
 - 1. Colors: Conform to NEMA WD 1.
 - 2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.

- 3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.
- B. Wiring Devices: As specified in Section 26 27 26.
- C. Flexible Conduit: As specified in Section 26 05 34.
- D. Wire and Cable: As specified in Section 26 05 19.
- E. Boxes: As specified in Section 26 05 37.

2.02 EQUIPMENT CONNECTIONS

- A. Direct-wired connections:
 - 1. Electrical Connection: Flexible conduit.
 - a. Provide flexible metallic conduit or liquid-tight flexible metal conduit suitable for environment of intended use.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Provide receptacle outlet to accommodate connection with attachment plug.
- E. Provide cord and cap where field-supplied attachment plug is required.
- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall switches.
- B. Receptacles.
- C. Wall plates.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 37 - Boxes.
- B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- C. Section 26 09 23 - Lighting Control Devices: Devices for automatic control of lighting, including occupancy sensors.

1.03 DEFINITIONS

- A. Wet Location: A location in which water or other liquid can drip, splash, or flow on or against electrical equipment.
- B. Damp Location: An exterior or interior location that is normally or periodically subject to condensation of moisture in, on, or adjacent to, electrical equipment, and includes partially protected locations.
- C. Finished Spaces: Rooms or spaces with painted or otherwise finished surfaces, intended for regular use by occupants.
 - 1. Spaces are considered finished spaces unless defined as unfinished.
- D. Unfinished Spaces: Mechanical rooms, shop spaces, bulk storage, shell space for future construction.

1.04 REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for; Federal Specification; Revision G, 2001.
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush-mounted (General Specification); Federal Specification; Revision F, 1999.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- D. NEMA WD 1 - General Color Requirements for Wiring Devices; National Electrical Manufacturers Association; 1999 (R 2010).
- E. NEMA WD 6 - Wiring Device -- Dimensional Specifications; National Electrical Manufacturers Association; 2012.
- F. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
- H. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
- I. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.
- J. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:

1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
 2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
 3. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
 4. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.
- B. Sequencing:
1. Do not install wiring devices until final surface finishes and painting are complete.

1.06 SUBMITTALS

- A. Action Submittals:
1. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
- B. Closeout Submittals:
1. Operation and Maintenance Manual:
 - a. Include testing requirement in Consolidated Maintenance Schedule, refer to Section 26 05 00.
 - b. Include approved Shop Drawings and Product Data.
 - c. Include Operation and Maintenance Data:
 - 1) GFCI Receptacles: Include information on status indicators.
- C. Project Record Documents: Record actual installed locations of wiring devices.

1.07 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.

1.08 DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Hubbell Incorporated: www.hubbell-wiring.com.
- B. Leviton Manufacturing Company, Inc: www.leviton.com.
- C. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us
- D. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Source Limitations:
1. Where possible, for each type of wiring device furnish products produced by a single manufacturer and obtained from a single supplier.
 2. Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer and material indicated in this section.

2.02 WIRING DEVICE APPLICATIONS

- A. Provide wiring devices suitable for intended use and with ratings adequate for load served.
- B. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.
- C. Provide GFCI protection for receptacles installed within 6 feet of sinks.
- D. Unless noted otherwise, do not use combination switch/receptacle devices.

2.03 WIRING DEVICE FINISHES

- A. Provide wiring device finishes as described below unless otherwise indicated.

- B. Wiring Devices Installed in Finished Spaces: Ivory with white stainless steel wall plate.
- C. Wiring Devices Installed in Unfinished Spaces: White with galvanized steel wall plate.
- D. Wiring Devices Installed in Wet or Damp Locations: White with specified weatherproof cover.

2.04 ALL WIRING DEVICES

- A. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

2.05 WALL SWITCHES

- A. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.
 - 1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.
- B. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

2.06 RECEPTACLES

- A. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
 - 1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
 - 2. NEMA configurations specified are according to NEMA WD 6.
- B. Convenience Receptacles:
 - 1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
- C. GFCI Receptacles:
 - 1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
 - 2. Tamper Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type.
 - 3. Tamper Resistant and Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.

2.07 WALL PLATES

- A. Wall Plates: Comply with UL 514D.
 - 1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
 - 2. Size: Standard.
 - a. Jumbo wall plates are not permitted.
 - 3. Screws: Metal with slotted heads finished to match wall plate finish.
- B. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.
- C. Weatherproof Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.
 - 1. Product: Large capacity, vertical, Hubbell WP26M.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- F. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

- A. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 26 05 37 as required for installation of wiring devices provided under this section.
- C. Install wiring devices in accordance with manufacturer's instructions.
- D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- E. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.
- F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
- G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- H. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.
- I. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- J. Install wall switches with OFF position down.
- K. Install vertically mounted receptacles with grounding pole on bottom and horizontally mounted receptacles with grounding pole on left.
- L. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- M. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Perform field inspection, testing, and adjusting in accordance with Section 01 40 00.
- C. Inspect each wiring device for damage and defects.

- D. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.
- E. Convenience Receptacles:
 - 1. Test each receptacle to verify operation and proper polarity.
 - 2. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.
- F. Correct wiring deficiencies and replace damaged or defective wiring devices.
 - 1. Replace branch circuit conductors for devices at locations that tests indicate are not within acceptable range.
 - 2. Repeat tests at devices found defective and replaced.

3.05 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

3.06 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION

SECTION 26 28 13

FUSES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fuses.

1.02 RELATED REQUIREMENTS

- A. Section 26 51 10 - Luminaires.

1.03 REFERENCE STANDARDS

- A. NEMA FU 1 - Low Voltage Cartridge Fuses; National Electrical Manufacturers Association; 2012.
- B. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements; Current Edition, Including All Revisions.
- D. UL 248-4 - Low-Voltage Fuses - Part 4: Class CC Fuses; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
 - 2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
 - 3. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Bussmann, a division of Eaton Corporation: www.cooperindustries.com.
- B. Littelfuse, Inc: www.littelfuse.com.
- C. Mersen: ep-us.mersen.com.
- D. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 APPLICATIONS

- A. In-Line Protection for Pole-Mounted Luminaires: Class CC, time-delay.

2.03 FUSES

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.
- C. Provide fuses of the same type, rating, and manufacturer within the same switch.
- D. Comply with UL 248-1.
- E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.
- F. Voltage Rating: Suitable for circuit voltage.
- G. Class CC Fuses: Comply with UL 248-4.

1. Class CC, Time-Delay Fuses:
- H. Provide the following accessories where indicated or where required to complete installation:
 1. Fuseholders: Compatible with indicated fuses.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.
- B. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Do not install fuses until circuits are ready to be energized.
- B. Install fuses with label oriented such that manufacturer, type, and size are easily read.

END OF SECTION

SECTION 26 51 10
LUMINAIRES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Luminaires.
- B. Light emitting diode (LED) luminaires (fixtures).
- C. Lamps.
- D. Luminaire accessories.

1.02 DEFINITIONS

- A. Emergency Lighting Unit: A fixture with integral emergency battery power supply and the means for controlling and charging the battery.
- B. Fixture: A complete lighting unit, exit sign. Fixtures include lamps and parts required to distribute the light, position and protect the lamps, and connect lamps to the power supply.
- C. Luminaire: Fixture.
- D. Average Life: The time after which 50 percent will have failed and 50 percent will have survived under normal conditions.
- E. LED Lumen Maintenance: The time of operation at which the lumen output is a percentage of the initial lumen output, as tested per IESNA LM-79-2008.
 - 1. Examples: L70 = 70% of initial lumens, L80 = 80% of initial lumens, etc.

1.03 RELATED REQUIREMENTS

- A. Section 26 0800 - Commissioning of Electrical.
- B. Section 26 09 23 - Lighting Control Devices: Occupancy sensors, photoelectric sensors, remote keypad controls.

1.04 REFERENCE STANDARDS

- A. ANSI C82.1 - American National Standard for Lamp Ballast - Line Frequency Fluorescent Lamp Ballast; 2004.
- B. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems; National Electrical Contractors Association; 2006.
- C. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; National Electrical Contractors Association; 2006.
- D. NEMA WD 6 - Wiring Devices - Dimensional Requirements; National Electrical Manufacturers Association; 2002.
- E. NFPA 70 - National Electrical Code; National Fire Protection Association; 2011.
- F. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures; National Fire Protection Association; 2006.
- G. UL 924 - Emergency Lighting and Power Equipment.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. This project includes commissioning of Electrical systems. Refer to Section 26 08 00 for the Contractor commissioning responsibilities.
- B. Coordination:
 - 1. Coordinate the placement of lighting fixtures with HVAC diffusers, sprinklers, smoke detectors, lighting sensors, etc. installed under other sections or by others.
 - 2. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

1.06 SUBMITTALS

- A. Action Submittals:

1. Shop Drawings:
 - a. Indicate dimensions, weights, support points, and accessory components for each luminaire.
 - b. Submit Product Data for each luminaire:
2. Product Data:
 - a. Include lamp manufacturer product data: Manufacturer, model number, initial lumens, mean lumens, color rendering index, color temperature, and rated lamp life.
 - b. LED Luminaires; include luminaire product data: Manufacturer, model number, start temperature, input current, ANSI input watts, total harmonic distortion, power factor, and efficiency (output lumens/watt).
 - c. Include emergency power supply where indicated.
 - d. Include components, mounting accessories, ratings, and photometric performance data.
- B. Information Submittals:
 1. Field quality control test reports.
- C. Closout Submittals:
 1. Operation and Maintenance Manual:
 - a. Include Shop Drawings and Product Data.
 - b. Include spare parts listing.
 2. Project Record Documents: Record actual installed locations of lighting fixture and actual installed circuiting and control arrangements.

1.07 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70 and NFPA 101.
- B. Coordination of Fixtures With Ceiling: Coordinate fixtures mounting hardware and trim with the ceiling system.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Products: Listed and classified by Underwriters Laboratories Inc. or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.08 COORDINATION

- A. Coordinate lighting and dimming controls with systems and components specified in the following sections:
 1. Section 26 09 23 - Lighting Control Devices.
- B. Field Quality Control functional tests for this section, and lighting controls systems components specified in other sections shall be performed by the same test agency. Coordinate field quality test requirements with systems and components specified in the following sections:
 1. Section 26 09 23 - Lighting Control Devices.

1.09 WARRANTY

- A. Manufacturer's warranty in which manufacturer agrees to repair or replace components of luminaires (fixtures) that fail in materials or workmanship within the specified warranty period following substantial completion.
 1. Warranty Period, LED Luminaires: 5 years minimum.
 - a. Warranty shall include components, transportation, removal, installation of new products, and all costs incidental to on-site replacement.
 - b. Provide 10 year extended warranty as indicated for specific lighting fixtures as indicated on Lighting Fixture Schedule on Drawings.
 - 1) After first 5 years, remainder of 10 year warranty shall include components and shipping. Labor not included.
- B. Manufacturer's "Terms and Conditions" stating that warranty period begins at date of shipment is prohibited. Provide extended warranty for time period indicated that begins at date of Substantial Completion.

1.10 EXTRA MATERIALS

- A. See Section 01 6000 - Product Requirements, for additional provisions.
- B. Supply 20 percent spare lenses for each fixture type, minimum two, for Owner's use in maintenance of project.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Complete Fixtures: Per lighting fixture schedule on the drawings.
 - 2. Lamps, except where limited to indicated manufacturers and models for specific lamp types:
 - a. Integrated LED Lamps:
 - 1) Cree.

2.02 FIXTURES

- A. Furnish products as indicated in Schedule included on the Drawings.
- B. Specification Grade: Where indicated "Specification Grade", paint after fabrication.
- C. Fixture Components:
 - 1. Doors and Frames: Smooth operating and free from light leakage under operating conditions.
 - 2. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic except as indicated.
 - a. Plastic: Highly resistant to yellowing and other changes due to aging, exposure to heat and UV radiation.
- D. Substitutions: See Section 01 60 00 - Product Requirements.
 - 1. Include point-by-point lighting calculations for each space where a product substitution is proposed.
 - 2. Include electronic Photometric.ies file for each proposed substitution.

2.03 SUSPENDED FIXTURE SUPPORT COMPONENTS

- A. Single-Stem Hangers: 1/2-inch steel tubing with ceiling canopy (with swivel ball fitting where required). Finish white, unless noted otherwise.
- B. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy arranged to mount a single fixture. Finish same as fixture.
- C. Rod Hangers: 3/16-inch diameter cadmium plated, threaded steel rod.
- D. Hook Hanger: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.
- E. Aircraft Cable: Factory supplied by fixture manufacturer with proper fittings for attaching to fixture. Other features are:
 - 1. Power feed canopy: 5" diameter White ceiling canopy with box support strap and knock-out for power feed cord.
 - 2. Power feed cord: Flexible straight cord with #18 AWG copper conductors and overall white thermoplastic covering. Number of conductors shall be three unless noted otherwise on the drawings.
 - 3. Non-power canopy: 2" diameter White ceiling canopy with hole in center for support stud.

2.04 LAMPS

- A. Conform to ANSI Standards, C78 series applicable to each type of lamp.
- B. Lamp Types: As specified for each luminaire in schedule on Drawings..
- C. Integrated Light Emitting Diode (LED) Lamps:
 - 1. Description: Omni-directional A19 size LED lamp with integrated driver.

2. Rated Life: L70 25,000 hours, minimum.
3. Luminous intensity - Initial lumens: 1100 lumens.
4. ANSI Input Watts: 13 watts.
5. Power Factor: Not less than 0.70.
6. Color Temperature: 2700 Kelvin.
7. Voltage: 120 volts.
8. Base: E26 Screw.
9. Product:
 - a. Cree A19 75W 27K.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.05 LIGHT EMITTING DIODE (LED) FIXTURES:

- A. Color Rendering Index (CRI): Minimum 83.
- B. Rated Lumens: Total fixture delivered light output, comply with LM79.
- C. Lumen Maintenance: Operation time to percentage of initial rated lumens, comply with IESNA LM-79-2008.
 1. Not less than indicated in Lighting Fixture Schedule on Drawings.
- D. Correlated Color Temperature: 4000 Kelvin, unless indicated otherwise.
- E. Efficacy: 90 delivered lumens per watt, minimum.
- F. Driver: Engine providing required power source characteristics to LEDs.
- G. Dimming Capability: 5 to 100 percent, 0-10 V.
- H. Power Factor: 0.90 minimum.
- I. Total Harmonic Distortion: Less than 10 percent THD.
- J. Surge Protection: Meet "C Low" waveforms as defined in ANSI/IEEE C62.41.2, Scenario 1 Location Category C.

2.06 ACCESSORIES

- A. Provide Lighting Control Devices integral with fixtures where indicated.
 1. Occupancy/vacancy sensors:
 - a. Product: See Section 26 09 23.
 2. Outdoor Motion Sensors:
 - a. Description: Factory-assembled wet location listed device suitable for integral lighting fixture mounting, with integral field adjustment of coverage, capable of detecting motion for automatic control of load indicated.
 - b. Finish: Black.
 - c. Product: See Section 26 09 23.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install fixtures securely, in a neat and workmanlike manner, as specified in NECA 500 and 502.
- B. Install suspended fixtures using cable suspension attached to fixture.
- C. Locate recessed ceiling luminaires as indicated on reflected ceiling plan (if available), or as indicated on the electrical drawings.
- D. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- E. Install recessed luminaires to permit removal from below.
- F. Install wall mounted luminaires at height as indicated on Drawings.
- G. Install accessories furnished with each luminaire.
- H. Connect luminaires to branch circuit outlets provided under Section 26 05 37 as indicated.

- I. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- J. Bond products and metal accessories to branch circuit equipment grounding conductor.
- K. Install specified lamps in each luminaire.

3.02 FIELD QUALITY CONTROL

- A. Perform field inspection, testing, and adjusting in accordance with Section 01 40 00.
- B. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- C. Operate each luminaire after installation and connection. Inspect for proper connection and operation.
- D. Perform tests and inspections
 - 1. Tests performed for this section shall be performed by the same agency and in conjunction with tests in the following sections:
 - a. Section 26 09 23 - Lighting Control Devices.
- E. Test lighting control devices integral with luminaires for proper operation.
- F. Replace or repair malfunctioning fixtures and components, then retest. Repeat procedure until all units operate properly.
- G. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.03 ADJUSTING

- A. Aim and adjust directional luminaires as directed, in the field, by the Engineer.
- B. Position exit sign directional arrows as indicated.

3.04 CLEANING

- A. Clean electrical parts to remove conductive and deleterious materials.
- B. Remove dirt and debris from enclosures.
- C. Clean finishes and touch up damage.

3.05 COMMISSIONING

3.06 CLOSEOUT ACTIVITIES

- A. Demonstrate luminaire operation for minimum of two hours.

3.07 PROTECTION

- A. Relamp luminaires that have failed lamps at Substantial Completion.

3.08 SCHEDULES - SEE DRAWINGS

- A. Lighting Fixture Schedule: See Drawings.

END OF SECTION

SECTION 30 10 00
BASIC CIVIL REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Governing Specification - Reference specification for civil work.
- B. Utility Property and Service - Identifying and working around existing utilities.
- C. Construction Surveying - Surveying necessary to perform the work.

1.02 REGULATORY CODES

- A. 29CFR1926. US Code of Federal Regulations-Safety and Health Regulations for Construction.

1.03 GOVERNING SPECIFICATION

- A. The State of Minnesota Department of Transportation, Standard Specifications for Construction (MNDOT), 2016 Edition shall apply on all Division 30 through 35 work, except as modified or altered in the following sections: 30 0000 through 35 9999.
- B. The City of Duluth Public Works & Utilities Department - Engineering Division 2016 Edition Standard Construction Specifications book, and any addendum or supplements shall apply on all Division 30 through 35 work, except as modified or altered in the following sections: 30 0000 through 35 9999.
- C. All traffic control devices and signing shall conform to the 2015 Minnesota MUTCD, including the field manual dated January 2014. The Contractor is responsible for all traffic control on the Project.
- D. All references to measurement and payment in the Governing Specifications shall not apply.

1.04 UTILITY PROPERTY AND SERVICE

- A. Construction operations in proximity of utility properties shall be performed in accordance with the provisions of MNDOT 1507, except as modified below:
 - 1. Interference of Underground Structures
 - a. When any underground structure interferes with planned placement of the pipeline or appurtenances, to such an extent that alterations in the work are necessary to eliminate conflict or avoid endangering effects on either existing or proposed facilities, Contractor shall immediately notify Engineer of the affected structure. When any existing facilities are endangered by Contractor's operations, Contractor shall cease work associated with the interference and take such precautions as may be necessary to protect in-place structures until a decision is made as to how the conflict will be resolved.
 - b. Without specific authorization from Engineer, no essential utility service shall be disrupted, nor shall any change be made in either the existing structures or the planned installations to overcome the interference. Alterations in existing facilities will be allowed only to the extent that service will not be curtailed unavoidably, and then only when the encroachment or relocation will satisfy all applicable regulations and conditions.
 - c. Whenever alterations are required as a result of unforeseen underground interferences, not due to any fault or negligence of Contractor, Engineer will issue a written order covering any additional or extra work involved and specifying the revised basis of payment, if any. Any alterations made strictly for the convenience of Contractor shall be subject to prior approval and shall be at Contractor's expense.

1.05 CONSTRUCTION SURVEYING

- A. GENERAL SURVEY SPECIFICATIONS
 - 1. This Contract provides for Contractor to accomplish Construction Surveying for this project. Furthermore, Contractor is advised that the Contract may not fully describe every detail or make specific allowances for all probable exceptions and contingencies related to Construction Surveying requirements for this Project.

2. The Contractor shall verify the building location with site interfaces including but not limited to utilities, sidewalks, existing grades, and proposed grades. The Contractor shall field verify all dimensions prior to executing the work. Notify the Engineer if field conditions vary from the plan.
- B. SURVEYING TO BE PERFORMED BY OWNER'S ENGINEER
1. Horizontal and vertical control points for the project are based upon owner provided survey by others. Upon request by the Contractor, the Engineer will also provide electronic data in the format that was used in the accomplishment of the surveys for the Construction Plan, and in Construction Plan development itself. However, due to the many different processes that the design survey data goes through and the large variety of sources of input in the final production of the Plan itself, no warrantee is made as to the value or adaptability of the electronic data to the Surveyor. No warrantee is made that the data systems used by the Engineer, or any consultants employed by the Owner for Surveying or Construction Plan preparation, will be compatible with the systems used by the Contractor's surveyor. Information shown on the printed "Plan" shall always govern over any electronic "Plan" data.
 2. At the discretion of the Owner's Engineer, spot checks may be performed upon the Contractor's surveying calculations, records, field procedures, and actual staking. If the Engineer determines that the work is not being performed in a manner that will assure proper controls and accuracy, the Engineer will order the Contractor to redo such work, to the standards specified in the Contract, at no additional cost to the Owner.
- C. CONSTRUCTION SURVEYING BY THE CONTRACTOR
1. Contractor Construction Surveying Requirements are as follows:
 - a. Construction Surveying is defined as accurately providing all necessary computations, stakes and marks to establish lines, slopes, elevations, points, continuous profile grades and the requirements shown in the Plan for Construction Staking; so that the Contractor's forces are able to construct all the required work for the project in accordance with the Contract requirements; and so that the Owner's Engineers and Inspectors are able to complete all necessary inspection and Contract Administration duties. The staking shall include, but not be limited to clearing, grubbing, removals, grading, culverts, embankments, borrow, aggregate base course, pavements, buildings, utilities, signs, pavement parking, erosion control and turf establishment items to complete the Project as represented in the Plans. The surveying must be done in a way that is timely, and that is reflective of the continuing and ongoing nature of construction and inspection activities which will generally require frequent, separate Project visits by the Contractor's survey crew to the Project to accommodate the various stages of construction and inspection activities that will occur.
 - b. The Surveyor shall be prepared to make all necessary surveying checks for field verification of actual conditions and shall make the necessary minor surveying and staking adjustments to fit the construction to actual field conditions. In addition, some Plan details may be dependent upon actual field conditions at the time of construction. It may be necessary to perform some field surveying or office computations in order to stake these components. All work referred to in this paragraph is considered part of the work of Construction Surveying and no additional payment will be made for this work.
 - c. The Contractor shall:
 - 1) Be responsible for the preservation of all reference points, monuments, government land corners, horizontal and vertical control points, stakes, and marks that are established by the Engineer or others within the Project limits. If the Contractor or its surveyor fails to preserve these items, and if they must be re-established by the Owner, the Engineer will deduct a charge from monies due or becoming due the Contractor according to the Owner's costs.
 - 2) Start and end all level runs, traverses, or GPS control surveys from known control.
 - 3) Perform all Construction Surveying.

- 4) Present the Engineer with the As-built Survey Data. The as-built survey data shall include the following:
 - (a) Changes from the Plan:
 - (1) Manhole and catch basin inverts and top of castings
 - (2) Entrance floor elevations
 - (3) Valve box covers
 - (4) Fence and gate locations
 - (5) Contours of constructed stormwater ponds and swales
 - (b) Locations of utilities relocated or replaced as part of the Project.
 - (c) Identify any alignment, property, or control monumentation destroyed during the Project.
 - (d) The information shall include the X, Y and if applicable, the Z coordinates in the Project datum. If the original item had no coordinate reference, then show the revised centerline station and offset.
- 5) Furnish survey documentation and as-built survey data to the Engineer within the time limits indicated in the surveying work schedule and prior to application for final payment.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 31 10 00
SITE CLEARING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Clearing and protection of vegetation.
- B. Removal of existing debris.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Fill Material: As specified in Section 31 23 23 - Fill

PART 3 EXECUTION

3.01 SITE CLEARING

- A. Comply with other requirements specified in Section 01 70 00.
- B. Minimize production of dust due to clearing operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

3.02 EXISTING UTILITIES AND BUILT ELEMENTS

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Contractor shall call Gopher State On Call in MN, 1-800-252-1166 for locating and marking of all utilities within the work area prior to any excavation on the project site.
- C. Protect existing utilities to remain from damage.
- D. Do not disrupt public utilities without permit from authority having jurisdiction.
- E. Protect existing structures and other elements that are not to be removed.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.

3.03 VEGETATION

- A. Scope: Remove trees, shrubs, brush, and stumps in areas to be covered by building structure, paving, lawns, and planting beds, unless specified on drawing to remain. The contractor shall remove all vegetation within the construction limits necessary to perform the work. All necessary vegetation removal is incidental to the work.
 - 1. Exception: Specific trees and vegetation indicated on drawings to remain.
- B. Do not remove or damage vegetation beyond the limits indicated on drawings.
- C. Vegetation Removed: Do not burn, bury, landfill, or leave on site, except as indicated. All other vegetation cleared shall be removed from the site.
- D. Restoration: If vegetation outside removal limits or within specified protective fences is damaged or destroyed due to subsequent construction operations, replace at no cost to Owner.

3.04 EXISTING BUILT ELEMENTS

- A. Scope:
 - 1. Neat line sawcut and remove paving as required to accomplish new work.
 - 2. Remove other items indicated for salvage and relocation as indicated on drawings.
 - 3. Remove manholes and manhole covers and catch basins as indicated on drawings.
 - 4. Remove fences and gates where indicated on drawings.
 - 5. Remove other items indicated, for salvage and relocation.
 - 6. Fill excavations, open pits, and holes in ground areas generated as result of removals, using General fill; compact fill as required so that required rough grade elevations do not subside within one year after completion.

- B. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.
 - 2. Provide, erect, and maintain temporary barriers and security devices.
 - 3. Conduct operations to minimize effects on, and interference with, adjacent structures and occupants.
 - 4. Do not close or obstruct public roadways or sidewalks without permit.
 - 5. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
- C. Do not begin removal until receipt of notification to proceed from Owner.
- D. Protect existing structures and other elements that are not to be removed.
 - 1. Prevent movement or settlement of adjacent structures.
- E. Perform demolition in a manner that maximizes salvage and recycling of materials.
- F. Partial Removal of Paving: Neatly sawcut at right angle to surface. Begin and end removal of contract walks and curbs at existing expansion joint locations.
- G. Dispose of demolished bituminous, concrete and other materials off site in compliance with MPCA and local regulations for waste disposal.

3.05 DEBRIS

- A. Remove debris, junk, and trash from site.
- B. Leave site in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 31 22 00

GRADING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Removal and storage of topsoil.
- B. Rough grading and preparing the site for site structures, building pads, and landscaped areas.
- C. Finish grading .

PART 2 PRODUCTS

2.01 MATERIALS

- A. Topsoil: See Section 31 23 23.
- B. Other Fill Materials: See Section 31 23 23.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that survey bench mark and intended elevations for the Work are as indicated.

3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Stake and flag locations of known utilities.
- C. Locate, identify, and protect from damage above- and below-grade utilities to remain.
 - 1. Contractor shall utilize the Minnesota Gopher State One Call, 1-800-252-1166 for locating and marking of all utility within the work area prior to any excavation on the project site.
- D. Notify utility company to remove and relocate utilities.
- E. Protect site features to remain, including but not limited to bench marks, survey control points, existing structures, fences, sidewalks, and paving, from damage by grading equipment and vehicular traffic.
- F. Protect trees to remain by providing substantial fencing around entire tree at the outer tips of its branches; no grading is to be performed inside this line.
- G. Protect plants, lawns, and other features to remain as a portion of final landscaping.

3.03 ROUGH GRADING

- A. Remove all unsuitable soils (topsoil, soils with trace organics, wet or otherwise disturbed soils) from the pavement areas. Refer to Geotechnical Report for the extent and depth of unsuitable soils and to Section 31 2316 - Excavation for unsuitable soil removal in specific areas.
- B. Remove topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials.
- C. Do not remove topsoil when wet.
- D. Do not remove wet subsoil, unless it is subsequently processed to obtain optimum moisture content.
- E. When excavating through roots, perform work by hand and cut roots with sharp axe.
- F. See Section 31 23 23 for filling procedures.
- G. Benching Slopes: Horizontally bench existing slopes greater than 1:4 to key fill material to slope for firm bearing.
- H. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.

3.04 SOIL REMOVAL AND STOCKPILING

- A. Stockpile topsoil to be re-used on site; remove remainder from site.
- B. See Section 31 2316 for subsoil stockpiling and disposal.

3.05 FINISH GRADING

- A. Before Finish Grading:
 - 1. Verify building and trench backfilling have been inspected.
 - 2. Verify subgrade has been contoured and compacted.
- B. Remove debris, roots, branches, stones, in excess of 1/2 inch in size. Remove soil contaminated with petroleum products from construction activities.
- C. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 8 inches.
- D. Place topsoil in areas indicated.
- E. Place topsoil to thickness indicated.
- F. Place topsoil during dry weather.
- G. Remove roots, weeds, rocks, and foreign material while spreading.
- H. Near plants spread topsoil manually to prevent damage.
- I. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.
- J. Lightly compact placed topsoil.

3.06 TOLERANCES

- A. Top Surface of Subgrade: Plus or minus 0.10 foot (1-3/16 inches) from required elevation.
- B. Top Surface of Finish Grade: Plus or minus 0.04 foot (1/2 inch).

3.07 REPAIR AND RESTORATION

- A. Existing Facilities, Utilities, and Site Features to Remain: If damaged due to this work, repair or replace to original condition.
- B. Trees to Remain: If damaged due to this work, trim broken branches and repair bark wounds; if root damage has occurred, obtain instructions from Architect as to remedy.
- C. Other Existing Vegetation to Remain: If damaged due to this work, replace with vegetation of equivalent species and size.

3.08 FIELD QUALITY CONTROL

- A. See Section 31 23 23 for compaction density testing.

3.09 CLEANING

- A. Remove unused stockpiled topsoil and subsoil. Grade stockpile area to prevent standing water.
- B. Leave site clean and raked, ready to receive landscaping.

END OF SECTION

SECTION 31 23 16
EXCAVATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Excavating for paving and site structures.
- B. Protection of existing built elements and adjacent areas.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that survey bench mark and intended elevations for the work are as indicated.

3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. See Section 31 22 00 for additional requirements.

3.03 EXCAVATING

- A. Excavate to elevations and dimensions required by the drawings and as necessary to complete the work.
- B. Excavate to accommodate new structures and construction operations.
- C. Notify Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- D. Slope banks of excavations deeper than 3 feet to angle of repose or less until shored.
- E. Do not interfere with 45 degree bearing splay of foundations.
- F. Cut utility trenches wide enough to allow inspection of installed utilities.
- G. Hand trim excavations. Remove loose matter.
- H. Correct areas that are over-excavated and load-bearing surfaces that are disturbed; see Section 31 23 23.
- I. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- J. Remove excavated material that is unsuitable for re-use from site.
- K. Stockpile excavated material to be re-used in area designated on site in accordance with Section 31 22 00.
- L. Remove excess excavated material from site.

3.04 COMMON EXCAVATION

- A. Material to be excavated that can be removed by hand shoveling, power shovel, bulldozer or other normal heavy equipment but not requiring the use of drills, and blasting shall be defined as common excavation. The contractor is responsible for all common excavation necessary to complete the work.

3.05 UNSUITABLE SOIL REMOVAL

- A. In all areas of fill remove all unsuitable soil (topsoil, soil with trace organics, soft or otherwise disturbed soils) prior to the placement of subsequent fill soils or foundations. Refer to the Geotechnical Report for the extent and depth of unsuitable soils.
 - 1. The contractor is responsible for all unsuitable soil removal necessary to complete the work.
 - 2. After all unsuitable soils are removed the Geotechnical Engineer shall observe the excavated surface to determine if all unsuitable soils have been removed and it is ready for subsequent fill soils or foundations. The Contractor shall coordinate with the Geotechnical Engineer for these observations.

3. Unauthorized over excavations by the Contractor shall be backfilled in accordance with Section 31 23 23, by the Contractor at no additional cost to the Owner.

3.06 EXCAVATED SOIL STOCKPILING, DISPOSAL AND REMOVAL

- A. See Section 31 22 00 for topsoil stockpiling and removal.
- B. Stockpile excavated subsoil to be re-used on site and protect from erosion, the remainder shall be removed from the site.

3.07 PROTECTION OF EXISTING BUILT ELEMENTS AND ADJACENT AREAS

- A. The Contractor is responsible for the protection of existing buildings, utilities, streets, etc. during construction and for design and installation of all necessary temporary bracing, shoring and underpinning to ensure such protection.
- B. Stability of Excavations: Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions, stability of material excavated or need to protect undermining of existing walks, streets and/ or utilities. Maintain sides and slopes of excavations in safe condition.
- C. Shoring and Bracing: Provide materials for shoring and bracing, such as soldier piles, sheet piling, uprights, stringers and cross-braces, in good serviceable condition. Establish requirements for shoring, trench shoring and bracing to comply with local codes and authorities having jurisdiction. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses. Remove temporary work when no longer required for overall project construction including building construction. Maintain existing roadway widths and surfaces at all locations unless indicated otherwise.
- D. Where sheeting/ shoring or other means is used to retain a vertical height of 3 feet or more (measured at face of sheeting/ shoring) it shall be designed by a licensed registered professional engineer in the State of Minnesota. Three copies of the design drawings for the sheeting/ shoring certified by said engineer shall be submitted to the Architect/ Engineer at least 10 days prior to installation. All sheeting/ shoring shall be designed and installed in a manner such that required construction clearances are maintained and such that no braces, supports or ties extend outward in front of the sheeting/ shoring face at locations where they may interfere with or impede the work. Upon completion of sheeting/ shoring installation and excavation/ rock removal and at appropriate intervals as the work progresses the Contractor shall have the Engineer responsible for the sheeting/ shoring design review the site and sheeting/ shoring installation work. Contractor shall make any corrections necessary to the sheeting/ shoring and excavated rock faces as determined necessary by the Engineers review. Upon completion of the review and any subsequent corrections Contractor shall then furnish to the Architect/ Engineer a signed statement from the licensed engineer whom performed the shoring design and reviewed the site attesting that the work has been reviewed and approved for conformance with his/ her design details and that it is in conformance with safe design codes and practices for excavations.
- E. Dewatering: Contractor is responsible for dewatering of site including all bailing and pumping necessary to keep all depressions, pits, trenches and other parts of the site and excavated areas free of water during the entire progress of the work. All dewatering operations shall pass through a sediment containment device prior to discharge from the site.

3.08 SUBGRADE PREPARATION

- A. Pavement: After unsuitable soils have been removed from proposed pavement areas, scarify and recompact subgrade to a depth of 12 inches.

3.09 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection and testing.
- B. Provide for visual inspection of load-bearing excavated surfaces before placement of foundations.

- C. Provide proof-rolling of excavated subgrade in pavement areas with a loaded tandem axle dump truck prior to placement of fill and/or pavement sub-base materials. Subgrade shall be approved by the Geotechnical Engineer prior to placement of fill and/or sub-base materials.

3.10 PROTECTION

- A. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.
- B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.
- C. Keep excavations free of water. Provide dewatering by approved means. Water pumped or otherwise discharged from the site during construction shall be directed towards sediment containing devices prior to discharge.

3.11 SUBGRADE APPROVAL/PROOF ROLLING

- A. Following excavation to the design subgrade elevations and scarify/recompaction of subgrade in all pavement areas, and prior to placement of any Base Course or other fill materials, the Contractor shall contact the Geotechnical Engineer to schedule inspection of the subgrade and observe proof rolling operations. Provide minimum of 24 hrs confirmed notice. All proof rolling shall be completed by the Contractor in the presence of the Geotechnical Engineer.
- B. To complete proof rolling, exposed subgrade areas shall be provided with a relatively smooth surface, suitable for observing soil reaction during proof rolling.
- C. Contractor shall schedule and provide a fully loaded double-axle dump truck for proof rolling. Loaded truck shall have a minimum gross operating weight of 20 tons. Test shall be conducted with "tag" or "pusher" axles retracted from the ground.
- D. Test rolling shall be accomplished in a series of traverses parallel to the centerline of the street, or parking area. The truck shall traverse the length of the street or parking areas once for each 12 feet of width. Additional passes along the traverse shall be completed as directed by the Geotechnical Engineer, to further define unsatisfactory subgrade.
- E. Soft areas, yielding areas, cracked areas or areas where rolling or wave action is observed shall be considered indicative of an unsatisfactory subgrade. Such areas shall be undercut as outlined in subsequent subsections of this specification.
- F. Once the subgrade has been proof rolled and approved, protect the soils from becoming saturated, frozen, or adversely altered.

END OF SECTION

SECTION 31 23 16.13

TRENCHING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Backfilling and compacting for utilities outside the building to connections to existing services.

1.02 REFERENCES

- A. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2014.
- B. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)); 2012.
- C. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.
- D. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth); 2005.
- E. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2005.

1.03 SUBMITTALS

- A. Samples: 10 lb sample of each type of fill; submit in air-tight containers to testing laboratory.
- B. Materials Sources: Submit name of imported materials source.
- C. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- D. Compaction Density Test Reports.

PART 2 PRODUCTS

2.01 FILL MATERIALS

- A. See Section 31 2323

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that survey bench marks and intended elevations for the work are as indicated.

3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. See Section 31 22 00 for additional requirements.

3.03 TRENCHING

- A. Notify Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- B. Conform to detail shown on the plans.
- C. Slope banks of excavations deeper than 3 feet to angle of repose or less until shored.
- D. Do not interfere with 45 degree bearing splay of foundations.
- E. Cut trenches wide enough to allow inspection of installed utilities.
- F. Hand trim excavations. Remove loose matter.
- G. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.
- H. Remove excavated material that is unsuitable for re-use from site.
- I. Stockpile excavated material to be re-used in area designated in Section 31 22 00.
- J. Remove or dispose of excess excavated material in accordance with Section 31 2316.

3.04 PREPARATION FOR UTILITY PLACEMENT

- A. See Section 31 2200 for additional requirements for dewatering.
- B. Cut out soft areas of subgrade or organic soils not capable of compaction in place, subexcavate organic or soft soils 24 inches and backfill with Granular Fill.
- C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- D. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation.

3.05 BACKFILLING

- A. Conform to the detail on the plans.
- B. See Section 31 23 23 Fill for filling requirements.
- C. Backfill to contours and elevations indicated using unfrozen materials.
- D. Fill up to subgrade elevations unless otherwise indicated.
- E. Employ a placement method that does not disturb or damage other work.
- F. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- G. Maintain optimum moisture content of fill materials to attain required compaction density.
- H. Granular Fill: Place and compact materials in equal continuous layers not exceeding 12 inches compacted depth.
- I. Slope grade away from building minimum 2 inches in 10 ft, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- J. Correct areas that are over-excavated.
 - 1. Thrust bearing surfaces: Fill with concrete.
 - 2. Other areas: Use Granular Fill, flush to required elevation, compacted to minimum 95 percent of maximum dry density.
- K. Compaction Density Unless Otherwise Specified or Indicated:
 - 1. Under paving: 100 percent of maximum dry density within 3ft of subgrade elevations and 95 percent of maximum dry density more than 3ft below subgrade elevations.
 - 2. At other locations: 95 percent of maximum dry density.

3.06 BEDDING AND FILL AT SPECIFIC LOCATIONS

- A. Utility Piping and Conduits and any other buried utilities:
 - 1. Conform to the detail on the plans.
 - 2. Bedding: Use Fill Type Aggregate Bedding.
 - 3. Cover with Fill Type Granular Fill.
 - 4. Fill up to subgrade elevation.
 - 5. See Section 31 23 16.13, 3.05.K for compaction requirements.
- B. Over Subdrainage Piping at Foundation Perimeter and Under Slabs:
 - 1. Drainage fill and geotextile fabric: Section 33 46 00 Subdrainage.

3.07 TOLERANCES

- A. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.
- B. Top Surface of Backfilling Under Paved Areas: Plus or minus 1 inch from required elevations.

3.08 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection and testing.
- B. Perform compaction density testing on compacted fill in accordance with ASTM D2922 or ASTM D3017.
- C. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D698 ("standard Proctor").

- D. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- E. Frequency of Tests: 1 test for every 100 linear feet of trench per 3 ft of depth, or fraction thereof.

3.09 PROTECTION

- A. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.
- B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.
- C. Keep excavations free of water. Provide dewatering by approved means. Water pumped or otherwise discharged from the site during construction shall be directed towards sediment containing devices prior to discharge.

3.10 CLEANING

- A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

END OF SECTION

SECTION 31 23 23

FILL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Filling, backfilling, and compacting for paving and site structures.
- B. Backfilling and compacting for utilities outside the building to connections to existing services.
- C. Filling holes, pits, and excavations generated as a result of removal (demolition) operations.

1.02 REFERENCE STANDARDS

- A. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2014.
- B. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)); 2012.
- C. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.
- D. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2010.

1.03 SUBMITTALS

- A. Samples: 10 lb sample of each type of fill; submit in air-tight containers to testing laboratory.
- B. Materials Sources: Submit name of imported materials source.
- C. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- D. Compaction Density Test Reports.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. When necessary, store materials on site in advance of need.

PART 2 PRODUCTS

2.01 FILL MATERIALS

- A. General Fill: Non-organic select compactible salvaged Subsoil excavated on-site and/or imported MNDOT 2105.2B Common Borrow. When on-site soils are exhausted the Contractor shall provide imported MNDOT Common Borrow as necessary to complete the work. General Fill excavated from on-site shall meet the following requirements.
 - 1. Graded.
 - 2. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
 - 3. General Fill salvaged from on-site shall be selected, separated and protected to manage the soils moisture content. The Contractor shall dry or moisture condition the soil as necessary in order to achieve the required compaction densities. If drying the soils is not feasible due to weather or the season, the Contractor shall provide Common Borrow to balance the site at no additional cost to the Owner.
 - 4. If salvaged subsoil from on-site is not compactible due to moisture content, or for other reasons, the Contractor shall remove the uncompactable soils and replace with MNDOT 2105.2B Common Borrow.
 - 5. Less than 20% of particles by weight passing a #200 sieve.
- B. Structural Fill (NFS): Imported borrow.
 - 1. Graded in accordance with ASTM C 136, within the following limits:
 - a. 1 inch sieve: 100 percent passing.
 - b. No. 4 sieve: 60 to 100 percent passing.
 - c. No. 40 sieve: 0 to 50 percent passing.
 - d. No. 200 sieve: 0 to 5 percent passing.

- C. Granular Fill (NFS): conforming to MNDOT 3149.2B Select Granular Borrow, modified so that of the portion passing the 1 inch sieve, not more than 7% by weight shall pass the No. 200 sieve, and no salvaged bituminous or concrete materials are allowed. Maximum particle size shall not exceed 2 inches and no less than 71% shall pass the 3/4 inch sieve.
- D. Topsoil: Friable loam; imported borrow. Topsoil excavated and salvaged on-site may be used on site provided the topsoil conforms to items 1-5 below. Contractor shall import topsoil to the site if insufficient amounts of salvaged onsite topsoil are available.
 - 1. Select.
 - 2. Graded.
 - 3. Free of roots, rocks larger than 1/2 inch, subsoil, debris, large weeds and foreign matter.
 - 4. Acidity range (pH) of 5.5 to 7.5.
 - 5. Containing a minimum of 4 percent and a maximum of 25 percent inorganic matter.
- E. Drainage Fill: Conforming to MNDOT 3149.2H Coarse Filter Aggregate.
- F. River Rock: 1.5"-2" washed rounded river rock.

2.02 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for testing and analysis of soil material.
- B. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.
- C. If tests indicate materials do not meet specified requirements, change material and retest.
- D. Provide materials of each type from same source throughout the Work. If source must change then retest at no cost to the Owner.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that survey bench marks and intended elevations for the Work are as indicated.
- B. Identify required lines, levels, contours, and datum locations.
- C. See Section 31 22 00 for additional requirements.
- D. Verify subdrainage, foundation insulation, dampproofing, and/or waterproofing installation has been inspected.
- E. Verify subgrade has been approved by the geotechnical engineer. See Section 31 2316.

3.02 PREPARATION

- A. Scarify and proof roll subgrade surface to a depth of 6 inches to identify soft spots.
- B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with Granular Fill.
- C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- D. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.

3.03 FILLING

- A. Fill to contours and elevations indicated using unfrozen materials.
- B. Employ a placement method that does not disturb or damage other work.
- C. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- D. Bench fill into the native soils on all sloped surface 5 horizontal to 1 vertical or steeper. Place fills in uniform horizontal lifts not exceeding 6-inch thickness.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. Slope grade away from building minimum 2 inches in 10 ft, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- G. Correct areas that are over-excavated.

- H. Fill Placement in Specified Areas:
 - 1. Under building area: Use Structural Fill (NFS), flush to required elevation, compacted to 95 percent maximum dry density.
 - 2. Under paving: Use Structural Fill (NFS), flush to required elevation, compacted to 100 percent of maximum dry density within 3 feet of subgrade elevations and 95 percent if more than 3 feet below subgrade elevations.
 - 3. Other areas: Use general fill, flush to required elevation, compacted to minimum 95 percent of maximum dry density.
- I. Compaction Density Unless Otherwise Specified or Indicated:
 - 1. Under paving: Use Structural Fill (NFS), compacted to 100 percent of maximum dry density within 3 feet of subgrade elevations and 95 percent if more than 3 feet below subgrade elevations.
 - 2. At other locations: Use general fill, compacted to 95 percent of maximum dry density.
- J. Reshape and re-compact fills subjected to vehicular traffic.

3.04 TOLERANCES

- A. Top Surface of General Filling: Plus or minus 1 inch from required elevations.
- B. Top Surface of Filling Under Paved Areas: Plus or minus 1 inch from required elevations.

3.05 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection and testing.
- B. Perform gradation testing on fill materials in accordance with ASTM C 136.
 - 1. If tests indicate work does not meet specified requirements, remove work, replace and retest.
 - 2. Frequency of Tests: Provide the minimum number of tests as follows, one test minimum.
 - a. Granular Borrow: One test at/of fill source and one test for every 1000 cu. yds. of fill placed on site.
 - b. Granular Fill, Structural Fill, Sand, Drainage Fill, aggregate Bedding: One test at/of fill source and one test for every 500 cu. yds. of fill placed on site.
- C. Perform compaction density testing on compacted fill in accordance with ASTM D2922 and ASTM D3017.
 - 1. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D698 ("standard Proctor").
 - 2. If tests indicate work does not meet specified requirements, remove work, replace and retest.
 - 3. Frequency of Tests: Provide the minimum number of tests as follows, one test minimum. .
 - a. Slabs-On-Grade: One test for every 1000 sq. ft. per 1 ft of depth of material placed or fraction thereof.
 - b. Exterior Paving and Similar Construction: One test for every 2500 sq. ft. per 1 ft of depth of material placed or fraction thereof.
 - c. Over Buried Utility Piping, and Conduits in Trenches: See Section 31 23 16.13.
 - d. Vegetated Areas: One test for every 10,000 sq. ft. per 1ft of depth of material placed or fraction thereof.
- D. Proof roll compacted fill at surfaces that will be under slabs-on-grade and paving.

3.06 CLEANING

- A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

END OF SECTION

SECTION 31 32 19

GEOTEXTILE SOIL STABILIZATION AND LAYER SEPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This work shall consist of placing geotextile below the fill material at the location(s) shown in the Plan.
- B. The purpose of the geotextile layer is to provide separation between the fill and underlying softer soils, to prevent mixing, to provide stability during compaction, to provide some reinforcement and to minimize differential movement.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Geotextile Fabric: Non-woven separator/strengthening material meeting the requirements of MNDOT 3733 Type V.

PART 3 EXECUTION

3.01 PREPARATION

- A. The prepared surface shall be relatively smooth and free of stones, sticks, or other debris or irregularities that would tend to puncture or tear the geotextile.
- B. Unless otherwise directed or approved by the Engineer, the geotextile shall be placed with the highest strength direction (usually the "machine" or roll direction) oriented in the direction of the greatest expected field stress (this will usually be at right angles to the centerline of the construction).

3.02 INSTALLATION

- A. If multiple pieces of geotextile are required, adjacent strips shall be field or factory sewn. All seams shall be sewn using a "double spool" machine capable of sewing a Federal Type 401 locking stitch. Seam type (flat, "J", or butterfly), thread strength 25 lbs. minimum, number of rows of stitching (1 or 2) and stitches per inch (typically 5-7) shall be consistent with achieving the required seam strength and as recommended by the geotextile manufacturer.
- B. The geotextile shall be adequately secured so that it is not displaced during subsequent construction. No traffic or construction equipment will be permitted to operate directly on the geotextile. Any damaged geotextile shall be repaired to the satisfaction of the Engineer by patching and sewing, or when appropriate, a 36 inch overlap on all sides without sewing.
- C. Fill shall be placed onto the fabric in uniform lifts as required by the applicable specification and approved by the Engineer, but in no case shall lifts in excess of 18 inches be used, unless required to bring the fill above water level or provide stability. Fill material shall be as shown in the Plan. For placement underwater and for 2 feet above water level, granular materials shall be used unless otherwise provided in the Plans or approved by the Engineer.

END OF SECTION

SECTION 31 66 15
HELICAL PIERS AND ANCHORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Furnishing and installation of Helical Piers and Helical Anchors.
- B. Design of Helical Piers and Helical Anchors.

1.02 RELATED SECTIONS

- A. Section 31 1000 - Site Clearing.
- B. Section 31 2200 - Grading.
- C. Section 31 2316 - Excavation.
- D. Section 31 2323 - Fill.

1.03 UNIT PRICES - MEASUREMENT AND PAYMENT

- A. The base bid shall include all necessary costs for the installation of Helical Piers and Helical Anchors as shown on the plans. See Section 01 2200 - Unit Prices, for additional unit price requirements.
- B. Designed Helical Piers and Helical Anchors:
 - 1. Design Pier and Anchor Quantity: Determined by the quantity of Piers and Anchors indicated in the Contract Documents.
 - 2. Design Pier and Anchor Length: By the linear foot measured from assumed Pier and Anchor end to cut-off elevation as indicated. Base bid shall be the lengths indicated in the Contract Documents.
- C. Actual Helical Piers and Helical Anchors:
 - 1. Actual Pier and Anchor Quantity: Determined by the quantity of Piers and Anchors identified in the Project Record Documents.
 - 2. Actual Pier and Anchor Length: Determined by length of Piers and Anchors identified in the Project Record Documents, measured from actual Pier and Anchor end to cut-off elevation.

1.04 REFERENCES

- A. ASTM A 36 / A 36M - Structural Steel; 2005
- B. ASTM A 123 / A 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2002
- C. ASTM A 153 / A 153M - Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware; 2005
- D. ASTM A 500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2007
- E. ASTM D 1143 - Standard Test Method for Individual Piles Under Static Axial Compressive Load; 2007
- F. ASTM D 3689 - Standard Test Method for Individual Piles Under Static Axial Tensile Load; 2007
- G. ASTM D 3966 - Standard Test Methods for Deep Foundations Under Lateral Load; 2007
- H. ANSI/ASME - Standard B18.2.1, Square and Hex Bolts and Screws, Inch Series; 1996
- I. AWS D1.1 / D1.1M - Structural Welding Code - Steel; American Welding Society; 2006 and Errata.
- J. Occupational Safety and Health Administration (OSHA) Excavation Safety Guidelines; 2008

1.05 SUBMITTALS

- A. The Contractor shall prepare and submit to the Architect/Engineer for review and approval, Shop Drawings for the Helical Piers and Helical Anchors intended for use on the project at least

14 calendar days prior to planned start of installation. The Shop Drawings shall include the following:

1. Helical Pier and Helical Anchor product identification number(s) and designation(s) for each type and size pile.
 2. Maximum allowable mechanical compression and tensile strength of the Helical Piers and Helical Anchors.
 3. Number of Helical Piers and Helical Anchors and respective design allowable capacities from the Drawings.
 4. Planned installation depth and the number of lead and extension sections.
 5. Helical configuration (number and diameter of helical bearing plates).
 6. Manufacturer's recommended capacity to installation torque ratio.
 7. Minimum final installation torque(s).
 8. Product identification numbers and designation for all Bracket Assemblies and number and size of connection bolts or concrete reinforcing steel detail.
 9. Corrosion protection coating on Helical Piers, Helical Anchors, and Bracket Assemblies.
- B. Contractor shall submit to the Architect/Engineer certified calculations from a Professional Engineer licensed in the state of the project location showing Helical Pier and Helical Anchor design allowable capacities. Calculations shall include, but not be limited to, considerations for downdrag (if any), corrosion, expansive soils (if any), minimum installation depth, buckling, soil bearing and pullout capacity, and lateral resistance (if required).
- C. The Contractor shall submit to the Architect/Engineer calibration information certified by an independent testing agency for the torque measurement device to be used on the project. Calibration information shall have been obtained within the year of the date submitted. Calibration information shall include, but is not limited to, the name of the testing agency, identification number or serial number of the device calibrated and the date of calibration.
- D. Helical Pier, Helical Anchor, and Bracket Assembly product warranty information.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: At least five (5) years experience in the design and manufacture of Helical Piers and Helical Anchors, and current ICC-ES /ICBO product evaluation report.
- B. Installer Qualifications: Minimum of five (5) projects in the last five (5) years, and be able to provide project name, number and type of Helical Piers or Helical Anchors installed, project location, and client contact information, a list of installation and testing equipment, and a detailed description of method of installation and load testing (if testing was required).
- C. Designer Qualifications: Helical Piers and Helical Anchors designed under the direct supervision of a Professional Engineer licensed in the State of the Project.

1.07 SHIPPING, STORAGE AND HANDLING

- A. All Helical Pier, Helical Anchor, and Bracket Assemblies shall be free of structural defects and protected from damage during shipping and delivery. Helical Piers, Helical Anchors, and Bracket Assemblies should be stored on wood pallets or supports to keep them from contacting the ground, and under protective cover from weather. Damage to materials shall be cause for rejection.

1.08 PRE-INSTALLATION MEETING

- A. Convene one week before starting work of this section.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Chance Civil Construction; 210 N. Allen, Centralia, MO 65240, (573) 682-8414
- B. Earth Contact Products; 15612 South Keeler Terrace, Olathe, KS 66062, (913) 393-0007
- C. Magnum Piering; 6083 Schumacher Park Drive, West Chester, OH 45069, (800) 822-7437
- D. Foundation Support Works; 12330 Cary Circle, Omaha, NE 6812/, (800) 281-8545

2.02 HELICAL PIERS, HELICAL ANCHORS, AND BRACKET ASSEMBLIES

- A. Unless noted otherwise, it is the Contractor's responsibility to select the appropriate size and type of Helical Piers, Helical Anchors, and Bracket Assemblies to support the design allowable loads shown on the Drawings. The size and number of helical bearing plates must be such that the Helical Piers and Helical Anchors achieve the appropriate torque capacity in the soils at the site within the minimum and maximum length requirements. Failure to achieve proper torque and capacity shall result in Contractor replacing Helical Piers and Helical Anchors, at Contractor's expense, as appropriate to support the required loads. All material replacements shall be acceptable to the Architect/Engineer.
- B. All Helical Piers and Helical Anchors shall be manufactured to the following criteria:
 - 1. Corrosion Protection: Helical Piers, Helical Anchors, and Bracket Assemblies shall be protected from corrosion by hot-dip galvanizing per ASTM A 123 or A 153, as applicable.
 - 2. Shaft Connections: The Helical Pier and Helical Anchor shaft connections shall be in-line, straight and rigid and shall have a maximum tolerable slack of 1/16-inch. Shaft connections shall have flexural strength at least as great as the shaft itself.
 - 3. Bolts: Helical Pier and Helical Anchor shaft connections shall be made via bolted connection, capable of developing maximum installation torque with a safety factor of not less than 2.0. All connection bolts shall be hot-dip galvanized.
- C. Helical Piers shall be fitted with a manufactured new construction or repair Bracket assembly rated for the design allowable loads shown on the Drawings. Helical Anchors shall be fitted with a manufactured adjustable Bracket Assembly that facilitates both post-tensioning and proof load testing.

2.03 WELDMENTS

- A. All welded connections shall conform to the requirements of the American Welding Society D1.1.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Contractor shall locate all utilities and structures above and underground in the area of the Work. Contractor shall pot hole to determine the exact location of underground utilities and buried structures within three (3) feet of a Helical Pier or Helical Anchor installation. Contractor is responsible for protection of utilities and structures shown on the Drawings. Costs of avoiding, relocating, or repair of utilities not shown on Drawings shall be paid by the Owner as extra work.
- B. Contractor shall review the Contract Documents and soil borings to determine subsurface conditions for sizing and installation of Helical Piers and Helical Anchors. In addition, Contractor shall make a site visit to observe conditions prior to the start of Work.
- C. Contractor shall notify Architect/Engineer of any condition that would affect proper installation of Helical Piers and Helical Anchors immediately after the condition is revealed. Contractor shall halt Work until the matter can be resolved upon mutual satisfaction of Contractor and Architect/Engineer. Costs associated with construction delays, product substitutions, pier or anchor relocations, or other related costs resulting from an unforeseen condition, and if the result of the unforeseen condition could not be inferred by a reasonable Contractor from the Drawings and Construction Documents, shall be the responsibility of the Owner.
- D. If excavation is required for proper installation of Helical Piers and Helical Anchors, Contractor shall make safe excavations in accordance with OSHA standards. All excavations greater than 20 feet in depth or not in strict accordance with OSHA standard details shall be designed by a registered design professional specializing in the design of excavations and shoring. The costs of all excavations, shoring, and related design shall be born by the Contractor unless noted otherwise in the Contract.
- E. Contractor shall notify Architect/Engineer at least 48 hours prior to installation of Helical Piers or Helical Anchors to schedule quality assurance observations required on the Drawings.

3.02 INSTALLATION EQUIPMENT

- A. Torque Motor: Helical Piers and Helical Anchors should be installed with high torque, low speed torque motors, which allow the helical plates to advance with minimal soil disturbance. The torque motor shall be hydraulic power driven with clockwise and counter-clockwise rotation capability. The torque motor shall be adjustable with respect to revolutions per minute during installation. Percussion drilling equipment shall not be permitted. The torque motor shall have torque capacity at least 25 percent greater than the minimum final installation torque required for the project.
- B. Installation Equipment: The installation equipment shall be capable of applying adequate crowd and torque simultaneously to ensure normal advancement of the Helical Piers and Helical Anchors. The equipment shall be capable of maintaining proper alignment and position.
- C. Torque Indicator: A torque indicator shall be used to measure installation torque during installation. The torque indicator can be an integral part of the installation equipment or externally mounted in-line with the installation tooling. The torque indicator shall be capable of torque measurements with a sensitivity of 500 ft-lb or less. Torque indicators shall be calibrated prior to start of Work. Torque indicators shall be calibrated either on-site or at an appropriately equipped test facility. Indicators that measure torque as a function of hydraulic pressure shall be calibrated at normal operating temperatures. Torque indicators shall be re-calibrated if, in the opinion of the COR, reasonable doubt exists as to the accuracy of the torque measurements.

3.03 INSTALLATION PROCEDURES

- A. Unless shown on the Drawings, the number and size of helical bearing plates shall be determined by the Contractor in order to achieve the required torque and tensile/bearing capacity for the soil conditions at the site. However, the ratio of design allowable capacity to the total area of the helical bearing plates shall not exceed the Maximum Plausible Bearing Capacity of the bearing stratum.
- B. Connect the lead section to the Torque Motor using the Drive Tool and Connection Pin. Position and align the Lead Section at the location and to the inclination shown on the Drawings. Advance the Lead Section and continue to add Extension Sections to achieve the Termination Criteria. All sections shall be advanced into the soil in a smooth, continuous manner at a rate of rotation not to exceed 30 revolutions per minute. Snug tight all coupling bolts.
- C. Constant axial force (crowd) shall be applied while rotating Helical Piers or Helical Anchors into the ground. The crowd applied shall be sufficient to ensure that the Helical Pier or Helical Anchor advances into the ground a distance equal to at least 80% of the blade pitch per revolution during normal advancement.
- D. The torsional strength rating of the Helical Pier or Helical Anchor shall not be exceeded during installation according to manufacturer's torsional strength ratings.
- E. Bolt hole elongation due to torsion of the shaft of a Helical Anchor at the drive tool shall be limited to ¼ inch. Helical Anchors with bolt hole damage exceeding this criterion shall be cause for rejection.
- F. When the Termination Criteria of a Helical Pier or Helical Anchor is obtained, the Contractor shall adjust the elevation of the top end of the shaft to the elevation shown on the Drawings or as required. This adjustment may consist of cutting off the top of the shaft and drilling new holes to facilitate installation of Bracket Assemblies to the orientation shown on the Drawings. Or, installation may need to continue until the final elevation and orientation of the pre-drilled bolt hole is in alignment. The Contractor shall not reverse the direction of torque and back out the Helical Pier or Helical Anchor to achieve final elevation or orientation.
- G. The Contractor shall install Bracket Assemblies in accordance with details shown on the Drawings.
- H. All Helical Pier and Helical Anchor components including the shaft and Bracket Assembly shall be isolated from making a direct electrical contact with any concrete reinforcing bars or other non-galvanized metal objects because these contacts may alter corrosion rates.

- I. After installation, Helical Anchors shall be pre-tensioned if indicated on the Drawings.

3.04 TERMINATION CRITERIA

- A. Helical Piers and Helical Anchors shall be advanced until all of the following criteria are satisfied:
 1. Design torque is achieved. The final installation torque is equal to the allowable capacity shown on the Drawings times a factor of safety of 2.0 divided by the manufacturer's capacity to torque ratio.
 2. Minimum depth is obtained. The minimum depth shall be as determined by the Contractor's Engineer, that which corresponds to the planned bearing stratum, or the depth at which the final installation torque is measured, whichever is greater. For Helical Anchors, advancement shall continue while maintaining or exceeding the required final installation torque for a distance of at least three (3) feet without augering.
- B. If the torsional strength rating of the Helical Pier or Helical Anchor has been reached, or if the maximum torque of the installation equipment has been reached, or if augering occurs prior to achieving the minimum depth required, the Contractor shall have the following options:
 1. Terminate the installation at the depth obtained subject to the review and acceptance of the Architect/Engineer.
 2. Remove the Helical Pier or Helical Anchor and install a new one with fewer and/or smaller diameter helical bearing plates or with dual cutting edge helical bearing plates. The new helical configuration shall be subject to review and acceptance of the Architect/Engineer.
 3. Remove the Helical Pier or Helical Anchor and pre-drill a 4-inch diameter pilot hole in the same location, and reinstall the Helical Pier or Helical Anchor.
 4. If the obstruction is shallow, remove the Helical Pier or Helical Anchor and remove the obstruction by surface excavation. Backfill and compact the resulting excavation, and reinstall the Helical Pier or Helical Anchor.
 5. Remove the Helical Pier or Helical Anchor and relocate 1 foot to either side of the installation location subject to the review and acceptance of the Architect/Engineer.
 6. Reverse the direction of torque, back-out the Helical Pier or Helical Anchor a distance of 1 to 2 feet and attempt to reinstall by decreasing crowd and Augering through the obstruction.
 7. Remove the Helical Pier or Helical Anchor and sever the uppermost helical bearing plate from the Lead Section if more than one helical bearing plate is in use. Reinstall the anchor or pier with revised helical bearing plate configuration.
- C. If the final installation torque is not achieved within the estimated length, the Contractor shall have the following options:
 1. Until the Maximum Length is achieved (if any), install the Helical Pier or Helical Anchor deeper using additional Extension Sections.
 2. Remove the Helical Pier or Helical Anchor and install a new one with additional and/or larger diameter helical bearing plates.
 3. Decrease the rated load capacity of the Helical Pier or Helical Anchor and install additional Helical Piers or Helical Anchors. The rated capacity and additional unit location shall be subject to the review and acceptance of the Architect/Engineer.

3.05 ALLOWABLE TOLERANCES

- A. Helical Piers, Helical Anchors, and Bracket Assemblies shall be installed as close to the specified installation and orientation angles as possible. Allowable installation tolerances are as follows:
 1. Maximum variation of installation angle: +/- 5 percent
 2. Maximum variation from vertical for plumb piers or anchors: 1" in 10'-0"
 3. Maximum variation from top of pier or anchor elevation noted on Drawings: 1"
 4. Maximum variation of pier or anchor location: 3"

3.06 FIELD QUALITY CONTROL

- A. Field inspection shall be performed in accordance with Section 01 4000.

- B. The Contractor shall provide the Architect/Engineer copies of installation records within 48 hours after each installation is completed. These installation records shall include, but are not limited to, the following information:
1. Name of project and Contractor.
 2. Name of Contractor's supervisor during installation.
 3. Date and time of installation.
 4. Name and model of installation equipment.
 5. Type of torque indicator used.
 6. Location of Helical Pier or Helical Anchor by grid location, diagram, or assigned identification number.
 7. Type and configuration of Lead Section with length of shaft and number and size of helical bearing plates.
 8. Type and configuration of Extension Sections with length and number and size of helical bearing plates, if any.
 9. Installation duration and observations.
 10. Total length installed.
 11. Final elevation of top of shaft and cut-off length, if any.
 12. Final plumbness or inclination of shaft.
 13. Installation torque at minimum three-foot depth intervals.
 14. Final installation torque.
 15. Comments pertaining to interruptions, obstructions, or other relevant information.
 16. Design allowable capacity.

3.07 CLEAN UP

- A. Following installation of pile terminations, all equipment shall be removed from the site. Any disturbed soils in the area shall be restored to the dimensions and conditions specified by the Architect/Engineer.

END OF SECTION

SECTION 32 11 23
AGGREGATE BASE COURSES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aggregate base course.

1.02 REFERENCE STANDARDS

- A. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2014.
- B. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)); 2012.
- C. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.
- D. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2005.
- E. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2010.

1.03 SUBMITTALS

- A. Samples: 10 lb sample of each type of aggregate; submit in air-tight containers to testing laboratory.
- B. Materials Sources: Submit name of imported materials source.
- C. Aggregate Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- D. Compaction Density Test Reports.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Aggregate Base: conforming to MNDOT 3138 Aggregate Base, Class 5.

2.02 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for testing and analysis of aggregate materials.
- B. If tests indicate materials do not meet specified requirements, change material and retest.
- C. Provide materials of each type from same source throughout the Work. If sources must change then retest at no cost to the Owner.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that survey bench marks and intended elevations for the work are as indicated.
- B. Verify substrate has been inspected, gradients and elevations are correct, and is dry.

3.02 PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.
- B. Do not place aggregate on soft, muddy, or frozen surfaces.

3.03 INSTALLATION

- A. Under Bituminous Concrete Paving:
 - 1. Place Aggregate Base to a total compacted thickness indicated on the plans.
 - 2. Compact to 100 percent of maximum dry density.
- B. Under Portland Cement Concrete Paving:

1. Place Aggregate Base to a total compacted thickness indicated on the plans.
 - a. Compact to 100 percent of maximum dry density.
- C. Place aggregate in maximum 8 inch lifts and roller compact to specified density.
- D. Level and contour surfaces to elevations and gradients indicated.
- E. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.
- F. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.04 TOLERANCES

- A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.
- B. Scheduled Compacted Thickness: Within 1/4 inch.
- C. Variation From Design Elevation: Within 1/2 inch.

3.05 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection and testing.
- B. Perform gradation testing on fill materials in accordance with ASTM C 136.
 1. If tests indicate material does not meet specified requirements, remove, replace and retest.
 2. Frequency of Tests: Provide the minimum number of tests as follows, one test minimum.
 - a. Aggregate Base: One test at/of fill source and one test for every 1000 cu. yds. of fill placed on site.
- C. Compaction density testing will be performed on compacted aggregate base course in accordance with ASTM D2922 or ASTM D3017.
 1. Results will be evaluated in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D698 ("standard Proctor").
 2. If tests indicate work does not meet specified requirements, remove work, replace and retest.
 3. Frequency of Tests: Provide the minimum number of tests as follows, one test minimum.
 - a. Exterior Paving and Similar Construction: One test for every 2500 sq. ft. per 1ft of depth of material placed or fraction thereof.
- D. Proof roll compacted aggregate at surfaces that will be under paving. Contractor shall obtain the approval of the geotechnical engineer regarding the suitability of the compacted aggregate surfacing layer prior to the placement of bituminous or concrete surfacing.

3.06 CLEANING

- A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

END OF SECTION

SECTION 32 12 16
ASPHALT PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Double course bituminous concrete paving.

1.02 SUBMITTALS

- A. Provide bituminous mix design data.

1.03 QUALITY ASSURANCE

- A. Perform Work in accordance with MNDOT 2360 except as modified below..

1.04 FIELD CONDITIONS

- A. Do not place asphalt when ambient air or base surface temperature is less than 32 degrees F, or surface is wet or frozen.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Tack Coat: Bituminous Tack Coat according to MNDOT 2357.

2.02 ASPHALT PAVING MIXES AND MIX DESIGN

- A. Wearing Course: conform to MNDOT Section 2360 mixture type Wearing Course SPWEB340B.

2.03 SOURCE QUALITY CONTROL

- A. Test mix design and samples in accordance with MNDOT 2360. All testing shall be performed by the Contractor.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that compacted Aggregate Base is dry and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.

3.02 PREPARATION - TACK COAT

- A. Apply tack coat in accordance with manufacturer's instructions and MNDOT 2357.
- B. Apply tack coat to contact surfaces of curbs, gutters and existing pavement match points..

3.03 PLACING ASPHALT PAVEMENT - DOUBLE COURSE

- A. Install Work in accordance with MNDOT 2360.
- B. Place asphalt binder course within 24 hours of applying primer or tack coat.
- C. Place base course to thickness indicated on drawings.
- D. Place wear course to thickness indicated on drawings.
- E. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.
- F. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

3.04 TOLERANCES

- A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.
- B. Compacted Thickness: Within 1/4 inch of specified or indicated thickness.
- C. Variation from True Elevation: Within 1/2 inch.

3.05 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for quality control.

- B. Provide field inspection and testing. Take samples and perform tests in accordance with MNDOT 2360. All testing shall be performed by the Contractor.

3.06 PROTECTION

- A. Immediately after placement, protect pavement from mechanical injury for 1 days or until surface temperature is less than 140 degrees F.

END OF SECTION

SECTION 32 13 13
CONCRETE PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete sidewalks and curb and gutters.

1.02 REFERENCE STANDARDS

- A. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International; 2000.
- B. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2013.
- C. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2015a.
- D. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2015.
- E. ASTM C150/C150M - Standard Specification for Portland Cement; 2015.
- F. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2014.
- G. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on joint filler and curing compound.

1.04 QUALITY ASSURANCE

- A. Concrete Pavement shall conform to MNDOT 2301.
- B. Concrete Sidewalks shall conform to MNDOT 2521.
- C. Concrete Curb & Gutter shall conform to MNDOT 2531.
- D. Except as modified below

PART 2 PRODUCTS

2.01 FORM MATERIALS

- A. See Section 03 1000

2.02 CONCRETE MATERIALS

- A. Concrete Materials: conforming to MNDOT 2461.
- B. Exposed Aggregate Concrete: As specified in Section 03 3523.

2.03 ACCESSORIES

- A. Curing Compound: White Membrane Curing Compound, conforming to ASTM C 309, Type 2.

2.04 CONCRETE MIX DESIGN

- A. Concrete Mix:
 - 1. Concrete Paving: conforming to MNDOT 2461, Mix No. 3A32.
 - 2. Concrete Sidewalks: conforming to MNDOT 2461, Mix No. 3A32.
 - 3. Concrete Curb & Gutter: conforming to MNDOT 2461, Mix No. 3A32 for manual placement and Mix No. 3A22 for slip-form placement.

2.05 MIXING

- A. Transit Mixers: Comply with ASTM C94/C94M.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify compacted Aggregate Base is acceptable and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.

3.02 PREPARATION

- A. Moisten base to minimize absorption of water from fresh concrete.
- B. Coat surfaces of manhole frames with oil to prevent bond with concrete pavement.

3.03 FORMING

- A. Place and secure forms to correct location, dimension, profile, and gradient.
- B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.04 PLACING CONCRETE

- A. Place concrete paving in accordance with MNDOT 2301.
- B. Place concrete sidewalks in accordance with MNDOT 2521.C1.
- C. Place concrete curb and gutter in accordance with MNDOT 2531.E, F & G.
- D. Do not place concrete when base surface is wet.

3.05 JOINTS

- A. Concrete paving joints and joint sealing shall conform to MNDOT 2301.
- B. Joint concrete sidewalks in accordance with MNDOT 2521.C2.
- C. Joint concrete curb and gutter in accordance with MNDOT 2531.C.
- D. Align curb, gutter, and sidewalk joints.
- E. Place 3/8 inch wide expansion joints at 50 foot intervals and to separate paving from vertical surfaces and other components and in pattern indicated.
 - 1. Form joints with joint filler extending from bottom of pavement to within 1/2 inch of finished surface.
 - 2. Secure to resist movement by wet concrete.

3.06 FINISHING

- A. Finish concrete pavement in accordance with MNDOT 2301 (metal-tine texturing is not required).
- B. Finish concrete sidewalks in accordance with MNDOT 2521.C1.
- C. Finish concrete curb and gutter in accordance with MNDOT 2531.E.
- D. Place curing compound on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer's instructions.

3.07 TOLERANCES

- A. Maximum Variation From True Position: 1/4 inch.

3.08 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
 - 1. Provide free access to concrete operations at project site and cooperate with appointed firm.
- B. Compressive Strength Tests: ASTM C39/C39M; for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cu yd or less of each class of concrete placed.

- C. Perform one slump and air test at the point of discharge for each and every concrete truck delivery on the site.

3.09 PROTECTION

- A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.

END OF SECTION

SECTION 32 14 40
STONE PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Natural stone pavers and steps.

1.02 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide characteristics of paver unit, dimensions, special shapes, and setting materials.
- C. Samples: Submit two samples of each paver, illustrating style, size, color range and surface texture of units being provided.

1.03 QUALITY ASSURANCE

- A. Source Limitations for Stone: Obtain each stone variety from a single quarry. Make stone available for examination by Landscape Architect.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Stone shall be carefully packed and loaded for shipment using reasonable care and customary precautions against damage in transit. Material, which may cause staining or discoloration shall not be used for blocking or packing.
- B. Stone shall be stacked on timber or platforms at least 4 inches above the ground. Care shall be taken to prevent staining or discoloration during storage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Natural Stone Pavers & Steps:
 - 1. Beuchel Stone Corp.; Product Landscape Stone Bluestone Flagstone; Fond du Lac Outcropping Steps: www.beuchelstone.com, 920-849-9361.
 - 2. Great Lakes Stone Supply; Product Natural bluestone flagstone pavers; Natural Bluestone steps: www.greatlakesstone.com, 218-525-6360.

2.02 STONE MATERIALS

- A. Natural Flagstone Pavers: 24x36 inch size, 2 inch thick; irregular flagstone shape, natural surface finish; natural bluestone or approved equal color selected from quarried range available.
- B. Natural Bluestone or Dolomitic Limestone Step: 24 x 36 inch wide, 4 inch thickness, stepper, natural surface finish; natural bluestone, limestone or approved equal color selected from quarried range available.

2.03 SAND BED MATERIALS

- A. Sand for Base: Clean washed bank sand containing maximum of 30 percent particle size of No. 10 (2 mm) sieve.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate is level, smooth, capable of supporting pavers and imposed loads, and ready to receive work of this section.
- B. Verify gradients and elevations of substrate are correct.

3.02 INSTALLATION - SAND SETTING BED

- A. Spread sand evenly over prepared substrate to a maximum thickness of 1-1/2 inch.
- B. Dampen and roller compact sand to level and even surface.
- C. Screed and scarify top 1/2 inch of sand.

- D. Place pavers in pattern shown on plans.
- E. Tamp and level pavers until units are firmly bedded, level, and to correct elevation and gradients.

3.03 CLEANING

- A. Rinse surfaces with clean water.
- B. Broom clean paving surfaces.

END OF SECTION

SECTION 32 92 00
NATIVE SEEDING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preparation of subsoil.
- B. Placing topsoil.
- C. Maintenance.

1.02 RELATED SECTIONS

- A. Section 31 2323 - Fill.

1.03 DEFINITIONS

- A. Pure Live Seed (PLS) = PLS is a unit of measure used to define the amount of viable seed in a seed lot. A PLS pound of grass seed may often have an actual bulk weight of 1.5 pounds or more because of the non-viable components of the individual seed lot (stems, chaff, immature seeds, etc.).
- B. Weeds: Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.04 PERFORMANCE REQUIREMENTS

- A. Take required field measurements and verify locations of seeding. Determine locations of underground utilities affecting this work. Alternate seed mix or mixes shall be selected by the Owner and Contractor for appropriateness to the project locality.

1.05 SUBMITTALS

- A. When requested by Landscape Architect, submit the following:
 - 1. Seed tickets with source and percentages of species indicated.
 - 2. Maintenance Data: Include maintenance instructions, cutting method and maximum grass height; types, application frequency, and recommended coverage of fertilizer.

1.06 REGULATORY REQUIREMENTS

- A. Comply with regulatory agencies for herbicide composition.
- B. Provide certificate of compliance from authority having jurisdiction indicating approval of seed mixture.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver seed mixtures in sealed containers. Seed in damaged packaging is not acceptable. Deliver seed mixtures in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.
- B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

1.08 MAINTENANCE SERVICE

- A. Furnish maintenance, including watering, of seeded areas throughout one full growing season from Date of Substantial Completion, unless otherwise arranged with Owner.
- B. Maintain seeded areas immediately after placement until grass is well established and exhibits a vigorous growing condition.

PART 2 PRODUCTS

2.01 SEED MIX

- A. MN State Seed Mix 34-361 ' Riparian Northeast' Mix or approved equal.
- B. Scotts Lawn Seed Mix: 80% Bluegrass, 20% Rye or approved equal.

2.02 ACCESSORIES

- A. Mulching Material: Oat, wheat, or Little bluestem straw, free from weeds, foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable.
- B. Water: Clean, fresh and free of substances or matter which could inhibit vigorous growth of grass.
- C. Erosion Fabric: MNDOT Category 3 Erosion Control Blanket.
- D. Herbicide: RoundUp or approved equal.
- E. Stakes: Softwood lumber, chisel pointed.

PART 3 EXECUTION

3.01 PREPARATION

- A. Areas of existing vegetation: Apply an herbicide such as Roundup to the site to kill all existing vegetation. Allow 10 to 14 days after herbicide application before disturbing the vegetation with other procedures. If the existing vegetation was tall and/or dense it may be necessary to remove excess dead plant material. It can be mowed and then mulched or raked away.
- B. Fine grade the project area before the seeding work begins.
- C. Disk or till the soil to a depth of 4 inches.
- D. Harrow or rake the soil to create a firm, smooth seedbed.
- E. Pick all rocks that exceed 4 inches in diameter.

3.02 SEEDING

- A. Seeding dates shall be in the spring or summer before August 10th or in the fall between September 20th and freeze-up.
- B. All grass seed shall be applied with a Truax or Tye seed drill.
- C. In areas too steep or small for equipment, the grass seed shall be hand broadcast and raked into the soil.
- D. All seed mix shall be applied by broadcasting.

3.03 SEED PROTECTION

- A. Cover seeded slopes with erosion control blanket. Roll fabric onto slopes without stretching or pulling.
- B. Lay fabric smoothly on surface, bury top end of each section in 6 inch deep excavated topsoil trench. Provide 12 inch overlap of adjacent rolls. Backfill trench and rake smooth, level with adjacent soil.
- C. Secure outside edges and overlaps at 36 inch intervals. Stake the erosion control blanket as necessary to maintain its position on slope. Remove stakes when planting is established.
- D. At sides of ditches, lay fabric laps in a rainlap manner. Lap ends and edges minimum 6 inches.

3.04 MAINTENANCE

- A. During 90 days after final construction date or for 90 days during spring following dormant seeding, cut planting one to three times on 30-day intervals using a scythe, mower or line trimmer. If mower is used, ensure that blade is above 24" to retain this minimum height.
- B. Control growth of noxious weeds. Hand weed periodically. Treat these and invading woody plants with spot spraying of herbicide (e.g., Roundup or approved equal) being careful to not apply to other vegetation. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.
- C. Immediately reseed areas which show bare spots.
- D. Protect seeded areas with warning signs during maintenance period.
- E. Water as necessary during maintenance period.

F. Maintain seeded areas throughout one full growing season after substantial completion.

END OF SECTION

SECTION 32 93 00

PLANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Topsoil bedding.
- B. New trees, plants, ground cover, and slope stabilization materials.
- C. Relocated trees.
- D. Mulch and Fertilizer.
- E. Tree Pruning.

1.02 REFERENCE STANDARDS

- A. ANSI A300 Part 1 - American National Standard for Tree Care Operations -- Tree, Shrub and Other Woody Plant Maintenance -- Standard Practices; 2008.

1.03 QUALITY ASSURANCE

- A. Nursery Qualifications: Company specializing in growing and cultivating the plants with three years documented experience.
- B. Installer Qualifications: Company specializing in installing and planting the plants approved by nursery.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Protect and maintain plant life until planted.
- B. Deliver plant life materials immediately prior to placement. Keep plants moist.

1.05 FIELD CONDITIONS

- A. Do not install plant life when ambient temperatures may drop below 35 degrees F or rise above 90 degrees F.
- B. Do not install plant life when wind velocity exceeds 30 mph.

1.06 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide one year warranty, except no warranty for relocated trees.
- C. Warranty: Include coverage for one continuous growing season; replace dead or unhealthy plants.
- D. Replacements: Plants of same size and species as specified, planted in the next growing season, with a new warranty commencing on date of replacement.

PART 2 PRODUCTS

2.01 PLANTS

- A. Plants: Species and size identified in plant schedule, grown in climatic conditions similar to those in locality of the work.

2.02 SOIL MATERIALS

- A. Topsoil: Type as specified in Section 31 23 23.

2.03 SOIL AMENDMENT MATERIALS

- A. Fertilizer: Containing fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil, as indicated in analysis..
- B. Peat Moss: Shredded, loose, sphagnum moss; free of lumps, roots, inorganic material or acidic materials; minimum of 85 percent organic material measured by oven dry weight, pH range of 4 to 5; moisture content of 30 percent.

- C. Water: Clean, fresh, and free of substances or matter that could inhibit vigorous growth of plants.

2.04 MULCH MATERIALS

- A. Mulching Material: cedar species wood ground bark, free of growth or germination inhibiting ingredients.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that prepared subsoil and planters are ready to receive work.
- B. Saturate soil with water to test drainage.

3.02 PLACING TOPSOIL

- A. Spread topsoil to a minimum depth of 4 inches over area to be planted. Rake smooth.
- B. Place topsoil during dry weather and on dry unfrozen subgrade.
- C. Remove vegetable matter and foreign non-organic material from topsoil while spreading.
- D. Grade topsoil to eliminate rough, low or soft areas, and to ensure positive drainage.
- E. Install topsoil into pits and beds intended for plant root balls, to a minimum thickness of 6 inches.

3.03 PLANTING

- A. Set plants vertical.
- B. Remove non-biodegradable root containers.
- C. Set plants in pits or beds, partly filled with prepared plant mix, at a minimum depth of 6 inches under each plant. Remove burlap, ropes, and wires, from the root ball.
- D. Place bare root plant materials so roots lie in a natural position. Backfill soil mixture in 6 inch layers. Maintain plant life in vertical position.
- E. Saturate soil with water when the pit or bed is half full of topsoil and again when full.

3.04 PLANT RELOCATION AND RE-PLANTING

- A. Relocate plants as indicated by Architect.
- B. Replant plants in pits or beds, partly filled with prepared topsoil mixture, at a minimum depth of 6 inches under each plant. Remove burlap, ropes, and wires, from the root ball.
- C. Place bare root plant materials so roots lie in a natural position. Backfill soil mixture in 6 inch layers. Maintain plant materials in vertical position.
- D. Saturate soil with water when the pit or bed is half full of topsoil and again when full.

3.05 TREE PRUNING

- A. Perform pruning of trees as recommended in ANSI A300.
- B. Prune newly planted trees as required to remove dead, broken, and split branches.

3.06 MAINTENANCE

- A. Maintain plant life for three months after Date of Substantial Completion.
- B. Irrigate sufficiently to saturate root system and prevent soil from drying out.
- C. Remove dead or broken branches and treat pruned areas or other wounds.
- D. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions.
- E. Replace mulch when deteriorated.
- F. Maintain wrappings, guys, turnbuckles, and stakes. Adjust turnbuckles to keep guy wires tight. Repair or replace accessories when required.

END OF SECTION

SECTION 33 05 13
MANHOLES AND STRUCTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Prefabricated catch basin structures.

1.02 REFERENCE STANDARDS

- A. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections; 2015.
- B. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals; 2008 (Reapproved 2013).
- C. ASTM C1634 - Standard Specification for Concrete Facing Brick; 2011.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate manhole locations, elevations, piping sizes and elevations of penetrations.
- C. Product Data: Provide manhole covers, component construction, features, configuration, and dimensions.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Catch Basins
 - 1. Grate and Frame Casting in Vegetated Area: Catch basins shall be precast concrete per Standard Plate 4005 or 4006 for the structure height indicated. Catch basin frame castings shall be No. 700-7 on Standard Plate 4101D Catch basin grate castings shall be No. 720 on Standard Plate 4140D.
- B. Non-Shrink Grout or Cement-Base Polymer Modified Patching Mortar
 - 1. Non-shrink grout shall be a non-metallic type grout which is durable in wetting and drying, freezing and thawing conditions and shall conform to the requirements set forth in ASTM C 1107-91. Cement-based polymer modified patching mortar shall conform to the requirements set forth in ASTM C 109, ASTM C 490-77, and ASTM C 807-83 (modified).
- C. Adjusting Rings: High density polyethylene (HDPE) recycled adjusting rings as defined in ASTM D-1248.

2.02 COMPONENTS

- A. Water Tight Seal: Water tight seal at pipe penetration including a internal expanding locking band creating a positive mechanical seal, flexible sleeve and a stainless steel exterior clamp. Seal shall be installed according to manufacturers instructions.

2.03 CONFIGURATION

- A. Shaft Construction: Concentric with concentric cone top section; lipped male/female dry joints; sleeved to receive pipe sections.
- B. Shape: Cylindrical.
- C. Clear Inside Dimensions: As indicated.
- D. Design Depth: As indicated.
- E. Clear Lid Opening: 26 inches diameter.

PART 3 EXECUTION

3.01 CATCH BASINS

- A. Place concrete base pad, trowel top surface level.
- B. Catch basins shall be bedded on 6 inch min. of Aggregate Bedding.
- C. Place catch basin sections plumb and level, trim to correct elevations, anchor to base pad.
- D. Form and place catch basin cylinder plumb and level, to correct dimensions and elevations. As work progresses, build in fabricated metal items.
- E. Cut and fit for pipe.
- F. Grout base of shaft sections to achieve slope to exit piping. Trowel smooth. Contour as required.
- G. Set cover frames and covers level without tipping, to correct elevations.
- H. Coordinate with other sections of work to provide correct size, shape, and location.

END OF SECTION

SECTION 33 10 00
WATER DISTRIBUTION

PART 1 GENERAL

1.01 SUMMARY

- A. The Work covered under this section includes providing a complete in place buried piping system as designated in the drawings and specified herein, including material, labor, tools, and equipment. This specification covers Work 5 feet or more outside of perimeter building walls.
- B. Section includes, but is not limited to:
 - 1. Staking and alignment.
 - 2. Excavation, backfilling and compaction of trenches.
 - 3. Protective provisions including sheeting, shoring, bracing, pumping and bailing.
 - 4. Pipe materials, appurtenances, etc. including installation.
 - 5. Hydrostatic leakage testing.
 - 6. Testing to comply with State Health Department requirements and local government regulations and requirements.
 - 7. Maintaining water and sewer separation.
 - 8. Notification of city inspector and payment of inspection and permit fees as applicable.

1.02 RELATED SECTIONS

- A. Section 31 2316.13 - Trenching.
- B. Section 33 3000 - Sewerage.

1.03 SUBMITTALS

- A. Data certified by the pipe and/or fitting manufacturer that the pipe, fitting, accessories and linings are as specified.

1.04 QUALITY CONTROL

- A. Furnish new, best quality pipes, fittings, valves, etc., of specified weight and dimensions.
- B. Utilize equipment of proper size and in good working condition to prosecute Work to full completion in a satisfactory manner.
- C. Utilize experienced personnel familiar with the equipment, methods and procedures for the job.
- D. Coordinate obtaining city permits and inspections with applicable city officials.
- E. Test per City requirements.

1.05 REFERENCES

- A. Standard specifications: City of Duluth Construction Standards 2504 Water Main and Service Line Installation, dated 2016.
- B. Standard plates: City of Duluth, standard plates for water services, dated 2016.
- C. Standard Utilities Specifications published by the City Engineers Association of Minnesota, 2013 Edition, Specification No. 2600 and 2611.

1.06 PERFORMANCE REQUIREMENTS

- A. Perform Work according to requirements of above referenced specification sections. This includes, but is not limited to materials, construction requirements, pipe laying operations, service installation, connections, disinfecting system, restoration, operational inspection, conductivity and leakage tests.
- B. Coordinate work with the City of Duluth.

1.07 EXISTING UTILITY INTERRUPTIONS

- A. Coordinate Work, required shutdowns, and duration of outages to existing water service with the City. Ensure this coordination is initiated at least 2 weeks prior to the Work.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Conform to the above referenced City of Duluth Specifications.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Conform to the above referenced City of Duluth Specifications

END OF SECTION

SECTION 33 31 11
SITE SANITARY UTILITY SEWER PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sanitary sewer drainage piping, fittings, and accessories.
- B. Connection of building sanitary drainage system to municipal sewers.

1.02 REFERENCE STANDARDS

- A. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; 2014.
- B. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2014.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

PART 2 PRODUCTS

2.01 SEWER PIPE MATERIALS

- A. Plastic Pipe: ASTM D 3034, Type PSM, Poly(Vinyl Chloride) (PVC) material; inside nominal diameter as indicated on the plans, bell and spigot style push-on with elastomeric gasketed joints which are bonded to the inner wall of the gasket recess of the bell socket.
- B. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required.

2.02 PIPE ACCESSORIES

- A. Trace Wire shall be #12 solid copper with "HMWPE" 30 mil insulation. Insulation for sanitary sewer applications shall be green.

2.03 BEDDING AND COVER MATERIALS

- A. Pipe Bedding Material: As specified in Section 31 23 16.13.
- B. Pipe Cover Material: As specified in Section 31 23 16.13.

PART 3 EXECUTION

3.01 TRENCHING

- A. See Section 31 23 16.13 for additional requirements.
- B. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

3.02 INSTALLATION - PIPE

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.
- B. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal watertight.
 - 1. Plastic Pipe: Also comply with ASTM D2321.
- C. Lay pipe to slope gradients noted on layout drawings; with maximum variation from true slope of 1/8 inch in 10 feet.
- D. Connect to building sanitary sewer outlet and municipal sewer system, through installed sleeves.
- E. Install trace wire 6 inches above top of pipe; coordinate with Section 31 23 16.13.

3.03 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01 40 00.

- B. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.
- C. Air Test: Test in accordance with City of Duluth requirements.
- D. Television Inspection: After the sanitary sewer is completed the Contractor shall provide closed circuit television inspection of the system. Two copies of the television inspection shall be provided to the Engineer.

END OF SECTION

SECTION 33 41 11
SITE STORM UTILITY DRAINAGE PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Storm drainage piping, fittings, and accessories.

1.02 REFERENCE STANDARDS

- A. AASHTO M 252 - Standard Specification for Corrugated Polyethylene Drainage Pipe; 2009.
- B. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2015.
- C. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; 2011.
- D. ASTM D2680 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite-Sewer Piping; 2001 (Reapproved 2009).
- E. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2011.
- F. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2014.
- G. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Material; 2012.

PART 2 PRODUCTS

2.01 SEWER PIPE MATERIALS

- A. Pipe size and type shall be specified on the plans.
- B. Plastic Pipe: ASTM D1785, Schedule 40, Poly Vinyl Chloride (PVC) material; inside nominal diameter of 4 inches, bell and spigot style solvent sealed joint end.

2.02 BEDDING AND COVER MATERIALS

- A. Bedding: As specified in Section 31 23 23.
- B. Cover: As specified in Section 31 23 16.13.

PART 3 EXECUTION

3.01 TRENCHING

- A. See Section 31 23 16.13 - Trenching for additional requirements.
- B. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

3.02 INSTALLATION - PIPE

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.
- B. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal watertight.
 - 1. Plastic Pipe: Also comply with ASTM D2321.
- C. Lay pipe to slope gradients noted on layout drawings; with maximum variation from true slope of 1/8 inch in 10 feet.
- D. Connect to subdrainage system where indicated on plan.

3.03 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01 40 00.

3.04 PROTECTION

- A. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

SECTION 33 46 00
SUBDRAINAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Building Perimeter and Under-Slab Drainage Systems.

1.02 REFERENCE STANDARDS

- A. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2011.

PART 2 PRODUCTS

2.01 PIPE MATERIALS

- A. Polyvinyl Chloride Pipe: ASTM D2729; plain end, 4 inch inside diameter; with required fittings.
- B. Use perforated pipe at subdrainage system; unperforated through sleeved walls.

2.02 AGGREGATE AND BEDDING

- A. Drainage Aggregate Material: Drainage Fill Type as specified in Section 31 2323.

2.03 ACCESSORIES

- A. Pipe Couplings: Solid plastic.
- B. Filter Fabric: Water pervious type, black polyolefin.
- C. Precast Concrete Headwall: in conformance with MnDOT Standard Plate 3131.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout Drawings.

3.02 PREPARATION

- A. Hand trim excavations to required elevations. Correct over-excavation with Granular Fill.
- B. Remove large stones or other hard matter that could damage drainage piping or impede consistent backfilling or compaction.

3.03 INSTALLATION

- A. Install and join pipe and pipe fittings in accordance with pipe manufacturer's instructions.
- B. Place drainage pipe on clean cut subsoil. Conform to details on Drawings.
- C. Lay pipe to slope gradients noted on Drawings; with maximum variation from true slope of 1/8 inch in 10 feet.
- D. Place pipe with perforations facing down. Mechanically join pipe ends.
- E. Install Drainage Aggregate at sides, over joint covers and top of pipe. Provide top cover compacted thickness of 12 inches.
- F. Place filter fabric over levelled top surface of aggregate cover prior to subsequent backfilling operations.
- G. Place aggregate in maximum 6 inch lifts, consolidating each lift.
- H. Refer to Section 31 23 23 for compaction requirements. Do not displace or damage pipe when compacting.

3.04 PROTECTION

- A. Protect pipe and aggregate cover from damage or displacement until backfilling operation begins.

END OF SECTION

