PROJECT MANUAL

P78 CP09 2024 27-Upgrade Parking Lot

Lighting

Gresham, Oregon 600 NE 8th Street. #300 Gresham, OR 97030



Project No.:	24051
Issue Date:	2/26/2025



Digitally signed by Margaret Wilson Date: 2025.02.26 14:26:26-08'00'



MULTNOMAH COUNTY PROJECT MANUAL

FACILITIES AND PROPERTY MANAGEMENT DIVISION

401 N DIXON STREET PORTLAND, OREGON 97227

P78 CP09 2024 27–Upgrade Parking Lot Lighting

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END OF DOCUMENT

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SECTION 01 11 00 – SUMMARY OF WORK

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes:
 - 1. Type of contract.
 - 2. Work covered by Contract Documents.
 - 3. Work under other Owner contracts.
 - 4. Owner furnished products.
 - 5. Safety and health standards.

1.2 TYPE OF CONTRACT

- A. Construct Work under single, fixed-price contract, furnished by Owner. Refer to Section 01 29 00 Payment Procedures for Allowances and Unit Prices.
- B. <u>Complete all Work required for Substantial Completion no later than date provided in Attachment B.</u>

1.3 WORK COVERED BY CONTRACT DOCUMENTS

- A. Project Identification: **P78 CP09 2024 27–Upgrade Parking Lot Lighting**
 - 1. Owner: Multnomah County Oregon.
 - 2. Building: **B437 Multnomah County East (MCE)**
 - 3 Location: 600 NE 8th St # 300, Gresham, OR 97030
 - 4. Architect: Scott Edwards Architecture, LLP
 - 5. Project Manager: The Owner will designate one representative responsible for contract scope, time, cost, and payment issues.
 - 6. Property Manager: The Owner will designate another representative as prime contact to represent building and site management, maintenance or repair. This contact will provide background, current and long-term Owner perspectives.
 - 7. Client Representative: The Owner will designate one additional representative as prime contact to represent building operations, occupants, and users. This prime contact will respond to <u>coordination issues and schedule notifications only</u>.
- B. Scope of Work: Construct or remodel building spaces and systems to accomplish the following:

1. Provide new parking lot lighting to existing site, including 3 new poles, replacement of existing luminaires, and installation and programming of new lighting control system.

C. Work Sequence: Perform Work in sequence or phases to accommodate Owner and public use of premises during construction period. Coordinate construction schedule

and operations with Project Manager. Refer to Section 01 33 00 – Submittal Procedures.

- 1. Coordinate with work under other Owner contracts.
- D. Permits: Owner pays for all building permits and inspection fees required to execute construction. All re-inspection fees caused by the Contractor shall be paid for by the Contractor. The Project Manager shall apply for all building permits. The Contractor shall obtain required permits and arrange all inspections.

1.4 WORK UNDER OTHER OWNER CONTRACTS

- A. Owner Contracted Services: Cooperate fully with Owner-engaged independent contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract. Coordinate the Work of this Contract with the following:
 - 1. Testing and Inspection Services: Owner will provide independent, third-party testing and inspection as required by Contract Documents and authorities having jurisdiction.
 - 2. Environmental Testing Services: If needed, Owner will provide independent, third-party testing and inspection as required by Contract Documents and authorities having jurisdiction.
- B. Owner Employed Services: Cooperate fully with Owner-employed County Trades so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract. Coordinate the Work of this Contract with the following:

1.5 OWNER FURNISHED PRODUCTS

- A. For Contractor responsibilities, refer to Section 01 60 00 Product Requirements. The Owner will furnish and pay for products, as described in the following Specification Sections:
 - 1. None

1.6 SAFETY AND HEALTH STANDARDS

- A. These Construction Documents and Work contemplated are governed at all times by applicable provisions of Federal Law, including but not limited to, the latest amendments and supplements of following:
 - 1. Williams-Steiger Occupational Safety & Health Act of 1970, Public Law 91-596.
 - 2. Part 1910 Occupational Safety and Health Standards, Chapter XVII of Title 29, Code of Federal Regulations.
 - 3. Part 1518 Safety and Health Regulations for Construction, Chapter XIII of Title 29, Code of Federal Regulations.
 - 4. 2010 ADA Standards for Accessible Design.

- B. Comply with Oregon Administrative Rules (OAR) as required by Oregon law, including but not limited, to the following:
 - 1. Oregon Utility Notification Center: OAR 952-001-0010 through OAR 950-001-0090.
- PART 2 PRODUCTS (NOT USED)
- PART 3 EXECUTION (NOT USED)

SECTION 01 14 00 – WORK RESTRICTIONS

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Owner Occupancy.
 - 2. Use of Premises.
 - 3. Contract Restrictions.
 - 4. Operational Procedures.
- B. This Section describes specific requirements related to use of the premises during construction.

1.2 OWNER OCCUPANCY

- A. Full Owner Occupancy: Owner will occupy the site and building(s) during entire construction period. Cooperate with Owner during construction to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner dayto-day operations. Maintain existing exits in clear and unobstructed manner, unless otherwise indicated.
 - 1. Accessibility: Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Project Manager and authorities having jurisdiction.
 - 2. Life Safety: Maintain building fire and security systems. Maintain code-required egress from site and obtain approval from authorities having jurisdiction for construction egress plans.
 - 3. Permission: Notify Project Manager not less than <u>72 hours</u> in advance of activities that will affect Owner operations. Do not proceed with those activities without written permission from Project Manager.
- B. Full Owner Operations: Provide for Owner and public use of the site and building.
 - 1. Building Operations: Maintain building operations every business day. Maintain space and utilities for Owner processes and telecom integrity 24 hours per day every calendar day. Where processes must permanently or temporarily relocate, coordinate with designated staff contact to schedule appropriate and adequate time.
 - 2. Employee Access: Maintain employee access to Owner occupied building floor(s) during all hours.
- C. Owner Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed areas of building, before Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial occupancy shall not

constitute acceptance of the total Work.

- 1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be used before Owner occupancy.
- 2. Obtain a Certificate of Occupancy from authorities having jurisdiction if required before Owner occupancy.
- 3. Before partial Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will provide, operate, and maintain mechanical and electrical systems serving occupied portions of building.
- 4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of building.

1.3 USE OF PREMISES

- A. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of site or building beyond areas where Work is indicated, temporary facilities are allowed, or access is required to complete the Work.
 - 1. Limits: Confine demolition and construction operations to the following:
 - a. Limit vehicle use inside the building (or parking garage) to material and equipment delivery or waste and recycling pickup, except for material-handling equipment designed for use within a building.
 - b. Limit delivery, loading, unloading, and waste collection to routes designated by the Owner.
 - c. Limit temporary facilities, storage, and staging for preparing the Work to areas designated by the Owner.
 - d. Limit parking on site to one stall designated by the Owner for Contractor errands, except after-hours parking on site is permissible as long as it does not interfere with building occupants and visitors.
 - e. Secure off-site parking as required for Contractor employees, subcontractors, and vendors. Do not use street parking within one block of the site, so the public has best access to the building.
 - f. Limit use of parking lot such that 2/3 of parking lot remains open for Owner's use at all times throughout construction.
 - 2. Driveways and Entrances: Keep driveways, loading areas, and entrances serving premises clear and available to Owner, Owner employees, and emergency vehicles. Do not use these areas for parking or storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- B. Use of Existing Building: Maintain existing building in a weathertight and secure condition throughout construction period. Repair damage caused by construction operations. Protect building and its occupants during construction period. Contractor access routes and access methods shall be subject to approval by the Project Manager. Elevators, doors, windows, stairs, and floors used in moving

materials shall be properly protected to prevent damage.

1. Do not use furniture, fixtures, equipment or other material of Owner or other contractors in the execution of the Work, without prior written approval.

1.4 CONTRACT RESTRICTIONS

A. On-Site Work Hours: Work shall be generally performed inside the existing building during <u>normal business hours of 8:00 a.m. to 5:00 p.m. Monday through Friday</u> for the building, except where otherwise indicated. Owner will provide a two week notice of changes in business hours due to seasonal work. For any work not during business hours, obtain written permission from Project Manager at least 72 hours in advance.

1. Loud or Disruptive Work: Do <u>not</u> schedule loud or otherwise disruptive work (e.g. bore drilling, core drilling, saw cutting, jack hammering, or major demolition) during business hours, unless coordinated and approved by County PM.

 Weekend Hours: Saturday and Sunday 7AM-5PM, defer to JHA restrictions.
Early morning and late hours: Case by case basis, Coordination and Approval by County PM required.

- B. Food & Beverage: Restrict food or beverage storage, consumption and waste to designated areas of the premises (Contractor Break Areas).
 - 1. Drugs: No illegal substances allowed on Owner property (zero-tolerance).
 - 2. Alcohol: No open or closed beverage containers allowed on Owner property.
 - 3. Tobacco: No smoking, chewing, ingesting or spitting allowed on Owner property.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated.
 - 1. Do not interrupt or shutdown utilities during business hours.
 - 2. Do not proceed with utility interruption or shutdown without written permission from Project Manager.
 - 3. For Major shutdowns, a pre-shutdown planning meeting is required one month prior (at minimum). For Minor shutdowns, a pre-shutdown planning meeting is required 2 weeks prior (at minimum).

1.5 OPERATIONAL PROCEDURES

- A. Authorization: Obtain written permission from the Project Manager 72 hours prior to:
 - 1. Mobilization: Moving material, equipment or personnel onto the premises; installing temporary barricades, partitions, signs or utilities; and relocating, storing or protecting existing building elements as required to perform the Work.
 - 2. Operations: Shutting down essential building operations, services; beginning building and site deconstruction, demolition or disconnection; undertaking disruptive, noisy, noxious or hazardous work; and working after business hours.

- 3. Demobilization: Removing material, equipment or personnel from the premises; removing temporary barricades, partitions, signs or utilities; and relocating, replacing or unprotecting existing building elements as required for the Work.
- B. Security: Adhere to posted building notices. Become acquainted and do not interfere with existing building security systems, protocols, and exits except as required to complete the Work. Provide site and building access only to known contractor employees, subcontractors or material vendors.
 - 1. Personal Identification: Provide one standard identification badge, card or name tag system to be worn in a clearly visible manner at all times while on the premises by Contractor employees, subcontractors, vendors and service personnel.
 - a. Contractor Superintendent shall wear distinct, identifying hard hat or vest at all times as identification.
 - 2. Building Access: Check out and return access keys or access cards as required. Do not duplicate or lend access keys or access cards. Safeguard keys, access cards, security codes, passwords, and other access means.
 - a. If any access means are lost, notify the Project Manager within 24 hours.
 - b. Contractor is responsible for cost to replace or re-program lost access means for all affected facilities.
 - c. After the Work is accepted by Owner, return all keys and access cards to Project Manager.
- C. Contact: Contractors, subcontractors, vendors, and service agents, employees, or providers thereof shall have no direct or indirect contact with Owner customers during any activity associated with the Work or while on the premises (or other Owner property) nor may they photograph or record customers, residents, or services provided to them.
 - 1. Enforcement: Contractor shall enforce the "no contact" requirement described above. All subcontracts shall contain language requiring adherence to this requirement. In the event this requirement is violated, the Owner shall have the right to require the Contractor to remove the individual or individuals violating this requirement from the job site immediately and permanently.
 - 2. Procedure: This requirement does not force Contractor personnel to be rude. Simple acknowledgement in response to greetings from a customer or resident will not be a violation of this requirement. However, no further conversation or contact is permitted thereafter.
- D. Work Rules: Adhere to requirements and follow suggestions contained in Contractor Work Rules, where issued for this facility and attached to this Section.
 - 1. MSDS Binder: Establish single location for Contractor to collect and maintain Material Safety Data Sheets (MSDS) from all contractors, subcontractors, and vendors.
 - 2. Evacuation Drills: Contractor employees, subcontractors, vendors and service

personnel shall fully participate in building evacuation drills.

- a. Keep a separate book to log Contractor employees, subcontractors, vendors and service personnel on and off the site daily.
- b. Designate Contractor employee to sweep the construction areas for persons left behind during evacuation drills.
- c. Contractor shall bring Log Book to emergency assembly site for verification of employee evacuation of the building.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

FORMS:

Health Department:

1. A Pre-Construction Risk Assessment Form will need to be completed by the General Contractor at the Pre-Construction Meeting when working on projects in Health Department .

SECTION 01 29 00 - PAYMENT PROCEDURES

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes:
 - 1. Allowances.
 - 2. Unit Prices.
 - 3. Alternates
 - 4. Application for payment.
 - 5. Change order procedures.

1.2 ALLOWANCES

1. None.

1.3 UNIT PRICES

1. None. See <u>Attachment B</u> Bid instructions.

1.4 ALTERNATES

1. None.

1.5 APPLICATION FOR PAYMENT

A. Application Forms: Use an application for payment containing the following information:

First Page:

1. County Project Manager's Name.

All Pages:

- 1. Owner Name: MULTNOMAH COUNTY OREGON.
- 2. County Building Number and Name.
- 3. County Project Number and Name.
- 4. Architect Name.
- 5. Contractor Name and Address.
- 6 Date of Submittal.
- 7. Unique Invoice Number.
- 8. Page # of #.
- B. Application Preparation: Complete every entry on form. Execute by a person authorized to sign legal documents on behalf of Contractor. Incomplete forms will be returned without action by Architect or Owner.
 - 1. Match data on approved Schedule of Values. Refer to Section 01 33 00 -

Submittal Procedures.

- 2. Include itemized statement of original sum, additions and deductions from Change Orders and Construction Change Authorizations, deductions for previous payments, and sum remaining due.
- 3. Submit certified payrolls to LCPtracker that match the period of the Application for Payment.
- 4. Attach current Construction Schedule amended to indicate progress of material delivery and completed Work up to and including the period covered by the current Application for Payment.
- 5. Attach current Submittals Schedule amended to indicate submittal and approval status up to and including the period covered by the current Application for Payment.
- C. Application Transmittal: See <u>Attachment E</u> Instructions.
- 1.6 CHANGE ORDER PROCEDURES
 - A. Submit a Change Order Request to the County Project Manager.
 - B. Complete accounting to obtain new Contract Sum and new Contract Time or Date of Completion.
 - C. Submit itemized breakdown of labor and materials including overhead and profit with each Proposal Request. Submit copies of estimating sheets to Architect and Project Manager upon request.
 - D. Submit to County's Project Manager.
- PART 2 PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

Multnomah County Vendor Guidelines for Electronic Invoicing

1) Vendors agree to use email as the ONLY transmittal method for invoices and finance related correspondence. Only use email address: <u>fae.invoices@multco.us</u> *Do not copy Multnomah County staff.

- 2) The subject line for all invoices must include the following:
 - Vendor Name
 - Invoice Number
 - Invoice Amount

For example: ABC Inc. Inv# 23456 \$1,500 *For multiple invoices:* ABC Inc. Inv#23456/\$1,500, 23457/\$2,500, 23542/\$500

<u>NOTE:</u> If a reasonable amount of information cannot be included in the subject line, send multiple emails with the remaining invoices.

3) Vendors must include all pertinent information clearly noted on each invoice to ensure prompt payment. All applicable items must be on the invoice including:

- Requestor's Name
- Work Order # and Building #
- Detailed Description of Service
- Service Dates
- Detailed Description of Product ordered/shipped
- Shipped Date and if available, tracking # of shipment

Incomplete invoices <u>may be rejected</u> for additional information.

4) Vendors agree to group any applicable back up documentation (i.e. service requests, detail reports etc...) to its invoice in a single PDF/attachment depending on their typical invoicing schedule (weekly, monthly, by the job, etc.)

BUSINESS NAME (print)	Contact Name and Number		

Acknowledged & Accepted (Signature)

Date

Multnomah County reserves the right to remove the electronic invoicing privileges from any non-compliant vendors without notice.

SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes:
 - 1. Coordination.
 - 2. Administration of Project Meetings.
 - 3. Pre-Construction Conference.
 - 4. Progress Meetings.
 - 5. Safety Meetings.
 - 6. Documentation.

1.2 COORDINATION

- A. General Coordination: Contract Documents are arranged for convenience only and do not necessarily determine which trades perform various portions of the Work. Coordinate construction operations included in various Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend upon each other for proper installation, connection, and operation. Pay particular attention to the following:
 - 1. Work of all subcontractors.
 - 2. Changes with Architect and Project Manager.
 - 3. Start-up, inspection, acceptance, and training for components, equipment and systems.
 - 4. Early order of material and equipment requiring long lead times. If requested, the Owner will reimburse the Contractor for early order items upon certification of receipt and storage of same in licensed, bonded warehouse, or delivery to Project Site and suitable storage.
 - 5. Construction Schedule and Submittals Schedule with Architect and Project Manager, in addition to Owner contracted services and Owner employed services if used. Schedule and coordinate Work to minimize conflicts and expedite successful project completion.
 - 6. For on-site work not during business hours, the Contractor's superintendent shall supervise subcontractor and vendor activity. Where only direct employees are involved in "off-hours" work, the Contractor shall provide a superintendent, foreman or lead to oversee and direct employee activity.
 - 7. Contingency Plans with Architect, Project Manager, and Client Representative.
- B. Mechanical and Electrical Coordination: Mechanical and electrical drawings are diagrammatic. Additional offsets and bends may be required. Coordinate and install additional offsets and bends in systems where required by field conditions, governing building codes, or authorities having jurisdiction.
 - 1. Coordinate rough-in, plumbing and wiring requirements for equipment with

equipment supplier. Install rough-in, plumbing and wiring in accordance with equipment manufacturer printed instructions.

2. Architect may make minor adjustments in fixture outlet, grill, louver, or ventilator locations prior to rough-in Work.

1.3 ADMINISTRATION OF PROJECT MEETINGS

- A. Schedule meetings and confirm dates with parties involved.
- B. Make physical arrangements for meetings (preferably on site) and <u>preside at</u> <u>meetings.</u>
- C. Briefly record significant discussions, issues raised, agreements made, and actions assigned.
 - 1. Forward meeting notes to Project Manager within 24 hours of meeting for review prior to publication.
 - 2. Issue to Architect, Project Manager, all attendees, and major subcontractors or vendors not in attendance.

1.4 PRE-CONSTRUCTION CONFERENCE

- A. Frequency: Once. Schedule meeting prior to site mobilization for review of Conditions of the Contract and Division 1 General Requirements.
- B. Attendance: Project Manager, Architect, Architect consultants as needed, Contractor, major subcontractors, and major product vendors.
 - 1. County Property Manager.
 - 2. Client Representative.
 - 3. County Contractor(s).
 - 4. County Trade(s).
- C. Minimum Agenda:
 - 1. Introductions: Identify meeting participants and project stakeholders not in attendance.
 - 2. Refer to Conditions of the Contract for compliance requirements, procedures, documentation, and forms.
 - a. Workforce Training and Hiring Program.
 - b. Good Faith Recruitment and Retention Practices.
 - c. Monthly Employment Reports.
 - 3. Refer to Section 01 14 00 Work Restrictions for requirements of continuing County operations.
 - a. Safety: Emphasize that safety is the number one concern and overriding factor at all times.

- b. Use of Premises: Discuss resolution to limitations on delivery, storage, staging, and parking.
- c. Noise Limitations: Identify noisy work to be done after hours, whether Owner presence needed.
- d. Security: Determine sign in/out procedures, key distribution, and Contractor personnel identification.
- e. Work Rules: Establish single location to collect Material Safety Data Sheets (MSDS) from all contractors, subcontractors, and vendors. Require all Contractors to fully participate in building evacuation drills.
- 4. Refer to Section 01 31 00 Project Management and Coordination for meetings and documentation.
 - a. Work Coordination: Establish procedures to schedule and coordinate Work under other Owner Contracts, including Owner contracted services and Owner employed services.
 - b. Change Management: Discuss procedures and forms for Change Orders, Construction Change Authorizations, and field decisions.
 - d. Project Record Documents: Discuss documentation procedures, maintenance, and periodic verification.
 - e. Progress Meetings: Establish time, place, and attendance requirements. The Project Manager will attend the weekly meeting. The Architect and Architect consultants will attend only when requested in advance.
- 5. Refer to Section 01 33 00 Submittal Procedures for documents required to be reviewed at the Pre-Construction Conference.
- 6. Refer to Section 01 40 00 Quality Requirements for coordination of testing and inspection services.
- 7. Refer to Section 01 50 00 Temporary Facilities and Controls for Contractor requirements.
 - a. Installation: Identify location and duration for temporary facilities, barriers, and signage.
 - b. Connection: Locate utility taps and additional service requirements (e.g. Contractor phone, fax).
 - c. County Material: Discuss the temporary use or non-use of County material, equipment and personnel.
- Refer to Section 01 70 00 Execution Requirements for examination, preparation, installation, cleaning, adjustment, and protection responsibilities; cutting and patching; selective demolition; and closeout procedures.
- 9. Other Items: Discuss other pertinent site mobilization and project start-up topics, such as the following:
 - a. Work Not in Contract. **NONE**

1.5 PROGRESS MEETINGS

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- A. Frequency: Regular meetings every week as determined by the Project Manager, with additional meetings as required.
- B. Attendance: Project Manager, Architect and Architect consultants as needed, Contractor, major subcontractors, major product vendors, and others whose work requires coordination and cooperation during that or the following week.
 - 1. Minor subcontractors and vendors.
 - 2. County Property Manager.
 - 3. Client Representative.
 - 4. County Contractor(s).
 - 5. County Trade(s).
- C. Minimum Agenda:
 - 1. Construction progress since previous meeting.
 - 2. Field decisions, Construction Change Authorizations, Change Orders, and proposed changes.
 - 3. Construction Schedule, Submittals Schedule, delivery schedule, and other project timetables.
 - 4. Specific current or pending operations that may affect the quality, time or cost of the Work.
 - 5. Site conditions, construction problems, coordination issues, and other observations.
 - 6. Notice of field work or deliveries that may impact County personnel or operations.
 - 7. Proposed responses and assigned actions.

1.6 SAFETY MEETINGS

- A. Frequency: Regular meetings every week, with additional meetings as required by insurance carrier.
- B. Attendance: Contractor, major subcontractors, major product vendors, minor subcontractors and vendors whose employees will be on site during that or the following week.
- C. Minimum Agenda:
 - 1. Construction accidents, injuries, and near misses since previous meeting.
 - 2. General safety precautions, practices, procedures, equipment, gear, and clothing.
 - 3. Specific current or pending operations that may raise personnel safety and security concerns.
 - 4. Proposed responses and assigned actions.

1.7 DOCUMENTATION

A. Documentation Requirements: Forward copies of accident, injury, or incident reports; inspection reports by authorities having jurisdiction; and notice of significant

changes or impacts to Construction Schedule, Submittals Schedule, and Contingency Plans (if any) to Architect and Project Manager within 24 hours of those events.

- B. Record-Keeping Requirements: At site, maintain one clean unmarked copy of the following:
 - 1. Building permits and Contract Documents including Project Manual and Drawings.
 - 2. Change Orders, Construction Change Authorizations, minor changes in Work issued by Architect, Request for Substitution with responses, and Request for Information with responses.
 - 3. Current Contact List, Construction Schedule, Submittals Schedule, Schedule of Values, and approved submittals.
 - 4. Manufacturer instructions, supplemental instructions, and training manuals.
 - 5. Meeting notes, field test records, inspection reports, and safety incident reports.
- C. Project Record Documents: At site, maintain and make available to the Architect and Owner on request, one marked up set of Contract Documents including Project Manual and Drawings that record changes in Work and deviations from Contract Documents.
 - 1. Label the markup set as "Project Record" and keep current, with no more than one week delay.
 - 2. Record Change Orders, Construction Change Authorizations, and Minor Changes in the Work.
 - 3. Record field changes in dimensions, connections, and/or materials used.
 - 4. Record location of concealed items and utility lines.
 - 5. Deliver final version of the Project Record to Architect prior to Final Completion.
- D. Submit to the Owner, on a daily basis, a superintendent's daily report documenting the progress of the Work, the number of workmen at the site, and such_other information as is agreed upon by the Owner and the Contractor.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

SECTION 01 33 00 – SUBMITTAL PROCEDURES

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes:
 - 1. Submittal Requirements.
 - 2. Contract Submittals.
 - 3. Pre-Construction Submittals.
 - 4. Construction Submittals.
 - 5. Project Calendar.
 - 6. Time Schedule for Submittals, located at the end of this Section.
- B. Related Sections include the following:
 - 1. Section 00 60 00 Payment Bond.
 - 2. Section 00 61 00 Performance Bond.
 - 3. Section 00 90 00 Multnomah County Public Improvements Contract Sample.
 - 4. Section 01 14 00 Work Restrictions for other required submittals.
 - 5. Section 01 77 00 Closeout Procedures for delivery requirements.

1.2 SUBMITTAL REQUIREMENTS

- A. Contractor Requirements: Prepare submittals that comply with Contract Documents as specified in this and other Sections, including operational requirements of the Project. Refer to Section 01 14 00 Work Restrictions for other required submittals.
- B. Contractor Review: Review submittals prior to submission and provide stamp of approval signed or initialed by Contractor, indicating Contractor has inspected submittals and certifying that they are complete, correct, in compliance with Contract Documents and suitable for the Project. Note corrections and field dimensions.
- C. Contractor Submittal: Provide sufficient information and adequate detail for each system, product, component and material to facilitate acceptable review by Architect and Owner. Package each submittal individually and attach a transmittal form. Use the transmittal to notify recipient in writing whether a submittal deviates from Contract Document requirements, there are problems anticipated in the installation or use of a Product, or the submittal is a re-submittal. Label each submittal item with:
 - 1. Multnomah County Oregon.
 - 2. County building number and building name.
 - 3. County project number and project name.
 - 4. Specification section number and name.
 - 5. Product name or use (e.g. carpet).
- D. Contractor Responsibility: Architect, Project Manager or other reviews do not relieve Contractor responsibility for submittal deviations from Contract Document requirements, unless Architect and Project Manager give written acceptance of

specific deviations.

- E. Architect Review: Architect will review submittals for design concept and conformance with Contract Documents. Architect will return submittals with corrections noted thereon (if any) and indicate whether re-submittal is required.
- F. Project Manager Review: Project Manager may review submittals for operation requirements and conformance with Project intent. Project Manger will return submittals with corrections noted thereon (if any) and indicate whether re-submittal is required.
- G. Contractor Corrections: Incorporate any required corrections into submittals immediately. If requested, resubmit for further review in accordance with Time Schedule for Submittals, located at the end of this Section.

1.3 CONTRACT SUBMITTALS

- A. Submit copies to Facilities and Property Management (Contracts Section).
 - 1. Contract Agreements: <u>One</u> copy of executed County contract agreements.
 - 2. Performance-Payment Bond: <u>One</u> copy of Performance-Payment Bond.
 - a. Section 00 60 00 Payment Bond.
 - b. Section 00 61 00 Performance Bond.
 - c. Section 00 90 00 Multnomah County Public Improvements Contract Sample.
 - 3. Certificate of Insurance: <u>One</u> copy of each Certificate of Insurance.
 - a. Refer to Attachment A-1 of the Multnomah County General Conditions for Public Improvement Contracts Section G.3 Insurance.

1.4 PRE-CONSTRUCTION SUBMITTALS

- A. Submit <u>one</u> opaque print or electronic copy prior to or at Pre-Construction Conference, to Project Manager.
- B. Contact List: At top, provide <u>two</u> after-hours phone numbers to contact Contractor in case of emergency. Also list two after-hours phone numbers to contact Owner in case of emergency (as provided by Owner). Provide company or organization name, person name, position or title, mailing address, email address, telephone number, and mobile phone number for all primary project participants.
 - 1. General or Prime Contractor(s): Contract signatory, project manager, and project superintendent.
 - 2. Prime Subcontractor(s): Project manager and project lead.
 - 3. Major Vendor(s): Sales representative and manufacturers' technician.
 - 4. Architect: Contract administration personnel for Architect and Architect consultants (as provided by Architect).
 - 5. Utilities: Regular and emergency contacts for building services (as provided by

Owner).

- 6. City: Building inspectors assigned to this project (as provided by Owner).
- 7. Owner: Designated County Project Manager, County Property Manager, and Client Representative (as provided by Owner).
- 9. Work Under Other Owner Contracts: Designated contacts for Owner contracted services and Owner employed services (as provided by Owner).
- C. Site-Specific Safety Plan: Provide a Site-Specific Safety (SSSP) including information designed to protect workers, subcontractors, visitors, and members of the public from potential safety risks presented on-site. The Site Safety Plan shall identify project work scope, safety hazards associated with the project tasks, and include specific safety procedures and training appropriate and necessary to complete the work. The Site Safety Plan is subject to review and acceptance by the County Project Manager.

Include the following specifics:

- i. List and Description of the site conditions and exposures.
- ii. Routes of travel and delivery to and within the site.
- iii. Building entries and stairwells.
- iv. Safety standards related to Personal Protective Equipment requirements.
- v. Locations of potential hot work, including lock-out and tagging procedures.
- vi. Hazard communication and response plan in case of accident.
- vii. Material safety data sheet (MSDS) for any chemicals or other potentially hazardous materials, and their locations on-site.
- viii. First aid protocols and where first aid can be obtained.
- ix. List of construction site safety rules, such as designated smoking areas or restrictions on operating certain equipment in defined areas.
- D. Staging Plan: Provide a Staging Plan, to include proposed locations for storage of materials, construction waste, tools and equipment. The Staging Plan is subject to review and acceptance by the County Project Manager.
- E. Mobilization Plan: Provide a Mobilization Plan, to include proposed locations for contractor and subcontractor parking, access into the site, sequence of arrival and movement into the building for deliveries, temporary field office, temporary construction signage, construction hours and crane staging (if applicable).
- F. Construction Schedule: Show dates for mobilization, demolition, utility shutoff, enclosing interior space, mechanical system completion, Substantial Completion(s), Final Review, Owner occupancy, and demobilization. Identify product delivery and installation dates for major elements. Indicate primary tasks required for each phase of the work. Provide separate line items for those activities that may most impact Owner staff and operations: e.g. temporary closure, disruptive or noisy work, hazardous materials or procedures, and restroom or essential services availability.
 - Phases: Separate gross portions of the Project that must be complete, before other work may begin. Identify phases where specific areas will have barriers and be inaccessible to Owner. State which phase(s) will have a separate Substantial Completion, after which the Owner would occupy and have beneficial use of completed work. The Owner envisions the Project divided into mobilization, demobilization, and at least the following major phases:

a. None.

- 2. Activities: Include significant events or operations identified by Owner in the Project Calendar below. Refer to Section 01 10 00 Summary of Work to schedule Work Under Other Contracts.
- 3. Updates: Indicate progress on each activity. Show revised completion dates. List the current and anticipated accelerations and delays. Describe proposed corrective action when required.
- 4. Refer to Section 00 62 83 Construction Schedule Form for additional requirements.
- G. Submittals Schedule: Identify all submittals required by Contract Documents and show dates for their first delivery. Include information provided on the "Time Schedule for Submittals" which is located at the end of this Section.
 - 1. Provide a column to list the final date for submission by the Contractor in order to provide time for Architect review and material order without affecting the Construction Schedule.
 - 2. Provide additional columns to later track when the submittal was sent, when it was returned, and for comments. The Architect and Owner may use this schedule to track submittal progress.
 - 3. For each re-submittal, add new row immediately under the row for the previous submittal and label the new row as a re-submittal.
- H. Closeout Schedule: Identify all close-out submittals required by Contract Documents. Submit preliminary draft of proposed formats and outlines of contents. Include information provided on the "Time Schedule for Submittals" which is located at the end of this Section.
 - 1. Provide a schedule similar in format to the Submittals Schedule.
 - 2. Refer to Section 01 77 00 Closeout Procedures for additional requirements.
- I. Schedule of Values: Submit Schedule of Values covering various parts of the Work, including quantities aggregating total sum of Contract. This schedule will be basis for Contractor's Application for Payment. Use Contractor's Application for Payment form as the template to prepare Schedule of Values (and for later invoicing).
 - 1. Provide separate line items for mobilization, monthly overhead, project closeout, demobilization, and other major elements of the General Conditions.
 - 2. Divide material and labor costs into separate line items; break down large subcontracts into separate items; and identify smaller contracts and significant tasks as unique items.
 - 3. Provide sufficient organization and adequate detail to facilitate monthly progress review by Architect and Owner. Where practical, order items to correspond with Specification sections.
- J. Contingency Plans: Identify major areas of concern such as Owner staff or operation disruption, material delivery delay, utility service loss, unscheduled events, and potential hindrances or obstacles to successfully completion. Describe alternate strategies to avoid, alleviate or resolve critical scope, time or cost issues.

1.5 CONSTRUCTION SUBMITTALS

- A. For samples, refer to Section covering specific system, product, component or material for size and quantity required. For quality assurance documents, submit <u>one</u> original. For other submittals, provide <u>one</u> copy. Submit construction submittals to Architect.
- B. Shop Drawings: Submit shop drawings that identify materials and show connections, details, dimensions, finishes and fasteners.
- C. Product Data: Submit manufacturer catalog sheets, brochures, diagrams, schedules, performance charts, illustrations, and other descriptive data for manufactured systems, products, components and materials. Where the specified manufacturer and catalog number will be furnished, the Contractor must still submit information that each system, product, component and material meets specified performance data.
- D. Office Samples: Submit office samples of size and quantity specified or of sufficient size and quantity to clearly illustrate functional characteristics of the system, product, component or material with integrally related parts and attachment devices. Label samples and show range of finishes where appropriate.
- E. Field Samples: Construct each sample complete, including work of all trades required in finished Work. After approval, where appropriate, field samples may be incorporated into Project if approved in writing by County Project Manager. Remove field samples not incorporated into Project.
- F. Quality Assurance: Submit affidavits, service and maintenance agreements, workmanship bonds, final certifications, guarantees and warranties, contractor qualifications, and similar quality assurance documents with appropriate seals, signatures and dates.
 - 1. Submit certifications and documents sealed, signed and dated by registered professional engineer of discipline required for specific service on Project and licensed in the State of Oregon, where required by Contract Documents or authorities having jurisdiction.

1.6 PROJECT CALENDAR

- A. Project Calendar provides a general timeline for milestone events. Calendar days are shown as Monday starting the week, unless specific dates fall within that week (e.g. County holidays). The Calendar is preliminary and may change if currently unscheduled activities or special events occur. Currently scheduled significant Owner activities or public events during the forecast period of construction activity are:
 - 1. None.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

"TIME SCHEDULE FOR SUBMITTALS" FOLLOWS THIS PAGE.

TIME SCHEDULE FOR SUBMITTALS

	FIRST	REVISED	A/E, OWNER	CONTRACTOR	
ITEM	SUBMITTAL	SUBMITAL	REVIEW	UPDATE	COMMENTS
Performance Payment Bond	Submit with signed contract	n/a	n/a	n/a	
Certificate of Insurance	Submit with signed contract	n/a	n/a	n/a	
Contact List	Pre-Construct Conference	Monthly update (minimum)	7 days	7 days	Resubmit with next
Construction	Pre-Construct	Monthly update	7 days	7 days	Resubmit with next
Schedule	Conference	(minimum) Monthly			payment application
Submittals Schedule	Pre-Construct	update (minimum)	7 days	7 days	Resubmit with next
Closeout	Pre-Construct	Monthly update	7 days	7 days	Resubmit with next
Schedule of Values	Pre-Construct Conference	Monthly update	7 days	7 days	Resubmit with next
Contingency Plans	Pre-Construct Conference	Monthly update	7 days	7 days	Resubmit with next payment application
Shop Drawings	14 days prior to ordering	14 days prior to ordering	14 days	7 days	
Product Data	14 days prior to ordering	14 days prior to ordering	14 days	7 days	
Office	7 days prior	7 days prior	7 days	7 days	
Samples	to ordering	to ordering			
Field	7 days prior	7 days prior	7 days	7 days	
Samples	to installation	to installation			
Quality Assurance	7 days prior	7 days prior	7 days	7 days	
Closeout Submittals	14 days before Final Review	As soon as practical	14 days	14 days after Final Review	

SECTION 01 40 00 – QUALITY REQUIREMENTS

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes:
 - 1. Regulatory agency compliance.
 - 2. Special tests and inspections.
 - 3. Quality Assurance

1.2 REGULATORY AGENCY COMPLIANCE

- A. Comply with Contract Document requirements, applicable codes, and regulatory or governing authorities having jurisdiction. Comply with the code of ethics and standards of practice issued by the professional and trade associations of the project participants. Perform work in accordance with applicable County policies, standards and guidelines where provided. Where any requirements, codes or documents conflict, comply with the more stringent and legally binding. Compliance shall include, but not be limited to, the latest rules, regulations, amendments and supplements of following:
 - 1. Federal United States of America:
 - a. Williams-Steiger Occupational Safety & Health Act of 1970, Public Law 91-596.
 - b. Rehabilitation Act of 1973.
 - c. 2010 ADA Standards for Accessible Design.
 - 2. State State of Oregon:
 - a. 2022 Structural Specialty Code.
 - b. 2022 Fire Code.
 - c. Department of Environmental Quality (DEQ).
 - d. Department of Transportation (ODOT).
 - 3. Local City of Gresham

1.3 SPECIAL TESTS AND INSPECTIONS

- A. Owner will engage qualified independent testing and inspection agencies or engineering consultants to conduct special tests and inspections required by authorities having jurisdiction to satisfy permit requirements.
 - 1. These services do not relieve the Contractor of responsibility for compliance with Contract Documents.
 - 2. Where tests indicate non-compliance with Contract Documents, subsequent retesting occasioned by non-compliance shall be performed by same agency or

consultant, and all costs (including additional Architect and Project Manager services made necessary by such failure) shall be reimbursed by Contractor.

- B. Owner reserves right to perform additional tests and inspections of systems, products, components, or materials delivered to site or incorporated into Work, to assure compliance with Contract Document requirements.
 - 1. Unless otherwise specified, Owner shall employ and pay costs for independent testing and inspection agencies or engineering consultants that may be required to perform Owner elected tests and inspections.
 - 2. Where tests indicate non-compliance with Contract Documents, both initial tests and subsequent retesting occasioned by non-compliance shall be performed by same agency or consultant, and all costs (including additional Architect and Project Manager services made necessary by such failure) shall be reimbursed by Contractor.
- C. Notify testing and inspection agency or engineering consultant at least 24 hours in advance of operations to allow for personnel assignments and test scheduling.
- D. Grant representatives of testing agencies or engineering consultants access to Work at any or all times. Provide all job site facilities necessary for representatives to perform their respective functions.
- E. On completion of testing, inspecting, sample taking, and similar services, the Contractor shall repair damaged construction and restore substrates and finishes. Refer to Section 01 73 29 – Cutting and Patching.
- F. Where results of tests or inspections indicate work does not meet Contract Document requirements, the Contractor shall bear the cost to repair or replace that portion of Work as directed by Architect or Project Manager.

1.4 QUALITY ASSURANCE

- A. Factory-Authorized Service Representative: An authorized representative of manufacturer who is trained by manufacturer to inspect installation of products that are similar in material, design, and extent to those indicated for this project.
- PART 2 PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

SECTION 01 50 00 - TEMPORARY FACILITES AND CONTROLS

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes:
 - 1. Temporary Utilities.
 - 2. Temporary Controls.
 - 3. Temporary Facilities.
- B. Related Sections include the following:
 - 1. Section 01 14 00 Work Restrictions for additional requirements.

1.2 TEMPORARY UTILITIES

- A. Temporary Power
 - 1. Contractor may use permanent power systems belonging to Owner, where available.
 - 2. Contractor shall provide and pay for additional power as needed to complete the Work as outlined in the specifications if existing power is not adequate or not available due to Owner use.
- B. Temporary Water
 - 1. Contractor may use permanent water systems belonging to Owner, where available.
 - 2. Contractor shall provide and pay for additional water as needed to complete the Work as outlined in the specifications if existing water is not adequate or not available due to Owner use.
- C. Temporary Sanitary Facilities
 - 1. Contractor may use permanent toilet and washing facilities belonging to Owner where available, in or adjacent to areas of Work only. Contractor will be responsible for maintaining cleanliness of the path between the work area and the public bathrooms. Do not track debris/mud inside building.
 - 2. Contractor shall provide and pay for additional facilities as needed to complete the Work as outlined in the specifications if existing facilities are not adequate or not available due to Owner use.

1.3 TEMPORARY CONTROLS

- A. Safety Protection
 - 1. First Aid: Provide required first aid facilities for construction personnel in

adequate amounts, in accessible locations, and in operational order that are clearly visible and marked.

- 2. Safety Equipment: Contractors, subcontractors, vendors, and service agents, employees, or providers thereof shall wear Hard Hats at all times on site, except when on break or in meetings not in active construction areas. Wear additional protective gear and use safety devices as recommended by authorities having jurisdiction, insurance carriers, and trade associations.
- B. Fire Protection
 - 1. Fire Safety: Take all precautions to prevent possibility of fire resulting from construction operations. Particularly avoid hazardous accumulations of rubbish and unsecured flammable materials.
 - 2. Fire Equipment: Provide emergency fire extinguishers of adequate type and quantity, properly maintained, and in accessible locations that are clearly visible and marked, as required and approved by authorities having jurisdiction.
 - 3. Emergency Egress: Maintain existing fire/smoke detection, fire suppression, and emergency egress for the Work and other portions of the premises where evacuation is impacted by the Work, as required and approved by authorities having jurisdiction.
 - 4. Fire Watch Personnel: Provide and pay for appropriate personnel where required by authorities having jurisdiction, insurance carriers covering the property or Work, Architect, Project Manager, or manufacturer written recommendations due to the Work.
 - 5. Hot Work Procedures: Contractors, subcontractors, vendors, and service agents, employees, or providers thereof involved with hot work operations shall take precautions to prevent fire loss or injury from hot work ignition sources. Hot work is any temporary operation involving open flames or producing heat or sparks including brazing, cutting, grinding, soldering, arc welding, and torchapplied roofing. Follow Factory Mutual Global (FM Global) standards and recommendations for Hot Work including the use of Hot Work Permits, and Red Tags when shutting down fire suppression.
 - 6. Lock Out-Tag Out: Comply with County risk management procedures. Refer to <u>https://commons.multco.us/document/1268/download</u>
- C. Construction Aids and Barriers
 - 1. Provide barriers to protect materials, equipment, new Work, construction personnel, Owner personnel, the public and ongoing Owner operations. Barricade and sign all hazardous areas.
 - 2. Provide heavy-duty, smoke-tight dustproof barriers where required to protect personnel sensitive to fumes or computer equipment that require expensive cleaning and recalibration if exposed to smoke or dust.
 - 3. Provide sound-attenuation barriers where construction is adjacent to noisesensitive work areas.
 - 4. Seal all existing ventilation ducts tightly within the construction area to prevent dust accessing the HVAC system. Provide coverings sufficient to withstand airflow in either direction.
 - 5. Provide adhesive mats or carpets at barricade entrances and in anteroom areas. Keep clean and change daily, or as necessary, to prevent accumulation of dust.

- 6. Seal openings made into the ceiling outside the construction area. Use polystyrene enclosure around the ladder to seal off the opening. Fit enclosure tight to the ceiling and floor.
- 7. Replace immediately any ceiling access panels opened for investigation or inspection (not construction) beyond sealed areas when unattended. Open only one panel per 50 feet at one time.
- D. Access, Parking and Traffic Regulation
 - 1. Keep public right-of-way, access roads and loading areas clear. Obtain necessary permits for work in or closure of public right-of-way(s).
 - 2. Provide barricades, warning signs, or other traffic regulators which may become necessary for protection of public, construction personnel or property.
 - 3. Refer to Section 01 14 00 Work Restrictions for additional requirements.

1.4 TEMPORARY FACILITIES

- A. Contractor may use designated portions of the site and building for the duration of the Work.
 - 1. Contractor may use those spaces for offices, storage, staging, preparation, meetings, or location of temporary facilities.
 - 2. Contractor may lock its own temporary facilities and storage areas, but may not impede emergency egress.
 - 3. Refer to Section 01 14 00 Work Restrictions for exceptions.
- B. Temporary facilities shall comply with building codes, ordinances and regulations of governing authorities having jurisdiction.
- C. Completely remove temporary materials and equipment upon completion of contract or as directed by Architect or Project Manager.
- D. Repair damage caused by temporary installation and restore finished to specified condition.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

SECTION 01 60 00 – PRODUCT REQUIREMENTS

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes:
 - 1. Material Selection.
 - 2. Substitution Procedures.
 - 3. Substitution Requests After Bidding Phase
 - 4. Manufacturer Instructions.
 - 5. Delivery and Handling.
 - 6. Storage and Protection.
 - 7. Installation and Protection.
 - 8. Substitution Request Forms, located at the end of this Section.

PART 2 – PRODUCTS

2.1 MATERIAL SELECTION

- A. Provide products that comply with the Contract Documents, that are undamaged, and unless otherwise indicated, that are new at time of installation.
 - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
- B. Where specifications list both manufacturer and product names, provide one of the products listed that complies with the requirements.
- C. Where specifications list manufacturer names only, provide a product by one of the manufacturers listed that complies with the requirements.
- D. Where specifications name one or more manufacturers or products, followed by the phrases "or approved", "or approved substitute" or "approved substitution", provide a named product that complies with the requirements or submit a Substitution Request for any manufacturer or product not specifically named.
- E. Wherever practical, provide related products from one manufacturer to ensure compatibility.

2.2 SUBSTITUTION PROCEDURES

A. Substitution Request: Change in products, materials, equipment, and methods of construction proposed by the Contractor that are different from those required by the Contract Documents.

- B. Substitution Format: The Architect and Owner will consider a Substitution Request only if submitted on a copy of the appropriate Portland Chapter Construction Specifications Institute "Substitution Request" form, which is located at the end of this Section. Prepare and submit a separate form for each product substitution request.
- C. Supporting Data: Support the Substitution Request for each product with complete data, drawings and samples to indicate the request complies with product requirements.
- D. Procedures: Architect will forward recommendation to Project Manager within 7 days. Project Manager will return decision to Architect and Contractor within 7 days.
- E. Substitutions may be rejected without explanation.
- 2.3 SUBSTITUTION REQUESTS AFTER BIDDING PHASE
 - A. Consideration: Refer to Section 00 90 00 Multnomah County Public Improvement Contract Sample, Section B.19 Substitutions for substitutions after contract award. The Owner will consider Substitution Requests after the bidding phase, only if submitted no less than 14 days before product order must be placed to maintain current Construction Schedule and only for following reasons:
 - 1. Architect or Project Manager request;
 - 2. Reduction in Contract Sum or Contract Time;
 - 3. Specified product is not available from any source through no fault of the Contractor;
 - 4. Specified product would cause significant delay in Contract Time;
 - 5. The substitution is required for compliance with interpretation of code requirements or insurance regulations then existing;
 - 6. Subsequent information discloses inability of specified products to perform properly or to fit in designated space;
 - 7. Manufacturer/fabricator refuses to certify or guarantee performance or specified product as required; or
 - 8. When in the judgment of the Owner or the Architect, a substitution would be substantially in the Owner's best interests, in terms of cost, time, or other consideration.
 - B. Acceptance: If a product appears, in the sole opinion of the Owner, to be an appropriate substitution for the product specified, the Architect will issue a Change Order where Contract Sum or Contract Time is affected or give written authorization (Minor Change in Work) where Contract Sum or Contract Time is not affected.

PART 3 – EXECUTION

- 3.1 MANUFACTURER INSTRUCTIONS
 - A. Perform Work in accordance with manufacturer printed installation instructions. Obtain and distribute copies of such instructions to parties involved in installation,

including one copy to Architect and Project Manager if requested.

- B. Maintain one set of complete installation instructions on site until Project completion.
 - 1. Refer to Section 01 31 00 Project Management and Coordination for project record-keeping requirements.
- C. Handle, install, connect, clean, condition and adjust products in strict accordance with manufacturer printed instructions and in conformity with specified requirements.
 - 1. Should job conditions or specified requirements conflict with manufacturer instructions, consult with Architect for further instructions.
 - 2. Do not proceed with Work without clear instructions.
- D. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by Contract Documents, or by prior written approval from the Architect.

3.2 DELIVERY AND HANDLING

- A. Arrange product deliveries in accordance with current Construction Schedule.
 - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces. Do not schedule material, equipment, or packages delivery to the site prior to mobilization or after demobilization.
 - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 3. Deliver products to Project site in undamaged condition, in manufacturer original container or other packaging system, complete with labels intact and legible and with instructions for handling, storing, unpacking, protecting, and installing. Clearly label as Contractor material.
 - 4. Inspect products on delivery to ensure compliance with the Contract Documents and ensure products are undamaged and properly protected.
- B. Provide equipment and personnel to handle products by methods that prevent soiling or damage to products or packaging.

3.3 STORAGE AND PROTECTION

- A. Store products in accordance with manufacturer instructions, with seals and labels intact and legible.
 - 1. Store products to allow for inspection and measurement of quantity or counting of units.
 - 2. Store materials in a manner that will not endanger Project structure.
 - 3 Store products that are subject to damage by the elements, under cover in a weather-tight enclosure above ground, with ventilation adequate to prevent condensation.
 - 4. Store cementitious products and materials on elevated platforms.

- 5. Store foam plastic away from exposure to sunlight, except to extent necessary for period of installation and concealment.
- 6. Comply with product manufacturer written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
- 7. Protect stored products from damage and liquids from freezing.
- 8. Bring and store on the Project site only the materials and equipment which are to be used directly in the Work
- 9. Promptly remove equipment that is no longer required for the Work,
- 10. Protect construction materials and equipment stored at the Project site from theft, damage and all other adversity.
- B. Exterior Storage.
 - 1. Store fabricated products above the ground, on blocking or skids, to prevent soiling or staining. Cover products which are subject to deterioration with impervious sheet coverings. Provide adequate ventilation to avoid condensation.
 - 2. Store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.
- C. Inspection: Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to assure that products are maintained under specified conditions, and free from damage or deterioration.

3.4 INSTALLATION AND PROTECTION

- A. Protection after installation.
 - 1. Comply with product manufacturer written instructions for temperature, humidity, ventilation, and weather-protection requirements for protection.
 - 2. Provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations.
 - 3. Plug or cap pipe and conduit openings to prevent entrance of foreign matter.
 - 4. Remove protection materials when no longer needed.
- B. Operation after installation.
 - 1. Comply with product manufacturer written instructions for temperature, humidity, ventilation, and weather-protection requirements for product use and operation.
 - 2. Maintain recommended filters and lubricants, whether products are idle or in use.
 - 3. Protect installed products from damage and liquids from freezing.

"SUBSTITUTION REQUEST – AFTER BIDDING PHASE" FORM FOLLOWS THIS PAGE.


Supporting Data Attached:

Drawings

Advancement of Construction Technology

SUBSTITUTION REQUEST

	(After the Bidding Pha
Project:	Substitution Request Number:
	From:
То:	Date:
	A/E Project Number
Re:	Contract For
Specification Title:	Description:
Section: Page:	Article/Paragraph:
Proposed Substitution:	
Manufacturer: Address	Phone:
Trade Name:	Model No.:
Installer: Address	Phone:
History: 🗌 New product 🔲 2-5 years old	5-10 yrs old More than 10 years old
Differences between proposed substitution and s	ecified product:
·	
Point-by-point comparative data attached - R	QUIRED BY A/E
Reason for not providing specified item:	
Similar Installation:	
Project:	Architect:
Address:	Owner:
	Date Installed:
Proposed substitution affects other parts of Work	🗋 No 🔄 Yes; explain
	· · · · · · · · · · · · · · · · · · ·
Savings to Owner for accepting substitution:	(\$
Proposed substitution changes Contract Time:	□ No □ Yes [Add] [Deduct] da

Product Data Samples

Tests

Reports

SUBSTITUTION REQUEST (Continued)

The U	Indersigned	certifies:
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- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by:	£		
Signed by:	4. 		
Firm:	•••••		
Address:	•	 	
Telephone:			
Attachments:		-	
		 · · · · · · · · · · · · · · · · · · ·	

A/ERS REVIEW AND ACTION

 Substitution approved - Make submittals in accordance with Specification Section 01330. Substitution approved as noted - Make submittals in accordance with Specification Section 01330. Substitution rejected - Use specified materials. Substitution Request received too late - Use specified materials. 								
Signed by:				Date:				
Additional Comments:	Contractor	Subcontractor] Supplier	Manufacturer	A/E			
•								
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-				λ.				
••••						-		
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SECTION 01 70 00 - EXECUTION REQUIREMENTS

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes:
 - 1. Examination.
 - 2. Preparation.
 - 3. Installation.
 - 4. Progress Cleaning.
 - 5. Starting and Adjusting.
 - 6. Protection of Installed Construction.
 - 7. Correction of Work.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of improvements, utilities, and other construction indicated as existing and the exactness of grades, elevations, dimensions or locations given on any Drawings issued by the Architect, and the work installed by other contractors are not guaranteed.
Before beginning work, investigate and varify the existence and location of

Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work and verify the accuracy of all grades, elevations, dimensions and locations. In all cases of interconnection of the Work with existing or other work, verify at the site all dimensions relating to such existing other work.

Undertake such further investigations and studies as may be necessary or useful to determine subsurface characteristics and conditions.

Prior to performing any Work locate all utility lines, telephone company lines and cables, sewer lines, water pipes, gas lines, electrical lines, including, without limitation, all buried pipelines and buried telephone cables.

B. Acceptance of Conditions: With applicator or installer present where indicated, examine substrates, areas, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility and Project Manager that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction.

Coordinate with authorities having jurisdiction.

- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings. Review Contract Documents for possible conflicts prior to rough-in. Verify equipment will fit in space provided. Resolve conflicts with Architect prior to rough-in Work.
- D. Clearances: Provide adequate clearance between and among Civil, Structural, Architectural, Mechanical, and Electrical systems, products and components. Verify physical dimensions of equipment, available space, and clearance requirements for installation and service. Check access routes through concealed spaces.
- E. Obtain appropriate governmental approvals and Owner's prior consent before any disruption to the streets and utilities.

3.3 INSTALLATION

- A. General: Locate Work and components of the Work accurately, in correct alignment and elevation, as indicated. Make vertical work plumb and horizontal work level except where a slope is required for drainage. Where space is limited, install components to maximize space available for maintenance, removal and replacement. Conceal pipes, ducts, and wiring in finished areas.
- B. Instructions: Comply with manufacturer written instructions and recommendations for installing products in applications indicated. Install products at the time and under conditions that ensure best possible results. Maintain conditions required for product performance until Substantial Completion.
- C. Operations: Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions or occupancy. Do not use tools or equipment that damage the product or produce harmful fumes, particulates or noise levels. Use products, cleaners, and installation materials that are not considered hazardous. Perform the Work in such a manner so as to avoid damaging any utilities.
- D. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work. Allow for building movement, including thermal expansion and contraction.
- E. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

3.4 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one subcontractor has worked. Enforce requirements strictly.
 - 1. Where dirt or dust would impair execution of the Work or Owner operations, broom-clean or vacuum the entire work area, as appropriate.
 - 2. Do <u>not</u> hold waste materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 degrees Fahrenheit.
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally in accordance with authorities having jurisdiction.
 - 4. Comply with requirements in NFPA 241 and authorities having jurisdiction for removal of combustible waste materials and debris.
 - 5. Maintain the streets and sidewalks around the Project site in a good and clean condition at all times. Remove from such areas all spillage and tracking arising from the Work and establish a regular maintenance program of sweeping and hosing to minimize the accumulation of dirt and dust upon such areas.
 - 6. Clean surfaces outside the construction area immediately, where exposed to construction dust or debris. Use HEPA filtered vacuum to clean carpets outside the barrier. Use damp mop to clean non-carpeted areas outside the barrier.
 - 7. Perform all vacuuming with a certified HEPA filtered vacuum.
- B. Work Areas: Maintain Project site free of waste materials and debris. Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work. Where dust may impair proper execution of the Work, broom-clean or vacuum the entire work area as appropriate. Remove liquid spills promptly. Remove debris from concealed spaces before enclosing the space.
- C. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of product manufacturer or fabricator, using only cleaning materials specifically recommended. If specific materials are not recommended, use cleaning materials that are not hazardous to health and property, will not damage exposed surfaces, and are approved by writing in advance by Project Manager.
 - 1. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at Substantial Completion.
 - 2. Apply protective covering where required to ensure protection from damage or deterioration.
 - 3. Adjust and lubricate operable components to ensure operability without damaging effects.
- D. Waste Disposal: Comply with local ordinances to dispose of materials lawfully. Do <u>not</u> bury or burn waste material on site. Do <u>not</u> deposit or wash solid, volatile, or other waste into sanitary sewers, storm drains, or waterways.
 - 1. Reuse, salvage or recycle as much waste materials as economically feasible. Minimize waste disposal in landfills.

- 2. Do <u>not</u> reuse salvaged materials in the Work without written approval from Architect, unless specified as a salvaged material elsewhere in the Project Manual.
- 3. Submit completed Construction and Demolition Debris Management Form for project costing \$50,000 or more to City of Portland Solid Waste and Recycling Division for projects within city limits. Provide a copy of completed forms to Architect and Project Manager.
 - a. Provide and identify specific area to separate materials for potential recycling, salvage, reuse, and return.
 - b. Keep recycling and waste bin areas neat and clean. Clearly mark storage to avoid contamination of materials.
 - c. At Contract Closeout, report the total percentage by weight of material recycled.

3.5 STARTING AND ADJUSTING

- A. Perform required tests and inspections prior to starting or operating equipment. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Provide a Factory-Authorized Service Representative to inspect field-assembled components and equipment installation. Refer to Section 01 40 00 Quality Requirements for qualification requirements.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer written instructions for temperature and relative humidity.

3.7 CORRECTION OF WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements for cutting and patching.
 - 1. Repair includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their original condition, unless specified otherwise.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot

be repaired without visible evidence of repair.

- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

RECYCLING LOCATIONS, HAZARDOUS WASTE DISPOSAL AND GREEN TENANT IMPROVEMENT GUIDE (ONE PAGE) FOLLOWS THIS PAGE

END OF SECTION

FYI RECYCLING LOCATIONS

Metro Central Transfer Station 6161 NW 61st Ave Portland, OR 97210

DISPOSAL OF HAZARDOUS MATERIALS

These materials require special handling due to health, safety, and/or environmental hazards. Call (503) 234-3000 for information on proper disposal.

- Any material containing asbestos, such as older pipe insulation, floor tiles, and old linoleum
- Empty Barrels
- Petroleum-contaminated soil
- Pressure treated wood, or creosote treated timbers such as railroad ties or utility poles
- Pressurized cylinders
- Florescent light bulbs and tubes
- Transformers

SUSTAINABLE TENTANT IMPROVEMENT INFORMATION

An excellent resource for creating sustainable tenant improvements is *Creating a High Performance Workplace*. The City of Portland's Bureau of Planning and Sustainability has developed "Portland's Green Tenant Improvement Guide" which is available online: <u>https://www.portlandoregon.gov/bps/article/296430</u>

SECTION 01 73 29 - CUTTING AND PATCHING

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes:
 - 1. Examination.
 - 2. Preparation.
 - 3. Performance.

1.2 DEFINITIONS

- A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work. Cutting includes wall and floor coring.
- B. Patching: Fitting and repair work required to restore surfaces to original or specified conditions after installation of other Work.
- C. Materials: New and existing products whose properties include finish, texture, color, and performance characteristics.

1.3 QUALITY ASSURANCE

- A. Structural Elements: Do <u>not</u> cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
- B. Operational Elements: Do <u>not</u> cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or results in increased maintenance or decreased operational life or safety.
- C. Visual Requirements: Do <u>not</u> cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in the opinion of the Architect, reduce the building aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

1.4 WARRANTY

A. Existing Warranties: Use materials and methods to <u>not</u> void existing warranties when removing, replacing, patching, and repairing materials and surfaces cut or damaged during cutting and patching operations.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections of these Specifications.
- B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing surfaces to the fullest extent possible. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 – EXECUTION

3.1 EXAMINATION

A. General: Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed, including elements subject to movement or damage during cutting and patching.

3.2 PREPARATION

- A. Temporary Support: Do <u>not</u> endanger any Work by cutting or altering Work or any part of it. Do <u>not</u> cut or alter Work of another Contractor without prior written approval of the Architect and Project Manager. Provide shoring, bracing and support as required to maintain structural integrity of the Project.
- B. Temporary Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.
- C. Preparatory Cleaning: Clean areas where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar material. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing material. Restore damaged pipe covering to its original condition.

3.3 PERFORMANCE

- A. Execute cutting, product removal and patching by methods which will prevent damage to other Work, will provide proper surfaces to receive installation of repairs and will comply with specified tolerances and finishes. Repair surfaces adjacent to cut areas to match the adjacent finish.
- B. Fill openings cut oversized to install equipment systems or sleeves until finished surface is tight against the equipment, system or sleeve installed in opening.
- C. Perform all cutting and patching for modification of existing and new work including excavating, fitting and patching of Work required to:
 - 1. Make its several parts fit together.
 - 2. Uncover work to provide for installation of ill-timed work.
 - 3. Remove and replace defective work.
 - 4. Remove and replace work not conforming to requirements of Contract

Documents.

- 5. Remove samples of installed work, as specified or where directed, for testing.
- 6. Install specified work in existing construction.
- 7. Uncover work to provide for observation of work covered prior to inspection or approval.
- D. For cutting of wood framing members for pipe, wires and conduit, do not cut or notch joists except 1-inch diameter holes drilled in the center 1/3 of the member depth. Do not drill or notch studs except:
 - 1. Notches in lower 1/5 of stud height and not more than 1/4 of the stud width.
 - 2. Holes not in center 1/3 of stud height and not more than 1/3 of stud width.

END OF SECTION

SECTION 01 77 00 – CLOSEOUT PROCEDURES

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes:
 - 1. Substantial Completion.
 - 2. Cleaning Prior to Final Review.
 - 3. Final Review.
 - 4. Extra Review.
 - 5. Closeout Operations.
 - 6. Closeout Documentation.
 - 7. Final Acceptance.

1.2 SUBSTANTIAL COMPLETION

- A. Submit written notice to Architect and Owner that Work, or a designated portion thereof, is substantially complete.
 - 1. List items (Contractor Punch List) to be completed or corrected, value of those items, and reasons Work is not complete.
 - 2. List contractor affidavits, maintenance and service agreements, workmanship bonds, final certifications, guarantees, warranties, and other quality assurance documents that may start at Substantial Completion.
 - 3. Attach releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 4. Advise Project Manager of pending insurance, utility or similar changeover requirements.
- B. Architect and Project Manager will review Work within <u>14 days</u>.
 - If Architect or Project Manager considers the Work is not substantially complete, Architect or Owner will notify Contractor in writing and attach the Contractor list of items edited to indicate those additional items considered incomplete or incorrect by the Architect or Project Manager. Contractor shall remedy deficiencies and submit another written notice to Architect that Work, or a designated portion thereof, is substantially complete.
 - 2. When Architect and Project Manager concur that Work, or a designated portion thereof, is substantially complete, Architect will prepare Certificate of Substantial Completion.
 - a. Architect or Owner will forward Certificate and revised list of incomplete or incorrect items (Architect Punch List) to Contractor and Project Manager for signature, indicating acceptance of responsibilities assigned to them in Certificate.
 - b. Architect will attach revised list of quality assurance documents effective as of

the date indicated on Certificate. That document list will <u>not</u> include items or portions of items on the Architect Punch List.

1.3 CLEANING PRIOR TO FINAL REVIEW

- A. General: Clean areas of Work and areas impacted by the Work. Maintain those areas in cleaned condition until final completion or Owner occupancy, whichever occurs first. Remove grease, dust, dirt, stains, manufacturer labels, fingerprints, etc. from sight exposed surfaces. Repair, patch and touch up marred surfaces.
- C. Dust Control: Broom clean exterior paved surfaces and walks. Rake clean landscaped areas. Vacuum clean interior spaces. Wash interior and exterior glazing and mirrors. Clean and mop floors.
- D. Pollution Control: Clean heating and cooling ducts, blowers, coils, fixtures, equipment, piping and grilles. Replace disposable air filters and clean permanent filters. Flush water systems and disinfect domestic water lines.

1.4 FINAL REVIEW

- A. Submit written notice to Architect or Owner that Work is complete, correct and final. Certify that:
 - 1. Authorities having jurisdiction reviewed and accepted the Project as complete.
 - 2. Contractor reviewed Contract Documents for completeness of the Work.
 - 3. All building components, equipment and systems are operational.
 - a. Attach copy of previously issued Certificate(s) of Substantial Completion, Architect Punch List(s) of items to be completed or corrected, and list(s) of quality assurance documents currently in effect.
 - b. Attach list of affidavits, agreements, bonds, certifications, guarantees, warrantees, and other quality assurance documents that will be effective as of the date for Final Acceptance.
 - c. Attach one final draft copy of all closeout documentation for review.
- B. Architect and Project Manager will review the Work and closeout documentation within <u>21 days</u>.
 - 1. If Architect or Project Manager considers that Work or documentation is incomplete or defective, Architect will notify Contractor in writing and list what elements were not acceptable as complete. Contractor shall remedy deficiencies and submit another written notice to Architect that Work is complete, correct and final.
 - 2. When Architect and Project Manager concur that Work and documentation is acceptable in accordance with Contract Documents, Architect will notify Contractor in writing to finish closeout operations and will return one draft copy of Contractor closeout documentation draft, with Architect and Project Manager comments.

1.5 EXTRA REVIEW

A. Where Architect or Project Manager performs <u>more than two reviews</u> for each Substantial Completion on the approved Construction Schedule or for the Final Review due to failure of the Work to comply with claims of completeness or correctness made by Contractor, all costs (including additional Architect and Project Manager services made necessary by such failure) shall be reimbursed by Contractor.

1.6 CLOSEOUT OPERATIONS

- A. Demonstration, Instruction and Training.
 - 1. Complete startup testing of equipment and systems not accepted at Substantial Completion.
 - 2. Fully demonstrate, instruct and train Owner designated operating and maintenance personnel in operation, adjustment, maintenance, repair, and replacement of products, equipment, and systems.
 - 3. Use Operation and Maintenance Manual as the basis of demonstration, instruction and training for Owner designated personnel.
 - a. Review organization and contents of manual in full detail to explain all aspects of operations and maintenance.
 - b. Review complete heating and cooling cycles. Review location of dampers, valves, and control equipment.
 - c. Review fire and life safety equipment and systems; emergency controls, shutoffs, and procedures; and incident-response scenarios.
- B. Site Demobilization.
 - 1. Clean, touch up and otherwise repair or restore marred exposed finishes to eliminate visual defects.
 - 2. Remove items under Contractor responsibility not part of Work described in Contract Documents.
 - 3. Remove all protective and temporary aids, barriers, facilities, signs, and Contractor owned items.
 - 4. Refer to Section 01 50 00 Temporary Facilities and Controls.
- C. Submit <u>one</u> electronic copy of approved closeout documentation in final form to Project Manager.
 - 1. Correct closeout documentation in accordance with Final Review comments.
 - 2. Deliver in entirety within <u>14 days</u> after receiving Final Review comments.
 - 3. Obtain delivery receipts from Project Manager.
- D. Materials to Owner.
 - 1. Make final changeover of permanent locks. Deliver key schedule, keys, key blanks, and construction keys specified to Project Manager.
 - 2. Deliver spare parts, maintenance materials, and salvage to Owner designated storage area.

- 3. Inventory and label all items. Deliver quantity specified for each product.
- 4. Obtain delivery receipts from Project Manager.

1.7 CLOSEOUT DOCUMENTATION

- A. Operation and Maintenance Manual Form: electronic.
 - 1. The electronic file should contain the following:
 - a. OPERATION AND MAINTENANCE MANUAL.
 - b. County building number and building name.
 - c. County project number and name.
 - d. General Contractor name.
 - e. Date of publication.
 - f. Copy of final permit if applicable.
 - g. Subject matter of contents.
 - 2. Organize the electronic information into a separate folder for each system and subsystem, and a separate folder for each piece of equipment not part of a system.
 - a. Arrange folder contents according to Specification Section number.
- B. Operation and Maintenance Manual Content: Provide the following for each product, equipment, subsystem, and system:
 - 1. Specification Section, product name, manufacturer catalog number, and replaceable parts list.
 - 2. Supplier, installer, maintenance program, and local source of supply for replacement parts.
 - 3. Name plate data, color coding, marker/tag, location, access, and other field identification.
 - 4. Approved submittals, field tests, test and balance reports, and inspection reports.
 - 5. Manufacturer information on installation, operation, maintenance, repair, and replacement.
 - a. Standards and procedures for startup, shutdown, seasonal, weekend, and normal operations.
 - b Sequence of operations, control diagrams, flow diagrams, and system relationship drawings.
 - c. Customized drawings and literature for site-specific modifications or recommendations.
 - d. Finish material, color, texture and recommended cleaning agents and schedule.
 - e. Maintenance and service schedules for preventive and routine maintenance.
 - f. Emergency controls and shutoffs, instructions and procedures.
 - 6. Affidavits, agreements, bonds, certifications, guarantees, warranties, and other quality assurance documents:

- a. Executed document, effective date, duration of coverage, and party to contact in case of claim.
- b. Description of coverage and conditions or requirements for maintaining effective coverage.
- 7. Approvals, releases or certificates (e.g. Certificate of Occupancy) from authorities having jurisdiction.
- C. Project Record Documents:
 - 1. Marked up Contract Documents including Project Manual and Drawings that records all changes in Work and/or deviations from original Contract Documents.
 - a. In Project Manual, highlight each Product actually used in list of acceptable Products.
 - b. In Project Manual, note Substitution Request where approved.
 - 2. Submit CAD drawings that comply with the latest version of the following: Multnomah County CAD Standards. Convert each drawing sheet from CAD file into an individual Adobe Acrobat PDF File and use the Sheet Identification as the Filename for the drawing sheet. Otherwise, submit, if approved by the County Project Manager, red-lined drawings that record all changes in work and/or deviations from original contract documents.

1.8 FINAL ACCEPTANCE

- A. Final Application for Payment:
 - 1. Submit one electronic copy of delivery receipts for Owner materials and corrected closeout documentation.
 - 2. Submit one electronic copy of Contractor's Affidavit of Payment of Debts and Claims, AIA G706 or equivalent approved by Owner.
 - 3. Submit one electronic copy of Contractor's Affidavit of Release of Liens, AIA G706A or equivalent approved by Owner.
 - a. Consent of Surety to Final Payment, AIA G707 or equivalent approved by Owner.
 - b. Contractor release or waiver of liens.
- B. Final payment by Owner constitutes final acceptance of the Work.
 - 1. Quality assurance documents not previous in effect (e.g. since Substantial Completion) will start on date of final payment, unless specified otherwise.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

- 1.1 SUMMARY
 - A. Section Includes:
 - 1. Demolition and removal of selected site elements.
 - B. Related Requirements:
 - 1. Multhomah County Facilities Specification Standards 2024.
 - 2. Section 01 11 00 "Summary of Work" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
 - 3. Section 01 73 29 "Cutting and Patching" for cutting and patching procedures.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- C. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.
- 1.3 MATERIALS OWNERSHIP
 - A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- 1.4 FIELD CONDITIONS
 - A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
 - B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
 - C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
 - D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. Hazardous materials will be removed by Owner before start of the Work.
 - 2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
 - E. Storage or sale of removed items or materials on-site is not permitted.
 - F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1.5 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

- 2.1 PERFORMANCE REQUIREMENTS
 - A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
 - B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. When demolition work has been performed by Owner, verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review Project Record Documents, when available, of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
 - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- D. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- E. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Arrange to shut off utilities with utility companies.
 - 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

3.3 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new

construction, to prevent water leakage and damage to structure and interior areas.

- 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
- 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
- 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 01 50 00 "Temporary Facilities and Controls."
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of selective demolition.
- C. Remove temporary barricades and protections where hazards no longer exist.
- 3.4 SELECTIVE DEMOLITION, GENERAL
 - A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 - 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 - 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 - 5. Maintain fire watch during and for at least two (2) hours after flame-cutting operations.
 - 6. Maintain adequate ventilation when using cutting torches.
 - 7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 - 8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 - 9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 - B. Site Access and Temporary Controls: Conduct selective demolition and debrisremoval operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and recycle or dispose of them.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn demolished materials.

3.7 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION

SECTION 03 10 00 - CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

- 1.1 SUMMARY
 - A. Section Includes:
 - 1. Form-facing material for cast-in-place concrete.

1.2 DEFINITIONS

- A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.
- B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.
- 1.3 ACTION SUBMITTALS
 - A. Shop Drawings: Detailing fabrication, assembly, and support of forms.
 - 1. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301.
 - a. Location of construction joints is subject to approval of the Architect.
 - 2. Indicate proposed schedule and sequence of stripping of forms.

PART 2 - PRODUCTS

- 2.1 PERFORMANCE REQUIREMENTS
 - A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
 - 1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
 - 2. Design formwork to limit deflection of form-facing material to no more than 1/240 of center-to-center spacing of supports.
- 2.2 FORM-FACING MATERIALS
 - A. As-Cast Surface Form-Facing Material:
 - 1. Provide continuous, true, and smooth concrete surfaces.
 - 2. Furnish in largest practicable sizes to minimize number of joints.
 - 3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 03 30 00 "Cast-In-Place Concrete, and as follows:
 - a. Plywood, metal, or other approved panel materials.
 - b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - 1) APA HDO (high-density overlay).

- 2) APA MDO (medium-density overlay); mill-release agent treated and edge sealed.
- 3) APA Structural 1 Plyform, B-B or better; mill oiled and edge sealed.
- 4) APA Plyform Class I, B-B or better; mill oiled and edge sealed.
- B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.
 - 1. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiberreinforced plastic, paper, or fiber tubes that produce surfaces not exceeding specified formwork surface class.
 - 1. Provide forms with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

2.3 RELATED MATERIALS

- A. Chamfer Strips: Wood, metal, PVC, or rubber strips, 1- by 1-inch, minimum.
- B. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- C. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

- A. Comply with ACI 301.
- B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 03 30 00 "Cast-In-Place Concrete" for as-cast finishes.
- C. Limit concrete surface irregularities as follows:
 - 1. Surface Finish-1.0: ACI 117 Class D, 1 inch.
 - 2. Surface Finish-2.0: ACI 117 Class B, 1/4 inch.
 - 3. Surface Finish-3.0: ACI 117 Class A, 1/8 inch.
- D. Construct forms tight enough to prevent loss of concrete mortar.
 - 1. Minimize joints.
 - 2. Exposed Concrete: Symmetrically align joints in forms.
- E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.

- 1. Provide crush or wrecking plates where stripping may damage castconcrete surfaces.
- 2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
- 3. Install keyways, reglets, recesses, and other accessories, for easy removal.
- F. Do not use rust-stained, steel, form-facing material.
- G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.
 - 1. Provide and secure units to support screed strips
 - 2. Use strike-off templates or compacting-type screeds.
- H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.
 - 1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
 - 2. Locate temporary openings in forms at inconspicuous locations.
- I. Chamfer exterior corners and edges of permanently exposed corners.
- J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.
- K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
 - 1. Determine sizes and locations from trades providing such items.
 - 2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.
- L. Construction and Movement Joints:
 - 1. Construct joints true to line with faces perpendicular to surface plane of concrete.
 - 2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 3. Place joints perpendicular to main reinforcement.
 - 4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.
 - a. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
- M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
 - 1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
 - 2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.
 - 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
 - 3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 4. Install dovetail anchor slots in concrete structures, as indicated on Drawings.
 - 5. Clean embedded items immediately prior to concrete placement.

3.3 REMOVING AND REUSING FORMS

- A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 12 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
 - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work.
 - 1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
 - 2. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
 - 1. Align and secure joints to avoid offsets.
 - 2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

END OF SECTION

SECTION 03 20 00 - CONCRETE REINFORCING

PART 1 - GENERAL

- 1.1 SUMMARY
 - A. Section Includes:
 - 1. Steel reinforcement bars.
 - 2. Welded-wire reinforcement.

1.2 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Each type of steel reinforcement.
 - 2. Bar supports.
- B. Shop Drawings: Comply with ACI SP-066:
 - 1. Include placing drawings that detail fabrication, bending, and placement.
 - 2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.
- C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.
 - 1. Location of construction joints is subject to approval of the Architect.
- D. Welding Certificates.
- 1.3 QUALITY ASSURANCE
 - A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.
- 1.4 DELIVERY, STORAGE, AND HANDLING
 - A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. and to avoid damaging coatings on steel reinforcement.
 - 1. Store reinforcement to avoid contact with earth.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

1.

- A. Reinforcing Bars: As indicated on the Drawings.
- B. Steel Bar Mats: ASTM A184/A184M, fabricated from ASTM A615/A615M, Grade 60, deformed bars, assembled with clips.

2.2 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.
 - Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
- B. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.
 - 1. Finish: Plain.
- C. Mechanical Splice Couplers: As indicated on the Drawings.

2.3 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

PART 3 - EXECUTION

- 3.1 PREPARATION
 - A. Protection of In-Place Conditions:
 - B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
- B. Accurately position, support, and secure reinforcement against displacement.
 - 1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
 - 2. Do not tack weld crossing reinforcing bars.
- C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- D. Provide concrete coverage in accordance with ACI 318.
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Splices: Lap splices as indicated on Drawings.
 - 1. Bars indicated to be continuous, and all vertical bars shall be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater, unless otherwise noted.
 - 2. Stagger splices in accordance with ACI 318.
 - 3. Weld reinforcing bars in accordance with AWS D1.4/D 1.4M, where indicated on Drawings.

3.3 JOINTS

- A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement.
 - 2. Continue reinforcement across construction joints unless otherwise indicated.
 - 3. Do not continue reinforcement through sides of strip placements of floors and slabs.
- 3.4 INSTALLATION TOLERANCES
 - A. Comply with ACI 117.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
 - 1. Steel-reinforcement placement.
 - 2. Steel-reinforcement welding.

END OF SECTION

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.
- B. Related Requirements:
 - 1. Section 03 10 00 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.
 - 2. Section 03 20 00 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.
- 1.2 DEFINITIONS
 - A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
 - B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.3 ACTION SUBMITTALS

- A. Product Data: For each of the following.
 - 1. Portland cement.
 - 2. Fly ash.
 - 3. Slag cement.
 - 4. Blended hydraulic cement.
 - 5. Silica fume.
 - 6. Performance-based hydraulic cement
 - 7. Aggregates.
 - 8. Admixtures:
 - a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
 - 9. Fiber reinforcement.
 - 10. Vapor retarders.
 - 11. Floor and slab treatments.
 - 12. Liquid floor treatments.
 - 13. Curing materials.
 - 14. Joint fillers.
 - 15. Repair materials.
- B. Design Mixtures: For each concrete mixture, no later than 15 days prior to the start of Work or mockups, include the following:
 - 1. Mixture identification, including location of the Work where employed.
 - 2. Minimum 28-day compressive strength.
 - 3. Durability exposure class.
 - 4. Maximum w/cm.

- 5. Calculated equilibrium unit weight, for lightweight concrete.
- 6. Slump limit.
- 7. Air content.
- 8. Nominal maximum aggregate size.
- 9. Steel-fiber reinforcement content.
- 10. Synthetic micro-fiber content.
- 11. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
- 12. Intended placement method.
- 13. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Shop Drawings:
 - 1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - a. Location of construction joints is subject to approval of the Architect.
- D. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:
 - 1. Concrete Class designation.
 - 2. Location within Project.
 - 3. Exposure Class designation.
 - 4. Formed Surface Finish designation and final finish.
 - 5. Curing process.
 - 6. Floor treatment if any.
- E. Placement Schedule: Submit before start of placement operations.
- 1.4 INFORMATIONAL SUBMITTALS
 - A. Preconstruction Test Reports: For each mix design.
 - B. Field quality-control reports.
- 1.5 QUALITY ASSURANCE

1.

A. Installer Qualifications: A firm specializing in work of this Section and able to demonstrate a minimum of 5 years documented experience in successful quality work of comparable scope and quality when requested by the Architect.

1.6 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.
 - Include the following information in each test report:
 - a. Admixture dosage rates.
 - b. Slump.
 - c. Air content.
 - d. Seven-day compressive strength.
 - e. 28-day compressive strength.
 - f. Permeability.
- 1.7 DELIVERY, STORAGE, AND HANDLING
 - A. Comply with ASTM C94/C94M and ACI 301.

- 1.8 FIELD CONDITIONS
 - A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.
 - 1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 3. Do not use frozen materials or materials containing ice or snow.
 - 4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
 - 5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
 - B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:
 - 1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
 - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

- 2.1 CONCRETE, GENERAL
 - A. ACI Publications: Comply with ACI 301unless modified by requirements in the Contract Documents.
 - B. Source Limitations:
 - 1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
 - 2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
 - 3. Obtain aggregate from single source.
 - 4. Obtain each type of admixture from single source from single manufacturer.
- 2.2 CONCRETE MATERIALS
 - A. Cementitious Materials:
 - 1. Portland Cement: ASTM C150/C150M, Type I/II, gray.
 - 2. Fly Ash: ASTM C618, Class C or F.
 - 3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
 - 4. Silica Fume: ASTM C1240, proportioned in accordance with ACI 211.1.
 - B. Normal-Weight Aggregates: ASTM C33/C33M, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.
 - 1. Maximum Coarse-Aggregate Size: 1-1/2 inches nominal for footings where concrete reinforcing spacing allows. Aggregate size shall not be greater than fifty percent of the smallest spacing between reinforcing bars. Reduce size to 3/4 inch for all other work.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
 - 3. Combined Aggregate Gradation: Well graded from coarsest to finest with not more than 18 percent and not less than 8 percent retained on an

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- individual sieve, except that less than 8 percent may be retained on sieves finer than No. 50.
- C. Air-Entraining Admixture: ASTM C260/C260M.
- D. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
 - 2. Retarding Admixture: ASTM C494/C494M, Type B.
 - 3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
 - 4. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
- E. Water and Water Used to Make Ice: ASTM C94/C94M, potable or complying with ASTM C1602/C1602M, including all limits listed in Table 2 and the requirements of paragraph 5.4.
- 2.3 CURING MATERIALS
 - A. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
 - a. <u>Creteseal</u>.
 - b. <u>Dayton Superior</u>.
 - c. W.R. Meadows, Inc.
 - d. Masco.
 - B. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete intended for application immediately after concrete placement.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
 - a. <u>BASF Corporation</u>
 - b. Dayton Superior.
 - c. W.R. Meadows, Inc.
 - d. The Euclid Chemical Company.
 - C. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
 - D. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
 - 1. Color:
 - a. Ambient Temperature Below 50 deg F: Black.
 - b. Ambient Temperature between 50 deg F and 85 deg F: Any color.
 - c. Ambient Temperature Above 85 deg F: White.
 - E. Curing Paper: Eight-feet-wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by the following:
 - a. Fortifiber Building Systems Group.
 - F. Water: Potable or complying with ASTM C1602/C1602M.

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- 2.4 **RELATED MATERIALS**
 - Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated Α. cellulosic fiber.
 - Curved Applications: ASTM D4819, Type II. 1.
 - Product: WR Meadows Deck-o-Foam or equal. a.
 - Thickness: 1/4-inch unless otherwise indicated or as required for b. application.
 - Semirigid Joint Filler, Normal-Duty: Two-component, semirigid, 100 percent Β. solids, epoxy resin with a Type A shore durometer hardness of 55 in accordance with ASTM D2240.
 - C. Semirigid Joint Filler, Heavy-Duty: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 in accordance with ASTM D2240.
 - Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic D. emulsion or styrene butadiene.
 - E. Floor Slab Protective Covering: Eight-feet-wide cellulose fabric.
- 2.5 REPAIR MATERIALS
 - Α. Repair, General:
 - For exposed applications, provide products and design mix using ASTM 1. C979 colored pigments and colored aggregates proportioned as required to match existing color and texture of existing concrete slabs.
 - Products: Provide products complying with requirements by one of the 2. following:
 - a. Ardex.
 - Laticrete. b.
 - Sika. C.
 - Mapei. d.
 - Repair Underlayment: Cement-based, polymer-modified, self-leveling product Β. that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - Cement Binder: ASTM C150/C150M portland cement or hydraulic or 1. blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested in accordance with ASTM C109/C109M.
 - Repair Overlayment: Cement-based, polymer-modified, self-leveling product that C. can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
 - Cement Binder: ASTM C150/C150M portland cement or hydraulic or 1. blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested in accordance with ASTM C109/C109M.

- 2.6 CONCRETE MIXTURES, GENERAL
 - A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.
 - 1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
 - B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash or Other Pozzolans: 25 percent by mass.
 - 2. Slag Cement: 50 percent by mass.
 - 3. Silica Fume: 10 percent by mass.
 - 4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: Except where otherwise indicated for concrete to receive a polished concrete finish, 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
 - 5. Total of Fly Ash or Other Pozzolans and Silica Fume: Except where otherwise indicated for concrete to receive a polished concrete finish, 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
 - C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
 - 1. Use water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete, and concrete with a w/cm below 0.50.
- 2.7 CONCRETE MIXTURES
 - A. Normal-Weight Concrete:
 - 1. Minimum Compressive Strength: 3000 psi at 28 days.
 - 2. Maximum w/cm: 0.50.
 - 3. Minimum Cementitious Materials Content: 470 lb/cu. yd..
 - 4. Slump Limit: 4 inches, plus or minus 1 inch for concrete with verified slump of 3 inches plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site.
 - 5. Slump Flow Limit: 22 inches, plus or minus 1.5 inches.
 - 6. Air Content:
 - a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
 - 7. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- 2.8 CONCRETE MIXING
 - A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M, and furnish batch ticket information.

3.1 EXAMINATION

- A. Verification of Conditions:
 - 1. Before placing concrete, verify that installation of concrete forms, accessories, reinforcement, and embedded items is complete and that required inspections have been performed.
 - 2. Do not proceed until unsatisfactory conditions have been corrected.
- 3.2 PREPARATION
 - A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:
 - 1. Daily access to the Work.
 - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 - 3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
 - 4. Security and protection for test samples and for testing and inspection equipment at Project site.
 - B. All plumbing piping, HVAC and sewerage piping penetrations shall have expansion joint material at interface with concrete. No piping shall be embedded without expansion material unless otherwise permitted by code any by Work of Divisions 21 through 28.

3.3 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
 - 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.

3.4 JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
 - 1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
 - 2. Place joints perpendicular to main reinforcement.
 - a. Continue reinforcement across construction joints unless otherwise indicated.
 - b. Do not continue reinforcement through sides of strip placements of floors and slabs, unless otherwise indicated.
 - 3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 - 4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.

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- 6. Space vertical joints in walls as indicated on Drawings. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
- 7. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- 3.5 CONCRETE PLACEMENT
 - A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
 - 1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
 - 2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
 - B. Notify Architect and testing and inspection agencies 48 hours prior to commencement of concrete placement.
 - C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.
 - D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
 - 1. If a section cannot be placed continuously, provide construction joints as indicated.
 - 2. Deposit concrete to avoid segregation.
 - 3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
 - a. Do not use vibrators to transport concrete inside forms.
 - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
 - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
 - d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- 3.6 FINISHING FORMED SURFACES
 - A. As-Cast Surface Finishes:
 - 1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
 - a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
 - b. Remove projections larger than 1 inch.
 - c. Tie holes do not require patching.
 - d. Surface Tolerance: ACI 117 Class D.
 - e. Apply to concrete surfaces not exposed to public view.

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- 2. ACI 301Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
 - a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
 - b. Remove projections larger than 1/4 inch.
 - c. Patch tie holes.
 - d. Surface Tolerance: ACI 117 Class B.
 - e. Locations: Apply to concrete surfaces exposed to public view.
- 3. ACI 301 Surface Finish SF-3.0:
 - a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
 - b. Remove projections larger than 1/8 inch.
 - c. Patch tie holes.
 - d. Surface Tolerance: ACI 117 Class A.
 - e. Locations: Apply to concrete surfaces exposed to public view, or to be covered with a coating or covering material applied directly to concrete.
- B. Related Unformed Surfaces:
 - 1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
 - 2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.7 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

- A. Filling In:
 - 1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
 - 2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
 - 3. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
 - 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 - 2. Construct concrete bases 6 inches high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
 - 3. Minimum Compressive Strength: 4000 psi at 28 days unless otherwise indicated on the Drawings.
 - 4. Install reinforcing dowels to connect concrete base to concrete floor. Unless otherwise indicated, install reinforcing dowels on 18-inch centers around the full perimeter of concrete base.
 - 5. For supported equipment, install anchor bolts as required to develop delegated-design-calculated equipment anchorage reactions; extend
through concrete base and anchor into structural concrete substrate if required.

- 3.8 CONCRETE CURING
 - A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
 - 1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
 - 2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
 - 3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h before and during finishing operations.
 - B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:
 - 1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
 - 2. If forms remain during curing period, moist cure after loosening forms.
 - 3. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:
 - a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
 - b. Continuous Sprinkling: Maintain concrete surface continuously wet.
 - c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
 - d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
 - C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:
 - 1. Begin curing immediately after finishing concrete.
 - 2. Interior Concrete Floors:
 - a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
 - Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12-inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.

- Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
- 3.9 TOLERANCES
 - A. Conform to ACI 117.
- 3.10 JOINT FILLING
 - A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least one month.
 - 2. Do not fill joints until construction traffic has permanently ceased.
 - B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
 - C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.
 - 1. Use Normal-Duty joint filler for typical locations subject to normal traffic.
 - 2. Use Heavy-Duty joint filler for locations subject to repeated forklift traffic or other heavy equipment.
 - D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.11 CONCRETE SURFACE REPAIRS

- A. Defective Concrete:
 - 1. Repair and patch defective areas when approved by Architect.
 - 2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.
 - a. Limit cut depth to 3/4 inch.
 - b. Make edges of cuts perpendicular to concrete surface.
 - c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
 - d. Fill and compact with patching mortar before bonding agent has dried.
 - e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
 - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.

- b. Compact mortar in place and strike off slightly higher than surrounding surface.
- 3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces:
 - 1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
 - a. Correct low and high areas.
 - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 3. After concrete has cured at least 14 days, correct high areas by grinding.
 - 4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.
 - a. Finish repaired areas to blend into adjacent concrete.
 - 5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
 - a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - b. Feather edges to match adjacent floor elevations.
 - 6. Correct other low areas scheduled to remain exposed with repair topping.
 - a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
 - b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - 7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.
 - a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
 - b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
 - c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
 - d. Place, compact, and finish to blend with adjacent finished concrete.
 - e. Cure in same manner as adjacent concrete.
 - 8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.
 - a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
 - b. Dampen cleaned concrete surfaces and apply bonding agent.
 - c. Place patching mortar before bonding agent has dried.
 - d. Compact patching mortar and finish to match adjacent concrete.

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- e. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.
- 3.12 FIELD QUALITY CONTROL
 - A. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
 - 1. Testing agency shall be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
 - 2. Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
 - 3. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
 - a. Test reports shall include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
 - 1) Project name.
 - 2) Name of testing agency.
 - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
 - 4) Name of concrete manufacturer.
 - 5) Date and time of inspection, sampling, and field testing.
 - 6) Date and time of concrete placement.
 - 7) Location in Work of concrete represented by samples.
 - 8) Date and time sample was obtained.
 - 9) Truck and batch ticket numbers.
 - 10) Design compressive strength at 28 days.
 - 11) Concrete mixture designation, proportions, and materials.
 - 12) Field test results.
 - 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
 - 14) Type of fracture and compressive break strengths at seven days and 28 days.
 - B. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
 - C. Inspections: As indicated on the Drawings and as follows:
 - 1. Headed bolts and studs.
 - 2. Verification of use of required design mixture.
 - 3. Concrete placement, including conveying and depositing.
 - 4. Curing procedures and maintenance of curing temperature.
 - 5. Verification of concrete strength before removal of shores and forms from beams and slabs.

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- 6. Batch Plant Inspections: On a random basis, as determined by Architect.
- D. Concrete Tests: As indicated on the Drawings and as follows:
 - 1. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing inplace concrete.
 - 2. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
 - 3. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
 - 4. Additional Tests:
 - a. Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
 - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
 - 1) Acceptance criteria for concrete strength shall be in accordance with ACI 301 section 1.6.6.3.
 - 5. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 - 6. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- 3.13 PROTECTION
 - A. Protect concrete surfaces as follows:
 - 1. Protect from petroleum stains.
 - 2. Diaper hydraulic equipment used over concrete surfaces.
 - 3. Prohibit vehicles from interior concrete slabs.
 - 4. Prohibit use of pipe-cutting machinery over concrete surfaces.
 - 5. Prohibit placement of steel items on concrete surfaces.
 - 6. Prohibit use of acids or acidic detergents over concrete surfaces.
 - 7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
 - 8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

END OF SECTION

SECTION 07 84 13 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Penetration firestopping systems for the following applications:
 - a. Penetrations in fire-resistance-rated walls.
 - b. Penetrations in horizontal assemblies.
 - c. Penetrations in smoke barriers.
- B. Related Requirements:
 - 1. Section 07 84 43 "Joint Firestopping" for joints in or between fireresistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.
- 1.2 PREINSTALLATION MEETINGS
 - A. Preinstallation Conference: Conduct conference at Project site.
- 1.3 ACTION SUBMITTALS
 - A. Product Data: For each type of product.
 - B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
 - C. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.
- 1.4 INFORMATIONAL SUBMITTALS
 - A. Qualification Data: For Installer.
 - B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.
- 1.5 CLOSEOUT SUBMITTALS
 - A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.
- 1.6 QUALITY ASSURANCE
 - A. Installer Qualifications: An installer who is qualified by the firestopping manufacturer as having been provided the necessary training to install firestop products per specified requirements.
- 1.7 PROJECT CONDITIONS
 - A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration

firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

- B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.
- 1.8 COORDINATION
 - A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.
 - B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

- 2.1 PERFORMANCE REQUIREMENTS
 - A. Fire-Test-Response Characteristics:
 - 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Product iQ[™]"
 - 2) Intertek Group in its "Directory of Listed Building Products."
 - 3) FM Approval in its "Approval Guide."
 - B. Provide products that, upon curing, do not re-emulsify, dissolve, leach, breakdown, or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during and after construction.
 - C. When intumescent products are used, provide products that do not contain sodium silicate or any other water-soluble intumescent ingredient in the formulation.
 - D. Provide firestop products that do not contain ethylene glycol.
 - E. Provide firestop sealants sufficiently flexible to accommodate movement such as pipe vibration, water hammer, thermal expansion and other normal building movement without damage to the seal.
 - F. Pipe insulation shall not be removed, cut away or otherwise interrupted through wall or floor openings. Provide products appropriately tested for the thickness and type of insulation utilized.
 - G. Dissimilar Materials: Noncombustible penetrating items shall not connect to combustible items beyond the point of firestopping unless it can be demonstrated that the fire-resistance integrity of the wall is maintained.
 - H. Cable Pathway Devices: For penetrations of data, video and communications cables in all locations where frequent cable moves, adds or changes will occur, provide fire-rated pathway devices with a built-in fire sealing system sufficient to maintain the hourly fire rating of the barrier penetrated and automatically adjust

to the cable loading and permit cables to be installed, removed, or retrofitted without the need to remove or reinstall any firestop materials.

- 1. Capable of retrofit around existing cables;
- 2. Designed such that two or more devices can be ganged together;
- 3. Maintenance-free such that no action is required to activate the smoke and fire sealing mechanism.
- I. When cable pathway devices are not practical, openings within walls and floors designed to accommodate data, video and communications cabling shall be provided with re-enterable products specifically designed for retrofit.
- J. Fire-Rated Cable Sleeve Kits: When used, provide complete kits designed for new or existing cable penetrations through walls, which include a precut metallic sleeve, end caps to prevent sharp edges, mounting escutcheons, intumescent escutcheon gaskets, firestop putty and wall warning labels, and are sized to same O.D. as standard EMT (Electrical Mechanical Tubing) to accept standard accessories.
- K. Thermal Wrap: For fire protection of membrane penetrations of utility boxes, electrical circuits, and exposed fuel lines, provide a flexible protective wrap which, when exposed to fire, releases chemically bound water to have a cooling effect (endothermic); and is tested and listed for up to 2-hour fire ratings in accordance with ASTM E814/UL 1479 for membrane penetrations or ASTM E1725/UL1724 for thermal barrier, circuit integrity and fuel line protection.

2.2 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
 - a. <u>3M Fire Protection Products</u>.
 - b. <u>Hilti, Inc</u>.
 - c. <u>Specified Technologies, Inc</u>.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
 - 1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
 - 1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
 - 2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for the following:
 - a. Floor penetrations within the cavity of a wall;
 - b. Floor penetrations by floor, tub or shower drains contained within the concealed space of a horizontal assembly;

- c. Floor penetrations of maximum 4" nominal diameter penetrating directly into metal-enclosed electrical power switch-gear.
- 3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.
- D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg.
 - 1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at and no more than 50-cfm cumulative total for any 100 sq. ft. at both ambient and elevated temperatures.
- E. Exposed Penetration Firestopping Systems: Flame-spread and smokedeveloped indexes of less than 25 and 450, respectively, per ASTM E84.
- F. Manufactured Piping Penetration Firestopping System: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
 - 1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
 - 2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
 - 3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.
 - 4. Sleeve: Molded-PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
 - 5. Stack Fitting: ASTM A48/A48M, gray-iron, hubless-pattern wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
 - 6. Special Coating: Corrosion resistant on interior of fittings.
- G. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.
 - 1. Permanent forming/damming/backing materials.
 - 2. Substrate primers.
 - 3. Collars.
 - 4. Steel sleeves.
- 2.3 FILL MATERIALS
 - A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-inplace concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
 - B. Latex Sealants: Single-component, intumescent, latex formulations that do not re-emulsify after cure during exposure to moisture, and do not contain water soluble intumescent ingredients.
 - C. Endothermic Sealants: Single component latex formulations which, when exposed to fire, absorb heat and release water vapor.

- D. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- E. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
- F. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- G. Intumescent Wrap Strips: Single-component intumescent elastomeric strips for use around combustible penetrants.
- H. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a non-shrinking, homogeneous mortar.
- I. Pillows/Bags: Reusable, non-curing, compressible, intumescent pillows/bags. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- J. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.
- K. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.
- L. Fire-Rated Cable Pathways: Factory-made, gangable, device modules comprised of a steel raceway with built-in intumescent material allowing 0 to 100 percent visual cable fill and requiring no additional products or action in the form of plugs, twisting closure, putty, pillow, or sealant or otherwise to achieve fire and air leakage ratings, and capable of being retrofitted around existing cables.
- M. Cable Sleeve Retrofit Device: Factory-made, intumescent, two-part hinged device for firestopping existing over-filled cable sleeves.
- N. Fire-Rated Cable Sleeve Kits: Complete kits for new or existing cable penetrations consisting of preformed steel sleeve with rolled edges, steel escutcheon plates with intumescent gaskets, and firestop putty.
- O. Wall Opening Protective Materials ("Putty Pads"): Intumescent, non-curing pads or inserts for protection of electrical switch and receptacle boxes.
- P. Fire-Rated HVAC Retaining Angles: Steel angle system with integral intumescent firestop gasket for use around rectangular steel HVAC ducts without fire dampers.
- Q. Firestop Plugs: Re-enterable foam rubber plug impregnated with intumescent material for use in blank openings and cable sleeves.
- R. Fire-Rated Cable Grommet: Molded two-piece grommet made of plenum-grade polymer with a foam inner core for sealing cable penetrations up to 0.5 in. diameter through gypsum walls.
- S. Fire-Rated Closet Flange Gasket: Molded, single-component, flexible, intumescent gasket for use beneath a closet (toilet) flange in floor applications.
- T. Thermal Wrap: Flexible, endothermic, fire-resistant wrap material for protecting membrane penetrations of utility boxes (electrical panels, medical gas boxes, elevator call boxes), electrical circuits (cables, conduits, cable trays), and exposed fuel lines.

2.4 MIXING

A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of

mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- 3.3 INSTALLATION
 - A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
 - B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
 - C. Install fill materials by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

END OF SECTION

SECTION 07 84 43 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Joints in or between fire-resistance-rated constructions.
 - 2. Joints in smoke barriers.
- B. Related Requirements:
 - 1. Section 07 84 13 "Penetration Firestopping" for penetrations in fireresistance-rated walls, horizontal assemblies, and smoke barriers and for wall identification.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.
- C. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
- 1.3 INFORMATIONAL SUBMITTALS
 - A. Qualification Data: For Installer.
 - B. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.
- 1.4 CLOSEOUT SUBMITTALS
 - A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.
- 1.5 QUALITY ASSURANCE
 - A. Installer Qualifications: An installer who is qualified by the firestopping manufacturer as having been provided the necessary training to install firestop products per specified requirements.
- 1.6 PROJECT CONDITIONS
 - A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
 - B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

- A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of joints to accommodate joint firestopping systems.

PART 2 - PRODUCTS

- 2.1 PERFORMANCE REQUIREMENTS
 - A. Fire-Test-Response Characteristics:
 - 1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Joint firestopping systems shall bear classification marking of a qualified testing agency.
 - B. Provide products that, upon curing, do not re-emulsify, dissolve, leach, breakdown, or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during and after construction.
 - C. When intumescent products are used, provide products that do not contain sodium silicate or any other water-soluble intumescent ingredient in the formulation.
 - D. Provide firestop products that do not contain ethylene glycol.
 - E. Provide firestop sealants sufficiently flexible to accommodate movement such as wind, thermal expansion and other normal building movement without damage to the seal.
 - F. Rain/Water Resistance: Where inclement weather or greater-than-transient water exposure is expected, use products which dry rapidly and cure in the presence of atmospheric moisture sufficient to pass ASTM D6904 early rain resistance test (24-hour exposure).
 - G. Where intumescent gaskets are applied to steel framing prior to framing installation, provide products with fire, smoke and acoustical ratings which allow movement up to 100% compression and/or extension in accordance with UL 2079 or ASTM E1966; have an L Rating < 1 cfm/linear foot in accordance with UL 2079; and have a minimum Sound Transmission Class (STC) rating of 50 in accordance with ASTM E90/ASTM C919.
 - H. For aluminum curtain wall systems with one or two-piece rectangular mullions at least 2-1/2 in. x 5 in., provide perimeter fire barrier system which does not require direct screw attachment to support and fasten curtain wall insulation and is tested in accordance with ASTM E2307 for up to 2 hour fire resistance and ASTM E1233 for wind cycling.

2.2 JOINT FIRESTOPPING SYSTEMS

A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases. Multnomah County Oregon B437 - MCE P78 CP09 2024 27-Upgrade Parking Lot Lighting

- B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E1966 or UL 2079.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
 - a. <u>3M Fire Protection Products</u>.
 - b. <u>Hilti, Inc</u>.
 - c. <u>Specified Technologies, Inc</u>.
 - 2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
- C. Joints in Smoke Barriers: Provide joint firestopping systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg.
 - 1. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
 - a. <u>3M Fire Protection Products</u>.
 - b. <u>Hilti, Inc</u>.
 - c. <u>Specified Technologies, Inc</u>.
 - 2. L-Rating: Not exceeding 5.0 cfm per linear foot of joint at both ambient and elevated temperatures.
- D. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E84.
- 2.3 JOINT FIRESTOPPING PRODUCTS
 - A. Elastomeric Sealants: Single component latex formulations which accommodate minimum ±25 percent movement for 500 cycles per UL2079 or ASTM E1399.
 - B. All-Weather Coatings: Moisture curing, single component silicone copolymer elastomeric spray coating for horizontal surfaces where greater water resistance is required or inclement weather is anticipated.
 - C. Perimeter Fire Barrier Spray Coating: Single component, water-based, nonhalogenated elastomeric coating containing no volatile solvents, inorganic fibers, or asbestos.
 - D. Endothermic Sealants: Single component latex formulations which, when exposed to fire, absorb heat and release water vapor, resisting the progress of smoke and flame.
 - E. Silicone Sealants: Moisture curing, single component, silicone elastomeric sealants for horizontal surfaces (self-leveling or non-sag) or vertical joints (non-sag).
 - F. Intumescent Gaskets: Intumescent cover for gypsum wall framing with pressure sensitive adhesive; capable of +/- 100 percent joint movement.
 - G. High-movement joint profile: High temperature fibrous joint forming material for use in head-of-wall construction joints in conjunction with firestop coating and allowing up to 100-percent movement in compression and extension.
 - H. For aluminum curtain wall systems with one or two-piece rectangular mullions at least 2-1/2 in. x 5 in., provide perimeter fire barrier system which, for the majority of applications, does not require direct screw attachment to install curtain wall insulation.

PART 3 - EXECUTION

- 3.1 EXAMINATION
 - A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.
 - B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing joint firestopping systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
 - 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
 - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Apply a suitable bond-breaker to prevent three-sided adhesion in applications where this condition may occur such as the intersection of a gypsum wallboard/steel stud wall to floor or roof assembly where the joint is backed by a steel ceiling runner or track.
- 3.3 INSTALLATION
 - A. General: Install joint firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
 - B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
 - C. Install elastomeric fill materials for joint firestopping systems by proven techniques to produce the following results:
 - 1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 - 2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
 - 3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 CLEANING AND PROTECTION

- A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated joint firestopping systems immediately and install new materials to produce joint firestopping systems complying with specified requirements.

END OF SECTION

SECTION 26 00 10 - SUPPLEMENTAL REQUIREMENTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Supplemental requirements generally applicable to the Work specified in Division 26. This Section is also referenced by related Work specified in other Divisions.

1.2 REFERENCES

- A. Abbreviations and Acronyms for Electrical Terms and Units of Measure:
 - 1. 8P8C: An 8-position 8-contact modular jack.
 - 2. A: Ampere, unit of electrical current.
 - 3. AC or ac: Alternating current.
 - 4. AFCI: Arc-fault circuit interrupter.
 - 5. AIC: Ampere interrupting capacity.
 - 6. AL, Al, or ALUM: Aluminum.
 - 7. ASD: Adjustable-speed drive.
 - 8. ATS: Automatic transfer switch.
 - 9. AWG: American wire gauge; see ASTM B258.
 - 10. BAS: Building automation system.
 - 11. BIL: Basic impulse insulation level.
 - 12. BIM: Building information modeling.
 - 13. CAD: Computer-aided design or drafting.
 - 14. CATV: Community antenna television.
 - 15. CB: Circuit breaker.
 - 16. cd: Candela, the SI fundamental unit of luminous intensity.
 - 17. CO/ALR: Copper-aluminum, revised.
 - 18. COPS: Critical operations power system.
 - 19. CU or Cu: Copper.
 - 20. CU-AL or AL-CU: Copper-aluminum.
 - 21. dB: Decibel, a unitless logarithmic ratio of two electrical, acoustical, or optical power values.
 - 22. dB(A-weighted) or dB(A): Decibel acoustical sound pressure level with A-weighting applied in accordance with IEC 61672-1.
 - 23. dB(adjusted) or dBa: Decibel weighted absolute noise power with respect to 3.16 pW (minus 85 dBm).
 - 24. dBm: Decibel absolute power with respect to 1 mW.
 - 25. DC or dc: Direct current.
 - 26. DCOA: Designated critical operations area.
 - 27. DDC: Direct digital control (HVAC).

- 28. EGC: Equipment grounding conductor.
- 29. ELV: Extra-low voltage.
- 30. EMF: Electromotive force.
- 31. EMI: Electromagnetic interference.
- 32. EPM: Electrical preventive maintenance.
- 33. EPS: Emergency power supply.
- 34. EPSS: Emergency power supply system.
- 35. ESS: Energy storage system.
- 36. EV: Electric vehicle.
- 37. EVPE: Electric vehicle power export equipment.
- 38. EVSE: Electric vehicle supply equipment.
- 39. fc: Footcandle, an internationally recognized unit of illuminance equal to one lumen per square foot or 10.76 lx. The simplified conversion 1 fc = 10 lx in the Specifications is common practice and considered adequate precision for building construction activities. When there are conflicts, lux is the primary unit; footcandle is specified for convenience.
- 40. FLC: Full-load current.
- 41. ft: Foot.
- 42. ft-cd: Foot-candle, the antiquated U.S. Standard unit of illuminance, equal to one international candle measured at a distance of one foot, that was superseded in 1948 by the unit "footcandle" after the SI unit candela (cd) replaced the international candle; see "fc,"
- 43. GEC: Grounding electrode conductor.
- 44. GFCI: Ground-fault circuit interrupter.
- 45. GFPE: Ground-fault protection of equipment.
- 46. GND: Ground.
- 47. HACR: Heating, air conditioning, and refrigeration.
- 48. HDPE: High-density polyethylene.
- 49. HID: High-intensity discharge.
- 50. HP or hp: Horsepower.
- 51. HVAC: Heating, ventilating, and air conditioning.
- 52. Hz: Hertz.
- 53. IBT: Intersystem bonding termination.
- 54. inch: Inch. To avoid confusion, the abbreviation "in." is not used.
- 55. IP: Ingress protection rating (enclosures); Internet protocol (communications).
- 56. IR: Infrared.
- 57. IS: Intrinsically safe.
- 58. IT&R: Inspecting, testing, and repair.
- 59. ITE: Information technology equipment.
- 60. kAIC: Kiloampere interrupting capacity.
- 61. kcmil or MCM: One thousand circular mils.
- 62. kV: Kilovolt.
- 63. kVA: Kilovolt-ampere.
- 64. kVAr or kVAR: Kilovolt-ampere reactive.
- 65. kW: Kilowatt.
- 66. kWh: Kilowatt-hour.
- 67. LAN: Local area network.
- 68. lb: Pound (weight).
- 69. lbf: Pound (force).

- 70. LCD: Liquid-crystal display.
- 71. LCDI: Leakage-current detector-interrupter.
- 72. LED: Light-emitting diode.
- 73. Li-ion: Lithium-ion.
- 74. Im: Lumen, the SI derived unit of luminous flux.
- 75. LNG: Liquefied natural gas.
- 76. LP-Gas: Liquefied petroleum gas.
- 77. LRC: Locked-rotor current.
- 78. LV: Low voltage.
- 79. Ix: Lux, the SI derived unit of illuminance equal to one lumen per square meter.
- 80. m: Meter.
- 81. MCC: Motor-control center.
- 82. MDC: Modular data center.
- 83. MG set: Motor-generator set.
- 84. MIDI: Musical instrument digital interface.
- 85. MLO: Main lugs only.
- 86. MV: Medium voltage.
- 87. MVA: Megavolt-ampere.
- 88. mW: Milliwatt.
- 89. MW: Megawatt.
- 90. MWh: Megawatt-hour.
- 91. NC: Normally closed.
- 92. Ni-Cd: Nickel-cadmium.
- 93. Ni-MH: Nickel-metal hydride.
- 94. NIU: Network interface unit.
- 95. NO: Normally open.
- 96. NPT: National (American) standard pipe taper.
- 97. OCPD: Overcurrent protective device.
- 98. ONT: Optical network terminal.
- 99. PC: Personal computer.
- 100. PCS: Power conversion system.
- 101. PCU: Power-conditioning unit.
- 102. PF or pf: Power factor.
- 103. PHEV: Plug-in hybrid electric vehicle.
- 104. PLC: Programmable logic controller.
- 105. PLFA: Power-limited fire alarm.
- 106. PoE: Power over Ethernet.
- 107. PV: Photovoltaic.
- 108. PVC: Polyvinyl chloride.
- 109. pW: Picowatt.
- 110. RFI: (electrical) Radio-frequency interference; (contract) Request for interpretation.
- 111. RMS or rms: Root-mean-square.
- 112. RPM or rpm: Revolutions per minute.
- 113. SCADA: Supervisory control and data acquisition.
- 114. SCR: Silicon-controlled rectifier.
- 115. SPD: Surge protective device.
- 116. sq.: Square.
- 117. SWD: Switching duty.

- 118. TCP/IP: Transmission control protocol/Internet protocol.
- 119. TEFC: Totally enclosed fan-cooled.
- 120. TR: Tamper resistant.
- 121. TVSS: Transient voltage surge suppressor.
- 122. UL: (standards) Underwriters Laboratories, Inc.; (product categories) UL, LLC.
- 123. UL CCN: UL Category Control Number.
- 124. UPS: Uninterruptible power supply.
- 125. USB: Universal serial bus.
- 126. UV: Ultraviolet.
- 127. V: Volt, unit of electromotive force.
- 128. V(ac): Volt, alternating current.
- 129. V(dc): Volt, direct current.
- 130. VA: Volt-ampere, unit of complex electrical power.
- 131. VAR: Volt-ampere reactive, unit of reactive electrical power.
- 132. VFC: Variable-frequency controller.
- 133. VOM: Volt-ohm-multimeter.
- 134. VPN: Virtual private network.
- 135. VRLA: Valve regulated lead acid; also called "sealed lead acid (SLA)" or "valve regulated sealed lead acid."
- 136. W: Watt, unit of real electrical power.
- 137. Wh: Watt-hour, unit of electrical energy usage.
- 138. WPT: Wireless power transfer.
- 139. WPTE: Wireless power transfer equipment.
- 140. WR: Weather resistant.
- B. Abbreviations and Acronyms for Electrical Raceway Types:
 - 1. EMT: Electrical metallic tubing.
 - 2. EMT-A: Aluminum electrical metallic tubing.
 - 3. EMT-S: Steel electrical metallic tubing.
 - 4. EMT-SS: Stainless steel electrical metallic tubing.
 - 5. ENT: Electrical nonmetallic tubing.
 - 6. EPEC: Electrical HDPE underground conduit.
 - 7. EPEC-40: Schedule 40 electrical HDPE underground conduit.
 - 8. EPEC-80: Schedule 80 electrical HDPE underground conduit.
 - 9. EPEC-A: Type A electrical HDPE underground conduit.
 - 10. EPEC-B: Type B electrical HDPE underground conduit.
 - 11. ERMC: Electrical rigid metal conduit.
 - 12. ERMC-A: Aluminum electrical rigid metal conduit.
 - 13. ERMC-S: Steel electrical rigid metal conduit.
 - 14. ERMC-S-G: Galvanized-steel electrical rigid metal conduit.
 - 15. ERMC-S-PVC: PVC-coated-steel electrical rigid metal conduit.
 - 16. ERMC-SS: Stainless steel electrical rigid metal conduit.
 - 17. FMC: Flexible metal conduit.
 - 18. FMC-A: Aluminum flexible metal conduit.
 - 19. FMC-S: Steel flexible metal conduit.
 - 20. FMT: Steel flexible metallic tubing.
 - 21. FNMC: Flexible nonmetallic conduit. See "LFNC."
 - 22. HDPE: See EPEC.

- 23. IMC: Steel electrical intermediate metal conduit.
- 24. LFMC: Liquidtight flexible metal conduit.
- 25. LFMC-A: Aluminum liquidtight flexible metal conduit.
- 26. LFMC-S: Steel liquidtight flexible metal conduit.
- 27. LFMC-SS: Stainless steel liquidtight flexible metal conduit.
- 28. LFNC: Liquidtight flexible nonmetallic conduit.
- 29. LFNC-A: Layered (Type A) liquidtight flexible nonmetallic conduit.
- 30. LFNC-B: Integral (Type B) liquidtight flexible nonmetallic conduit.
- 31. LFNC-C: Corrugated (Type C) liquidtight flexible nonmetallic conduit.
- 32. PVC: Rigid PVC conduit.
- 33. PVC-40: Schedule 40 rigid PVC conduit.
- 34. PVC-80: Schedule 80 rigid PVC Conduit.
- 35. PVC-A: Type A rigid PVC concrete-encased conduit.
- 36. PVC-EB: Type EB rigid PVC concrete-encased underground conduit.
- 37. RGS: See ERMC-S-G.
- 38. RMC: See ERMC.
- 39. RTRC: Reinforced thermosetting resin conduit.
- 40. RTRC-AG: Low-halogen, aboveground reinforced thermosetting resin conduit.
- 41. RTRC-AG-HW: Heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
- 42. RTRC-AG-SW: Standard wall, low-halogen, aboveground reinforced thermosetting resin conduit.
- 43. RTRC-AG-XW: Extra heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
- 44. RTRC-BG: Low-halogen, belowground reinforced thermosetting resin conduit.
- C. Abbreviations and Acronyms for Electrical Single-Conductor and Multiple-Conductor Cable Types:
 - 1. AC: Armored cable.
 - 2. CATV: Coaxial general-purpose cable.
 - 3. CATVP: Coaxial plenum cable.
 - 4. CATVR: Coaxial riser cable.
 - 5. CI: Circuit integrity cable.
 - 6. CL2: Class 2 cable.
 - 7. CL2P: Class 2 plenum cable.
 - 8. CL2R: Class 2 riser cable.
 - 9. CL2X: Class 2 cable, limited use.
 - 10. CL3: Class 3 cable.
 - 11. CL3P: Class 3 plenum cable.
 - 12. CL3R: Class 3 riser cable.
 - 13. CL3X: Class 3 cable, limited use.
 - 14. CM: Communications general-purpose cable.
 - 15. CMG: Communications general-purpose cable.
 - 16. CMP: Communications plenum cable.
 - 17. CMR: Communications riser cable.
 - 18. CMUC: Under-carpet communications wire and cable.
 - 19. CMX: Communications cable, limited use.

- 20. DG: Distributed generation cable.
- 21. FC: Flat cable.
- 22. FCC: Flat conductor cable.
- 23. FPL: Power-limited fire-alarm cable.
- 24. FPLP: Power-limited fire-alarm plenum cable.
- 25. FPLR: Power-limited fire-alarm riser cable.
- 26. IGS: Integrated gas spacer cable.
- 27. ITC: Instrumentation tray cable.
- 28. ITC-ER: Instrumentation tray cable, exposed run.
- 29. MC: Metal-clad cable.
- 30. MC-HL: Metal-clad cable, hazardous location.
- 31. MI: Mineral-insulated, metal-sheathed cable.
- 32. MTW: (machine tool wiring) Moisture-, heat-, and oil-resistant thermoplastic cable.
- 33. MV: Medium-voltage cable.
- 34. NM: Nonmetallic sheathed cable.
- 35. NMC: Nonmetallic sheathed cable with corrosion-resistant nonmetallic jacket.
- 36. NMS: Nonmetallic sheathed cable with signaling, data, and communications conductors, plus power or control conductors.
- 37. NPLF: Non-power-limited fire-alarm circuit cable.
- 38. NPLFP: Non-power-limited fire-alarm circuit cable for environmental air spaces.
- 39. NPLFR: Non-power-limited fire-alarm circuit riser cable.
- 40. NUCC: Nonmetallic underground conduit with conductors.
- 41. OFC: Conductive optical fiber general-purpose cable.
- 42. OFCG: Conductive optical fiber general-purpose cable.
- 43. OFCP: Conductive optical fiber plenum cable.
- 44. OFCR: Conductive optical fiber riser cable.
- 45. OFN: Nonconductive optical fiber general-purpose cable.
- 46. OFNG: Nonconductive optical fiber general-purpose cable.
- 47. OFNP: Nonconductive optical fiber plenum cable.
- 48. OFNR: Nonconductive optical fiber riser cable.
- 49. P: Marine shipboard cable.
- 50. PLTC: Power-limited tray cable.
- 51. PLTC-ER: Power-limited tray cable, exposed run.
- 52. PV: Photovoltaic cable.
- 53. RHH: (high heat) Thermoset rubber, heat-resistant cable.
- 54. RHW: Thermoset rubber, moisture-resistant cable.
- 55. SA: Silicone rubber cable.
- 56. SE: Service-entrance cable.
- 57. SER: Service-entrance cable, round.
- 58. SEU: Service-entrance cable, flat.
- 59. SIS: Thermoset cable for switchboard and switchgear wiring.
- 60. TBS: Thermoplastic cable with outer braid.
- 61. TC: Tray cable.
- 62. TC-ER: Tray cable, exposed run.
- 63. TC-ER-HL: Tray cable, exposed run, hazardous location.
- 64. THW: Thermoplastic, heat- and moisture-resistant cable.
- 65. THHN: Thermoplastic, heat-resistant cable with nylon jacket outer sheath.

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- 66. THHW: Thermoplastic, heat- and moisture-resistant cable.
- 67. THWN: Thermoplastic, moisture- and heat-resistant cable with nylon jacket outer sheath.
- 68. TW: Thermoplastic, moisture-resistant cable.
- 69. UF: Underground feeder and branch-circuit cable.
- 70. USE: Underground service-entrance cable.
- 71. XHH: Cross-linked polyethylene, heat-resistant cable.
- 72. XHHW: Cross-linked polyethylene, heat- and moisture-resistant cable.
- D. Abbreviations and Acronyms for Electrical Flexible Cord Types:
 - 1. SEO: 600 V extra-hard-usage, hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp locations.
 - 2. SEOW: 600 V extra-hard-usage, hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp or wet locations.
 - 3. SEOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp locations.
 - 4. SEOOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp or wet locations.
 - 5. SJEO: 300 V hard-usage, junior hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp locations.
 - 6. SJEOW: 300 V hard-usage, junior hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp or wet locations.
 - 7. SJEOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp locations.
 - 8. SJEOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp or wet locations.
 - 9. SJO: 300 V hard-usage, junior hard-service cord with thermoset insulation and oil-resistant thermoset outer cover for damp locations.
 - 10. SJOW: 300 V hard-usage, junior hard-service cord with thermoset insulation and oil-resistant thermoset outer cover for damp or wet locations.
 - 11. SJOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer cover for damp locations.
 - 12. SJOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer cover for damp or wet locations.
 - 13. SJTO: 300 V hard-usage, junior hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer cover for damp locations.

- SJTOW: 300 V hard-usage, junior hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer cover for damp or wet locations.
- 15. SJTOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer cover for damp locations.
- 16. SJTOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer cover for damp or wet locations.
- 17. SO: 600 V extra-hard-usage, hard-service cord with thermoset insulation and oil-resistant thermoset outer covering for damp locations.
- 18. SOW: 600 V extra-hard-usage, hard-service cord with thermoset insulation and oil-resistant thermoset outer covering for damp or wet locations.
- 19. SOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer covering for damp locations.
- 20. SOOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer covering for damp or wet locations.
- 21. STO: 600 V extra-hard-usage, hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer covering for damp locations.
- 22. STOW: 600 V extra-hard-usage, hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer covering for damp or wet locations.
- 23. STOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer covering for damp locations.
- 24. STOOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer covering for damp or wet locations.
- E. Definitions:
 - 8-Position 8-Contact (8P8C) Modular Jack: An unkeyed jack with up to eight contacts commonly used to terminate twisted-pair and multiconductor Ethernet cable. Also called a "TIA-1096 miniature 8position series jack" (8PSJ), or an "IEC 8877 8-pole jack."
 - a. Be careful when suppliers use "RJ45" generically. Obsolete RJ45 jacks used for analog telephone cables have rejection keys. 8P8C jacks used for digital telephone cables and Ethernet cables do not have rejection keys.
 - Basic Impulse Insulation Level (BIL): Reference insulation level expressed in impulse crest voltage with a standard wave not longer than 1.5 times 50 microseconds and 1.5 times 40 microseconds.

- 3. Cable: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "cable" is (1) a conductor with insulation, or a stranded conductor with or without insulation (single-conductor cable); or (2) a combination of conductors insulated from one another (multiple-conductor cable).
- 4. Communications Jack: A fixed connecting device designed for insertion of a communications cable plug.
- 5. Communications Outlet: One or more communications jacks, or cables and plugs, mounted in a box or ring, with a suitable protective cover.
- 6. Conductor: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "conductor" is (1) a wire or combination of wires not insulated from one another, suitable for carrying an electric current; (2) (National Electrical Safety Code) a material, usually in the form of wire, cable, or bar, suitable for carrying an electric current; or (3) (general) a substance or body that allows a current of electricity to pass continuously along it.
- 7. Designated Seismic System: A system component that requires design in accordance with Ch. 13 of ASCE/SEI 7 and for which the Component Importance Factor is greater than 1.0.
- 8. Direct Buried: Installed underground without encasement in concrete or other protective material.
- 9. Enclosure: The case or housing of an apparatus, or the fence or wall(s) surrounding an installation, to prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage. Types of enclosures and enclosure covers include the following:
 - a. Cabinet: An enclosure that is designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.
 - b. Concrete Box: A box intended for use in poured concrete.
 - c. Conduit Body: A means for providing access to the interior of a conduit or tubing system through one or more removable covers at a junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
 - d. Conduit Box: A box having threaded openings or knockouts for conduit, EMT, or fittings.
 - e. Cutout Box: An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the enclosure.
 - f. Device Box: A box with provisions for mounting a wiring device directly to the box.
 - g. Extension Ring: A ring intended to extend the sides of an outlet box or device box to increase the box depth, volume, or both.
 - h. Floor Box: A box mounted in the floor intended for use with a floor box cover and other components to complete the floor box enclosure.
 - i. Floor-Mounted Enclosure: A floor box and floor box cover assembly with means to mount in the floor that is sealed against the entrance of scrub water at the floor level.

- j. Floor Nozzle: An enclosure used on a wiring system, intended primarily as a housing for a receptacle, provided with a means, such as a collar, for surface-mounting on a floor, which may or may not include a stem to support it above the floor level, and is sealed against the entrance of scrub water at the floor level.
- k. Junction Box: A box with a blank cover that joins different runs of raceway or cable and provides space for connection and branching of the enclosed conductors.
- I. Outlet Box: A box that provides access to a wiring system having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for the entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting an outlet box cover, but without provisions for mounting a wiring device directly to the box.
- m. Pedestal Floor Box Cover: A floor box cover that, when installed as intended, provides a means for typically vertical or near-vertical mounting of receptacle outlets above the floor's finished surface.
- n. Pull Box: A box with a blank cover that joins different runs of raceway and provides access for pulling or replacing the enclosed cables or conductors.
- o. Raised-Floor Box: A floor box intended for use in raised floors.
- p. Recessed Access Floor Box: A floor box with provisions for mounting wiring devices below the floor surface.
- q. Recessed Access Floor Box Cover: A floor box cover with provisions for passage of cords to recessed wiring devices mounted within a recessed floor box.
- r. Ring: A sleeve, which is not necessarily round, used for positioning a recessed wiring device flush with the plaster, concrete, drywall, or other wall surface.
- s. Ring Cover: A box cover, with raised center portion to accommodate a specific wall or ceiling thickness, for mounting wiring devices or luminaires flush with the surface.
- t. Termination Box: An enclosure designed for installation of termination base assemblies consisting of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors, or both.
- 10. Emergency Systems: Those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction that are designed to ensure continuity of lighting, electrical power, or both, to designated areas and equipment in the event of failure of the normal supply for safety to human life.
- 11. Essential Electrical Systems: (healthcare facilities) Those systems designed to ensure continuity of electrical power to designated areas and functions of a healthcare facility during disruption of normal power sources, and also to minimize disruption within the internal wiring system.
- 12. Fault Limited: Providing or being served by a source of electrical power that is limited to not more than 100 W when tested in accordance with UL 62368-1.

- a. The term "fault limited" is intended to encompass most Class 1, 2, and 3 power-limited sources complying with Article 725 of NFPA 70; Class ES1 and ES2 electrical energy sources that are Class PS1 electrical power sources (e.g., USB); and Class ES3 electrical energy sources that are Class PS1 and PS2 electrical power sources (e.g., PoE). See UL 62368-1 for discussion of classes of electrical energy sources and classes of electrical power sources.
- 13. High-Performance Building: A building that integrates and optimizes on a life-cycle basis all major high-performance attributes, including energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations.
- 14. Jacket: A continuous nonmetallic outer covering for conductors or cables.
- 15. Luminaire: A complete lighting unit consisting of a light source such as a lamp, together with the parts designed to position the light source and connect it to the power supply. It may also include parts to protect the light source or the ballast or to distribute the light.
- 16. Mode: The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the Energy Independence and Security Act (EISA) of 2007.
- 17. Multi-Outlet Assembly: A type of surface, flush, or freestanding raceway designed to hold conductors, receptacles, and switches, assembled in the field or at the factory.
- 18. Plenum: A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.
- 19. Receptacle: A fixed connecting device arranged for insertion of a power cord plug. Also called a power jack.
- 20. Receptacle Outlet: One or more receptacles mounted in a box with a suitable protective cover.
- 21. Sheath: A continuous metallic covering for conductors or cables.
- 22. UL Category Control Number (CCN): An alphabetic or alphanumeric code used to identify product categories covered by UL's Listing, Classification, and Recognition Services.
- 23. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:
 - a. Control Voltage: Having electromotive force between any two conductors, or between a single conductor and ground, that is supplied from a battery or other Class 2 or Class 3 power-limited source.
 - b. Line Voltage: (1) (controls) Designed to operate using the supplied low-voltage power without transformation. (2) (transmission lines, transformers, SPDs) The line-to-line voltage of the supplying power system.
 - c. Extra-Low Voltage (ELV): Not having electromotive force between any two conductors, or between a single conductor and ground, exceeding 30 V(ac rms), 42 V(ac peak), or 60 V(dc).

- d. Low Voltage (LV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 30 V but not exceeding 1000 V.
- e. Medium Voltage (MV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated about 1 kV but not exceeding 69 kV.
- f. High Voltage: (1) (circuits) Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 69 kV but not exceeding 230 kV. (2) (safety) Having sufficient electromotive force to inflict bodily harm or injury.
- 24. Wire: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "wire" is a slender rod or filament of drawn metal. A group of small wires used as a single wire is properly called a "stranded wire." A wire or stranded wire covered with insulation is properly called an "insulated wire" or a "single-conductor cable." Nevertheless, when the context indicates that the wire is insulated, the term "wire" will be understood to include the insulation.

1.3 COORDINATION

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions:
 - 1. Notify Owner no fewer than 6 weeks for Major electrical service interruptions, and 2 to 4 weeks for minor (single circuit) in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Owner's written permission.
 - 3. Coordinate interruption with systems impacted by outage including, but not limited to, the following:
 - a. Exercising generators.
 - b. Emergency lighting.
 - c. Elevators.
 - d. Fire-alarm systems.
- B. Arrange to provide temporary electrical service in accordance with requirements specified in Division 01.

1.4 PREINSTALLATION MEETINGS

- A. Electrical Preconstruction Conference: Schedule conference with Architect and Owner, not later than 10 days after notice to proceed. Agenda topics include, but are not limited to, the following:
 - 1. Electrical installation schedule.

- 2. Status of power system studies.
- 3. Value analysis proposals and requests for substitution of electrical equipment.
- 4. Utility work coordination and class of service requests.
- 5. Commissioning activities.
- 6. Sustainability activities, including Measurement and Verification Plan.

1.5 INFORMATIONAL SUBMITTALS

- A. Electrical Installation Schedule: At preconstruction meeting, and periodically thereafter as dates change, provide schedule for electrical installation Work to Owner and Architect including, but not limited to, milestone dates for the following activities:
 - 1. Submission of power system studies.
 - 2. Submission of specified coordination drawings.
 - 3. Orders placed for major electrical equipment.
 - 4. Arrival of major electrical equipment on-site.
 - 5. Preinstallation meetings specified in Division 26.
 - 6. Utility service outages.
 - 7. Utility service inspection and activation.
 - 8. Closing of walls and ceilings containing electrical Work.
 - 9. System startup, testing, and commissioning activities for major electrical equipment.
 - 10. System startup, testing, and commissioning activities for emergency lighting.
 - 11. System startup, testing, and commissioning activities for automation systems (SCADA, BMS, lighting, HVAC, fire alarm, fire pump, etc.).
 - 12. Requests for inspections by authorities having jurisdiction.

1.6 FIELD CONDITIONS

A. Modeling, analysis, product selection, installation, and quality control for Work specified in Division 26 must comply with requirements specified in Section 26 00 11 "Facility Performance Requirements for Electrical."

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to the submitting of bids, visit the project site and become familiar with all conditions and other factors affecting the proposed installation and make provisions as to the cost thereof.
- B. The Contract Documents do not make representations regarding the character or extent of the sub-soils, water levels, existing structural, mechanical and electrical installations, above or below ground, or other sub-surface conditions which may be encountered during the work. Evaluate existing conditions, which may affect methods or cost of performing the work, based on examination of the site or other information. Failure to examine the Drawings or other information does not relieve the Contractor of responsibility for the satisfactory completion of the work.

3.2 DEVELOPMENT OF FACILITY EPM PROGRAM

- A. Facility EPM Program must be developed by qualified EPM specialist.
- B. Conduct Facility EPM Program analysis in accordance with NFPA 70B recommendations.
 - 1. Renovation Projects:
 - a. Facility diagrams must include connected existing equipment for entire facility where known. Areas of uncertainty should be clearly indicated.
 - b. Obtain copies of existing operation and maintenance data and existing Facility EPM Program information from Owner.
 - c. Facility EPM Program analysis should identify existing equipment that does not have available operation and maintenance data, and should explain the Owner's risks because this equipment is not included in Facility EPM Program.
 - d. Data for existing equipment outside scope of Project may be inserted in Facility EPM Program Binders without analysis.
 - e. Data for existing equipment impacted by scope of Project should be analyzed and documented similar to Project's new equipment data as much as possible.
- C. Compile operation and maintenance data from Facility EPM Program analysis and submit updated Facility EPM Program Binders.

3.3 INSTALLATION OF ELECTRICAL WORK

- A. Unless more stringent requirements are specified in the Contract Documents or manufacturers' written instructions, comply with NFPA 70 and NECA NEIS 1 for installation of Work specified in Division 26. Consult Architect for resolution of conflicting requirements.
- 3.4 SYSTEM STARTUP
 - A. Coordinate all system startup with commissioning agent.

3.5 FIELD QUALITY CONTROL

- A. Administration for Low-Voltage Electrical Tests and Inspections:
 - 1. Engage factory-authorized service representatives to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.

3.6 CLEANING

- A. Waste Management:
 - 1. Avoid accumulation of debris, boxes, loose materials, crates, etc., resulting from the installation of this work. Remove from the premises each day all debris, boxes, etc., and keep the premises clean and free of dust and debris.
 - 2. Clean all fixtures and equipment at the completion of the project. Wipe clean exposed lighting fixture reflectors and trim pieces with a non-abrasive cloth just prior to occupancy.
 - 3. All electrical equipment shall be thoroughly vacuumed and wiped clean prior to energization and at the completion of the project. Equipment shall be opened for observation by the Architect as required.

END OF SECTION

SECTION 26 00 11 - FACILITY PERFORMANCE REQUIREMENTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Field conditions and other facility performance requirements applicable to Work specified in Division 26.

1.2 FIELD CONDITIONS

- A. Seismic Hazard Design Loads:
 - 1. Unless otherwise indicated on Contract Documents, specified Work must withstand seismic hazard design loads determined in accordance with requirements specified in this Section, adjusted for installed elevation above or below grade.
 - a. The term "withstand" means "unit must remain in place without separation of parts from unit when subjected to specified seismic hazard design loads[and unit must be fully operational after seismic event]."
 - 2. Perform calculations to obtain force information necessary to properly select seismic-restraint devices, fasteners, and anchorage. Perform calculations using methods acceptable to applicable code authorities and as presented in ASCE/SEI 7-05. Where "ASCE/SEI 7" is used throughout this Section, it must be understood that the edition referred to in this subparagraph is the edition intended as reference throughout the Section Text.
 - a. Data indicated below to be determined by Delegated Design Contractor must be obtained by Contractor and must be included in individual component submittal packages.
 - b. Coordinate seismic design calculations with wind-load calculations for equipment mounted outdoors.
 - 3. Calculation Factors, ASCE/SEI 7-16, Ch. 13 Seismic Design Requirements for Nonstructural Components: All section, paragraph, equation, and table numbers refer to ASCE/SEI 7-16 unless otherwise indicated.

- a. Vertical Seismic Design Force: Calculated by Delegated Design Contractor using method explained in ASCE/SEI 7-16, Paragraph 13.3.1.2.
- Seismic Relative Displacement (Dpl): Calculated by Delegated Design Contractor using methods explained in ASCE/SEI 7-16, Paragraph 13.3.2. Factors below must be obtained for this calculation:
 - 1) Relative Seismic Displacement that Each Component Must Be Designed to Accommodate (Dp): Calculated by Delegated Design Contractor in accordance with ASCE/SEI 7-16, Paragraph 13.3.2.
- 4. Calculation Factors, ASCE/SEI 7-10, Ch. 13 Seismic Design Requirements for Nonstructural Components: All section, paragraph, equation, and table numbers refer to ASCE/SEI 7-10 unless otherwise indicated.
- 5. Calculation Factors, ASCE/SEI 7-05, Ch. 13 Seismic Design Requirements for Nonstructural Components: All section, paragraph, equation, and table numbers refer to ASCE/SEI 7-05 unless otherwise indicated.
 - a. Vertical Seismic Design Force: Calculated by Delegated Design Contractor using method explained in ASCE/SEI 7-05, Paragraph 13.3.1.
- B. Wind Hazard Design Loads:
 - 1. Perform calculations to obtain force information necessary to properly select wind-load restraint devices, fasteners, and anchorage. Perform calculations using methods acceptable to applicable code authorities and as presented in ASCE/SEI 7-05. Where "ASCE/SEI 7" is used throughout this Section, it must be understood that the edition referred to in this subparagraph is intended as referenced throughout the Section Text unless otherwise indicated.
 - a. Data indicated below that are specific to individual pieces of equipment must be obtained by Contractor and must be included in individual component submittal packages.
 - b. Coordinate design wind-load calculations with seismic-load calculations for equipment requiring both seismic- and wind-load reinforcement. Comply with requirements in other Sections in addition to those in this Section.
 - 2. Design wind pressure "p" for rooftop equipment must be calculated by Delegated Design Contractor using methods in ASCE/SEI 7-16, Ch. 30, PART 6: Building Appurtenances and Rooftop Structures and Equipment.

- a. Risk Category: II.
- Velocity Pressure at Height z (qz): Value is calculated by delegated wind-load design Contractor using methods detailed in ASCE/SEI 7-16 Section 26.10.1 or other source approved by authorities having jurisdiction.
- velocity Pressure at Height h (qh): Value is calculated by delegated wind-load design Contractor using methods detailed in ASCE/SEI 7-16 Section 26.10.1 or other source approved by authorities having jurisdiction.
- 3. Design wind pressure "p" for rooftop equipment must be calculated by Delegated Design Contractor using methods in ASCE/SEI 7-10, Ch. 30, PART 6: Building Appurtenances and Rooftop Structures and Equipment.
 - a. Risk Category: II.
 - Velocity Pressure at Height z (qz): Value is calculated by delegated wind-load design Contractor using methods detailed in ASCE/SEI 7-10 Section 26.10.1 or other source approved by authorities having jurisdiction.
 - velocity Pressure at Height h (qh): Value is calculated by delegated wind-load design Contractor using methods detailed in ASCE/SEI 7-10 Section 26.10.1 or other source approved by authorities having jurisdiction.
- 4. Design wind-load "F" for rooftop equipment and external sidewall-mounted equipment must be calculated by Delegated Design Contractor using methods in ASCE/SEI 7-05, Ch. 6.
 - Velocity Pressure at Height z (qz): Value is calculated by delegated wind-load design Contractor using methods detailed in ASCE/SEI 7-05 Section 6.5.10 or other source approved by authorities having jurisdiction.
 - Velocity Pressure at Roof Height h (qh): Value is calculated by delegated wind-load design Contractor using methods detailed in ASCE/SEI 7-05 Section 6.5.10 or other source approved by authorities having jurisdiction.
 - c. Force Coefficient (Cf): Value is determined by delegated wind-load design Contractor from ASCE/SEI 7-05, Figures 6-21 through 6-23 or other source approved by authorities having jurisdiction.
 - d. Projected Area Normal to the Wind (Af): Except where Cf is specified for the actual surface area. Value is determined by delegated wind-load design Contractor from equipment submittal or manufacturer.
- C. Altitude:
 - 1. Sea level to 1000 ft.
- D. Temperature Variation: Allow for thermal movements from the following differential temperatures:
 - 1. Ambient Temperature Differential: 120 deg F.
 - 2. Material Surface Temperature Differential: 180 deg F.
- E. Ground Water:
 - 1. Assume ground-water level is at grade level unless a lower water table is noted on Drawings.
 - 2. Assume ground-water level is 36 inch below ground surface unless a higher water table is indicated on Drawings.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 26 05 01 – MINOR ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electrical demolition.

1.2 RELATED REQUIREMENTS

- A. Section 01 70 00, Execution and Closeout Requirements: Additional requirements for alterations work.
- B. Section 02 41 19, Selective Demolition: Refer to published project hazardous materials survey results prior to alterations to existing facility surfaces for this project work installation.

1.3 SUBMITTALS

A. See Section01 33 00 Submittal Procedures, for submittal procedures.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

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

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that abandoned wiring and equipment serve only abandoned facilities.
- B. Demolition drawings are based on casual field observation and existing record documents.
- C. Report discrepancies to Architect before disturbing existing installation.
- D. Beginning of demolition means installer accepts existing conditions.

E. Determine exact location of existing utilities and equipment prior to commencing work and compensate Owner for damages caused by failure to locate or preserve utilities.

3.2 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings to be removed.
- B. Coordinate utility service outages with utility company.

3.3 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-containing electrical equipment, including transformers, capacitors, and switches.
 - 2. PCB- and DEHP-containing lighting ballasts.
 - 3. 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. Remove, relocate, and extend existing installations to accommodate new construction.
- C. Remove abandoned wiring to source of supply.
- D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- E. 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.
- F. Disconnect and remove abandoned panelboards and distribution equipment.
- G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- I. Repair adjacent construction and finishes damaged during demolition and extension work.

- J. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.
- K. Remove and Restore wiring which serves usable outlets clear of construction or demolition.

3.4 CLEANING AND REPAIR

- A. See Section 02 41 19 Selective Demolitionfor additional requirements.
- B. Clean and repair existing materials and equipment that remain or that are to be reused.

END OF SECTION

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Copper building wire.
 - 2. Nonmetallic underground conduit with conductors, Type NUCC.
 - 3. Metal-clad cable, Type MC.
 - 4. Armored cable, Type AC.
 - 5. Fire-alarm wire and cable.
 - 6. Connectors and splices.
- B. Related Requirements:
 - 1. Section 26 00 10 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 26 00 11 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
 - 1. Product Data: For solvents and adhesives, indicating VOC content.
 - 2. Laboratory Test Reports: For solvents and adhesives, indicating compliance with requirements for low-emitting materials.
- C. Product Schedule: Indicate type, use, location, and termination locations.
- 1.3 INFORMATIONAL SUBMITTALS
 - A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cerro Wire LLC.
 - 2. Encore Wire Corporation.
 - 3. Service Wire Co.
 - 4. Southwire Company.
- C. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- E. Conductor Insulation:
 - 1. Type THHN and Type THWN-2: Comply with UL 83.
 - 2. Type XHHW-2: Comply with UL 44.

2.2 NONMETALLIC UNDERGROUND CONDUIT WITH CONDUCTORS, TYPE NUCC

- A. Description: A factory assembly of conductors or cables inside a nonmetallic, smooth wall raceway with a circular cross section.
- B. Applicable Standards:
 - 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - 2. General Characteristics:
 - a. Reference Standards: UL 1990.

2.3 METAL-CLAD CABLE, TYPE MC

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Atkore International (AFC Cable Systems).
 - 2. Encore Wire Corporation.
 - 3. Service Wire Co.
 - 4. Southwire Company.
- C. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. Comply with UL 1569.
 - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Circuits:
 - 1. Single circuit multicircuit with color-coded conductors.
- E. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- F. Ground Conductor: .
- G. Conductor Insulation:
 - 1. Type TFN/THHN/THWN-2: Comply with UL 83.
 - 2. Type XHHW-2: Comply with UL 44.
- H. Armor: Steel, interlocked.
- I. Jacket: PVC applied over armor.
- 2.4 CONNECTORS AND SPLICES
 - A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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- 1. 3M Electrical Products.
- 2. Ideal Industries, Inc.
- 3. Service Wire Co.
- 4. TE Connectivity Ltd.
- C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
 - 1. Termination: Compression Crimp.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders:
 - 1. Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
 - 2. Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Conductors must be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits:
 - 1. Copper. Solid for No. 10 AWG; stranded for No. 8 AWG and larger.
- C. ASD Output Circuits Cable: Extra-flexible stranded for all sizes.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN/THWN-2, single conductors in raceway Type XHHW-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway Type XHHW-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway Type XHHW-2, single conductors in raceway.
- E. Feeders Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.

- F. Feeders in Cable Tray: Type THHN/THWN-2, single conductors in raceway Type XHHW-2, single conductors larger than No. 1/0 AWG.
- G. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway.
- H. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
- I. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway Type XHHW-2, single conductors in raceway.
- J. Branch Circuits Installed below Raised Flooring: .
- K. Branch Circuits in Cable Tray: Type XHHW-2, single conductors larger than No. 1/0 AWG.
- L. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless steel, wire-mesh, strain relief device at terminations to suit application.
- M. ASD Output Circuits: Type XHHW-2 in metal conduit.

3.3 INSTALLATION, GENERAL

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 26 05 33 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 26 05 29 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torquetightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inch of slack.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 26 05 53 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 07 84 13 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors and conductors feeding critical equipment and services for compliance with requirements.

- 3. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - b. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - 3) Thermographic survey.
 - c. Inspect compression-applied connectors for correct cable match and indentation.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.
 - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable for a one-minute duration.
 - g. Continuity test on each conductor and cable.
 - h. Uniform resistance of parallel conductors.
- 4. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
 - a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- 5. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
- B. Cables will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

- 1.1 SUMMARY
 - A. Section Includes:
 - 1. Grounding and bonding conductors.
 - 2. Grounding and bonding clamps.
 - 3. Grounding and bonding bushings.
 - 4. Grounding and bonding connectors.
 - 5. Intersystem bonding bridge grounding connector.
 - 6. Grounding and bonding busbars.
 - 7. Grounding (earthing) electrodes.
 - B. Related Requirements:
 - 1. Section 26 00 10 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 26 00 11 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. For each type of product indicated.
- B. Shop Drawings: Plans showing dimensioned locations of grounding features described in "Field Quality Control" Article, including the following:
 - 1. Test wells.
 - 2. Rod electrodes.
 - 3. Ring electrodes.
 - 4. Grounding arrangements and connections for separately derived systems.
- C. Sustainable Design Submittals:
 - 1. Environmental Product Declaration: For each product.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:
 - 1. In addition to items specified in Section 26 00 10 "Supplemental Requirements for Electrical," include the following:
 - a. Plans showing locations of grounding features described in "Field Quality Control" Article, including the following:
 - 1) Test wells.
 - 2) Rod electrodes.
 - 3) Ring electrodes.
 - 4) Grounding arrangements and connections for separately derived systems.
 - b. Instructions for periodic testing and inspection of grounding features at test wells based on NFPA 70B.
 - 1) Tests must determine if ground-resistance or impedance values remain within specified maximums, and instructions must recommend corrective action if values do not.
 - 2) Include recommended testing intervals.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

- A. Equipment Grounding Conductor:
 - General Characteristics: 600 V, THWN-2, copper wire or cable, green color, in accordance with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- B. Isolated Equipment Grounding Conductor:
 - General Characteristics: 600 V, THWN-2, copper wire or cable, green color with one or more yellow stripes, in accordance with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- C. ASTM Bare Copper Grounding and Bonding Conductor:
 - 1. Referenced Standards: Complying with one or more of the following:
 - a. Soft or Annealed Copper Wire: ASTM B3
 - b. Concentric-Lay Stranded Copper Conductor: ASTM B8.
 - c. Tin-Coated Soft or Annealed Copper Wire: ASTM B33.

d. 19-Wire Combination Unilay-Stranded Copper Conductor: ASTM B787/B787M.

2.2 GROUNDING AND BONDING CLAMPS

- A. Description: Clamps suitable for attachment of grounding and bonding conductors to grounding electrodes, pipes, tubing, and rebar. Grounding and bonding clamps specified in this article are also suitable for use with communications applications.
- B. Source Limitations: Obtain products from single manufacturer.
- C. Performance Criteria:
 - 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Listing Criteria:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
 - b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

2.3 GROUNDING AND BONDING BUSHINGS

- A. Description: Bonding bushings connect conduit fittings, tubing fittings, threaded metal conduit, and unthreaded metal conduit to metal boxes and equipment enclosures, and have one or more bonding screws intended to provide electrical continuity between bushing and enclosure. Grounding bushings have provision for connection of bonding or grounding conductor and may or may not also have bonding screws.
- B. Source Limitations: Obtain products from single manufacturer.
- C. Performance Criteria:
 - 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

2.4 GROUNDING AND BONDING CONNECTORS

- A. Source Limitations: Obtain products from single manufacturer.
- B. Performance Criteria:
 - 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Listing Criteria:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
 - b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

2.5 INTERSYSTEM BONDING BRIDGE GROUNDING CONNECTORS

- A. Description: Devices that provide means for connecting communications systems grounding and bonding conductors at service equipment or at disconnecting means for buildings or structures.
- B. Performance Criteria:
 - 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Listing Criteria:
 - a. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

2.6 GROUNDING AND BONDING BUSBARS

- A. Description: Miscellaneous grounding and bonding device that serves as common connection for multiple grounding and bonding conductors.
- B. Source Limitations: Obtain products from single manufacturer.

- C. Performance Criteria:
 - 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Listing Criteria:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

2.7 GROUNDING (EARTHING) ELECTRODES

- A. Description: Grounding electrodes include rod electrodes, ring electrodes, metal underground water pipes, metal building frames, concrete-encased electrodes, and pipe and plate electrodes.
- B. Source Limitations: Obtain products from single manufacturer.
- C. Performance Criteria:
 - 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Listing Criteria:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine facility's grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of electrical system.
- B. Inspect test results of grounding system measured at point of electrical service equipment connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with connection of electrical service equipment only after unsatisfactory conditions have been corrected.

3.2 SELECTION OF BUSBARS

- A. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus horizontally, on insulated spacers 2 inch minimum from wall, 6 inch above finished floor unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

3.3 SELECTION OF GROUNDING AND BONDING CONDUCTORS

- A. Conductors: Install solid conductor for 8 AWG and smaller, and stranded conductors for 6 AWG and larger unless otherwise indicated.
- B. Custom-Length Insulated Equipment Bonding Jumpers: 6 AWG, 19-strand, Type THHN.
- C. Bonding Cable: 28 kcmil, 14 strands of 17 AWG conductor, 1/4 inch in diameter.
- D. Bonding Conductor: 4 AWG or 6 AWG, stranded conductor.
- E. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.
- F. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.
- G. Underground Grounding Conductors: Install bare copper conductor, 2/0 AWG minimum.
 - 1. Bury at least 30 inch below grade.
 - 2. Duct-Bank Grounding Conductor: Bury 12 inch above duct bank when indicated as part of duct-bank installation.

3.4 SELECTION OF CONNECTORS

- A. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.

- 3. Connections to Ground Rods at Test Wells: Bolted connectors.
- 4. Connections to Structural Steel: Welded connectors.

3.5 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Reference Standards:
 - Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
 - 2. Consult Architect for resolution of conflicting requirements.
- C. Special Techniques:
 - 1. Conductors:
 - a. Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
 - 2. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
 - a. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 - b. Make connections with clean, bare metal at points of contact.
 - c. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
 - d. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 - e. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
 - f. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1) Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate adjacent parts.

- 2) Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
- 3) Use exothermic-welded connectors for outdoor locations; if disconnect-type connection is required, use bolted clamp.
- g. Grounding and Bonding for Piping:
 - 1) Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use bolted clamp connector or bolt lug-type connector to pipe flange by using one of lug bolts of flange. Where dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2) Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with bolted connector.
 - 3) Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- h. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
- i. Grounding for Steel Building Structure: Install driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 ft apart.
- 3. Electrodes:
 - a. Ground Rods: Drive rods until tops are 2 inch below finished floor or final grade unless otherwise indicated.
 - 1) Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2) Use exothermic welds for below-grade connections.
 - b. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least same distance from other grounding electrodes, and connect to service grounding electrode conductor.
 - c. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes and must be at least 12 inch deep, with cover.

- Install at least one test well for each service unless otherwise indicated. Install at ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- d. Ring Electrode: Install grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around perimeter of building.
 - 1) Install tinned-copper conductor not less than 2/0 AWG for ring electrode and for taps to building steel.
 - 2) Bury ring electrode not less than 24 inch from building's foundation.
- e. Concrete-Encased Electrode (Ufer Ground):
 - 1) Fabricate in accordance with NFPA 70; use minimum of 20 ft of bare copper conductor not smaller than 4 AWG.
 - a) If concrete foundation is less than 20 ft long, coil excess conductor within base of foundation.
 - b) Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.
 - 2) Fabricate in accordance with NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 ft long. If reinforcing is in multiple pieces, connect together by usual steel tie wires or exothermic welding to create required length.
- 4. Grounding at Service:
 - a. Equipment grounding conductors and grounding electrode conductors must be connected to ground bus. Install main bonding jumper between neutral and ground buses.
- 5. Grounding Separately Derived Systems:
 - a. Generator: Install grounding electrode(s) at generator location. Electrode must be connected to equipment grounding conductor and to frame of generator.
- 6. Grounding Underground Distribution System Components:
 - a. Duct-Bank Grounding Conductor: Bury 12 inch above duct bank when indicated as part of duct-bank installation.
 - b. Comply with IEEE C2 grounding requirements.

- c. Grounding Manholes and Handholes: Install driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inch will extend above finished floor. If necessary, install ground rod before manhole is placed and provide 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inch above to 6 inch below concrete. Seal floor opening with waterproof, nonshrink grout.
- d. Grounding Connections to Manhole Components: Bond exposedmetal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields in accordance with manufacturer's published instructions with splicing and termination kits.
- e. Pad-Mounted Transformers and Switches: Install two ground rods and ring electrode around pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than 2 AWG for ring electrode and for taps to equipment grounding terminals. Bury ring electrode not less than 6 inch from foundation.
- 7. Equipment Grounding:
 - a. Install insulated equipment grounding conductors with feeders and branch circuits.
 - b. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1) Feeders and branch circuits.
 - 2) Lighting circuits.
 - 3) Receptacle circuits.
 - 4) Single-phase motor and appliance branch circuits.
 - 5) Three-phase motor and appliance branch circuits.
 - 6) Flexible raceway runs.
 - 7) Armored and metal-clad cable runs.
 - Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
 - 9) X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.

- c. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- d. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- e. Isolated Grounding Receptacle Circuits: Install insulated equipment grounding conductor connected to receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of applicable derived system or service unless otherwise indicated.
- f. Isolated Equipment Enclosure Circuits: For designated equipment supplied by branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of applicable derived system or service unless otherwise indicated.
- g. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
- h. Metallic Fences: Comply with requirements of IEEE C2.
 - 1) Grounding Conductor: Bare copper, not less than 8 AWG.
 - 2) Gates: Must be bonded to grounding conductor with flexible bonding jumper.
 - 3) Barbed Wire: Strands must be bonded to grounding conductor.
- 8. Fence Grounding: Install at maximum intervals of 1500 ft except as follows:
 - a. Fences within 100 ft of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 ft.
 - 1) Gates and Other Fence Openings: Ground fence on each side of opening.
 - a) Bond metal gates to gate posts.
 - b) Bond across openings, with and without gates, except at openings indicated as intentional fence discontinuities. Use 2 AWG wire and bury it at least 18 inch below finished grade.

- b. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at maximum distance of 150 ft on each side of crossing.
- c. Grounding Method: At each grounding location, drive grounding rod vertically until top is 6 inch below finished grade. Connect rod to fence with 6 AWG conductor. Connect conductor to each fence component at grounding location.
- d. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.
- e. Bonding to Lightning-Protection System: If fence terminates at lightning-protected building or structure, ground fence and bond fence grounding conductor to lightning-protection down conductor or lightning-protection grounding conductor, complying with NFPA 780.

3.6 FIELD QUALITY CONTROL

- A. Field tests and inspections must be witnessed by authorities having jurisdiction.
- B. Tests and Inspections:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with calibrated torque wrench in accordance with manufacturer's published instructions.
 - 3. Test completed grounding system at each location where maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells. Make tests at ground rods before conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method in accordance with IEEE Std 81.
 - c. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.
 - 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to record of tests and observations. Include number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- C. Nonconforming Work:

- 1. Grounding system will be considered defective if it does not pass tests and inspections.
- 2. Remove and replace defective components and retest.
- D. Collect, assemble, and submit test and inspection reports.
 - 1. Report measured ground resistances that exceed the following values:
 - a. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
 - b. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
- 3.7 PROTECTION
 - A. After installation, protect grounding and bonding cables and equipment from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Support, anchorage, and attachment components.
 - 2. Fabricated metal equipment support assemblies.

B. Related Requirements:

1. Section 26 00 10 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Slotted support systems, hardware, and accessories.
 - b. Clamps.
 - c. Hangers.
 - d. Sockets.
 - e. Eye nuts.
 - f. Fasteners.
 - g. Anchors.
 - h. Saddles.
 - i. Brackets.
 - 2. Include rated capacities and furnished specialties and accessories.
- B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.
 - 1. Hangers. Include product data for components.
 - 2. Slotted support systems.
 - 3. Equipment supports.
 - 4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame Rating: Class 1.
 - 2. Self-extinguishing according to ASTM D635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32 inch diameter holes at a maximum of 8 inch on center in at least one surface.
 - 1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 2. Material for Channel, Fittings, and Accessories: Galvanized steel.
 - 3. Channel Width:
- B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs must have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body must be made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Mechanical-Expansion Anchors: Insert-wedge-type, steel, for use in hardened Portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - 2. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
 - 3. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
 - 4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.

5. Hanger Rods: Threaded steel.

PART 3 - EXECUTION

3.1 SELECTION

- A. Comply with the following standards for selection and installation of hangers and supports, except where requirements on Drawings or in this Section are stricter:
 - 1. NECA NEIS 101
 - 2. NECA NEIS 102.
 - 3. NECA NEIS 105.
 - 4. NECA NEIS 111.
- B. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for raceways and boxes specified in Section 26 05 33 "Raceway and Boxes for Electrical Systems."
- D. Provide vibration and seismic controls with hangers and supports.
- E. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and ERMC as required by NFPA 70. Minimum rod size must be 1/4 inch in diameter.
- F. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- G. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2 inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 INSTALLATION OF SUPPORTS

A. Comply with NECA NEIS 101 for installation requirements except as specified in this article.

- B. Raceway Support Methods: In addition to methods described in NECA NEIS 1, EMT may be supported by openings through structure members, in accordance with NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination must be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standardweight concrete 4 inch thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inch thick.
 - 6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
 - 7. To Light Steel: Sheet metal screws.
 - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slottedchannel racks attached to substrate by means that comply with seismicrestraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inch larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000 psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 03 30 00 "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base as follows:

- 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
- 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
- 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.4 PAINTING

- A. Touchup:
 - 1. Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - a. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
 - 2. Comply with requirements in Section 09 91 23 "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION

SECTION 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Type EMT-S raceways and elbows.
 - 2. Type ERMC-A and Type ERMC-SS raceways, elbows, couplings, and nipples.
 - 3. Type ERMC-S raceways, elbows, couplings, and nipples.
 - 4. Type IMC raceways.
 - 5. Type PVC raceways and fittings.
 - 6. Fittings for conduit, tubing, and cable.
 - 7. Threaded metal joint compound.
 - 8. Surface metal raceways and fittings.
 - 9. Wireways and auxiliary gutters.
 - 10. Metallic outlet boxes, device boxes, rings, and covers.
 - 11. Nonmetallic outlet boxes, device boxes, rings, and covers.
 - 12. Termination boxes.
 - 13. Cabinets, cutout boxes, junction boxes, pull boxes, and miscellaneous enclosures.
 - 14. Cover plates for device boxes.
- B. Related Requirements:
 - 1. Section 26 00 10 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 26 00 11 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
 - 3. Section 26 05 19 "Low-Voltage for Electrical Power Conductors and Cables" for nonmetallic underground conduit with conductors (Type NUCC).

1.2 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Wireways and auxiliary gutters.
 - 2. Surface metal raceways.
 - 3. Surface nonmetallic raceways.

- 4. Floor boxes.
- 5. Cabinets, cutout boxes, and miscellaneous enclosures.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details. Show that floor boxes are located to avoid interferences and are structurally allowable. Indicate floor thickness at location where boxes are embedded in concrete floors and underfloor clearances where boxes are installed in raised floors.
- 1.3 INFORMATIONAL SUBMITTALS
 - A. Manufacturers' Instructions:
 - 1. For Type ERMC-S-PVC.

PART 2 - PRODUCTS

- 2.1 TYPE EMT-S RACEWAYS AND ELBOWS
 - A. Performance Criteria:
 - 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - 2. General Characteristics: UL 797 and UL Category Control Number FJMX.
 - B. Steel Electrical Metal Tubing (EMT-S) and Elbows:
 - 1. Material: Steel.
- 2.2 TYPE ERMC-S RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES
 - A. Performance Criteria:
 - 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - 2. General Characteristics: UL 6 and UL Category Control Number DYIX.
 - B. Galvanized-Steel Electrical Rigid Metal Conduit (ERMC-S-G), Elbows, Couplings, and Nipples:
 - 1. Exterior Coating: Zinc.

2.3 TYPE IMC RACEWAYS

- A. Performance Criteria:
 - 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - 2. General Characteristics: UL 1242 and UL Category Control Number DYBY.

2.4 TYPE PVC RACEWAYS AND FITTINGS

- A. Performance Criteria:
 - 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - 2. General Characteristics: UL 651 and UL Category Control Number DZYR.
- B. Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings:
 - 1. Dimensional Specifications: Schedule 40.
- C. Type EB Rigid PVC Concrete-Encased Underground Conduit (PVC-EB) and Fittings:
 - 1. Dimensional Specifications: Type EB.

2.5 FITTINGS FOR CONDUIT, TUBING, AND CABLE

- A. Performance Criteria:
 - 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- B. Fittings for Type ERMC, Type IMC, Type PVC, Type EPEC, and Type RTRC Raceways:
 - 1. General Characteristics: UL 514B and UL Category Control Number DWTT.
 - 2. Options:
 - a. Coupling Method: Compression coupling Setscrew coupling. Setscrew couplings with only single screw per conduit are unacceptable.
 - b. Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
 - c. Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.

- C. Fittings for Type EMT Raceways:
 - 1. General Characteristics: UL 514B and UL Category Control Number FKAV.
 - 2. Options:
 - a. Coupling Method: Compression coupling Setscrew coupling. Setscrew couplings with only single screw per conduit are unacceptable.
 - b. Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
 - c. Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.

2.6 SURFACE METAL RACEWAYS AND FITTINGS

- A. Performance Criteria:
 - 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - 2. General Characteristics: UL 5 and UL Category Control Number RJBT.

2.7 WIREWAYS AND AUXILIARY GUTTERS

- A. Performance Criteria:
 - 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - 2. General Characteristics: UL 870 and UL Category Control Number ZOYX.
- B. Metal Wireways and Auxiliary Gutters:
 - 1. Additional Characteristics:
 - a. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
 - b. Finish: Manufacturer's standard enamel finish.
 - 2. Options:
 - a. Wireway Covers: Screw-cover type unless otherwise indicated.

2.8 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Performance Criteria:

- 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- 2. General Characteristics: UL 514A and UL Category Control Number QCIT.

2.9 NONMETALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

- A. Performance Criteria:
 - 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - 2. General Characteristics: UL 514C and UL Category Control Number QCMZ.
- B. Nonmetallic Conduit Bodies:
 - 1. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.

2.10 TERMINATION BOXES

- A. Description: Enclosure for termination base consisting of lengths of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors or both.
- B. Performance Criteria:
 - 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - 2. General Characteristics: UL 1773 and UL Category Control Number XCKT.
- 2.11 CABINETS, CUTOUT BOXES, JUNCTION BOXES, PULL BOXES, AND MISCELLANEOUS ENCLOSURES
 - A. Performance Criteria:
 - 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - 2. General Characteristics:
 - a. Non-Environmental Characteristics: UL 50.
 - b. Environmental Characteristics: UL 50E.

2.12 COVER PLATES FOR DEVICES BOXES

- A. Performance Criteria:
 - 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - 2. General Characteristics:
 - a. Reference Standards: UL 514D and UL Category Control Numbers QCIT and QCMZ.
 - b. Wall-plate-Securing Screws: Metal with head color to match wallplate finish.

PART 3 - EXECUTION

3.1 SELECTION OF RACEWAYS

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of raceways. Consult Architect for resolution of conflicting requirements.
- B. Indoors:
 - 1. Hazardous Classified Locations: ERMC IMC.
 - 2. Exposed and Subject to Severe Physical Damage: ERMC IMC. Subject to severe physical damage includes the following locations:
 - a. Loading docks.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallethandling units.
 - c. Mechanical rooms.
 - d. Gymnasiums.
 - 3. Exposed and Subject to Physical Damage: ERMC IMC. Subject to physical damage includes the following locations:
 - a. Locations less than 2.5 m (8 ft) above finished floor.
 - b. Stub-ups to above suspended ceilings.
 - 4. Exposed and Not Subject to Physical Damage: EMT.
 - 5. Concealed in Ceilings and Interior Walls and Partitions: ERMC IMC EMT.
 - 6. Damp or Wet Locations: ERMC IMC.
 - 7. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): .
 - 8. Circuits Operating Above 60 Hz: . Provide nonmetallic sleeve where aluminum raceways pass through concrete.
- C. Raceway Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.
 - 1. ERMC and IMC: Provide threaded type fittings unless otherwise indicated.

3.2 SELECTION OF BOXES AND ENCLOSURES

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Architect for resolution of conflicting requirements.
- B. Exposed Boxes Installed Less Than 2.5 m (8 ft) Above Floor:
 - 1. Provide cast-metal boxes.
 - 2. Provide exposed cover. Flat covers with angled mounting slots or knockouts are prohibited.

3.3 INSTALLATION OF RACEWAYS

- A. Installation Standards:
 - 1. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for installation of raceways. Consult Architect for resolution of conflicting requirements.
 - 2. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
 - 3. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.
 - 4. Comply with NECA NEIS 101 for installation of steel raceways.
 - 5. Comply with NECA NEIS 102 for installation of aluminum raceways.
 - 6. Comply with NECA NEIS 111 for installation of nonmetallic raceways.
 - 7. Install raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.
 - 8. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to metric designator 35 (trade size 1-1/4) and insulated throat metal bushings on metric designator 41 (trade size 1-1/2) and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
 - 9. Raceway Terminations at Locations Subject to Moisture or Vibration:
 - a. Provide insulating bushings to protect conductors, including conductors smaller than No. 4 AWG. Install insulated throat metal grounding bushings on service conduits.

- B. General Requirements for Installation of Raceways:
 - 1. Complete raceway installation before starting conductor installation.
 - 2. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 ft above finished floor.
 - 3. Install no more than equivalent of three 90-degree bends in conduit run. Support within 12 inch of changes in direction.
 - 4. Make bends in raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
 - 5. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
 - 6. Support conduit within 12 inch of enclosures to which attached.
 - 7. Install raceway sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings in accordance with NFPA 70.
 - 8. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of raceways at the following points:
 - a. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - b. Where an underground service raceway enters a building or structure.
 - c. Conduit extending from interior to exterior of building.
 - d. Conduit extending into pressurized duct and equipment.
 - e. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
 - f. Where otherwise required by NFPA 70.
 - 9. Do not install raceways or electrical items on "explosion-relief" walls or rotating equipment.
 - 10. Do not install conduits within 2 inch of the bottom side of a metal deck roof.
 - 11. Keep raceways at least 6 inch away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
 - 12. Cut conduit perpendicular to the length. For conduits metric designator 53 (trade size 2) and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.

- 13. Install pull wires in empty raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb tensile strength. Leave at least 12 inch of slack at both ends of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- C. Requirements for Installation of Specific Raceway Types:
 - 1. Types ERMC and IMC:
 - a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
 - 2. Types PVC and EPEC:
 - a. Do not install Type PVC or Type EPEC conduit where ambient temperature exceeds 122 deg F. Conductor ratings must be limited to 75 deg C except where installed in a trench outside buildings with concrete encasement, where 90 deg C conductors are permitted.
 - b. Comply with manufacturer's written instructions for solvent welding and fittings.
- D. Raceways Embedded in Slabs:
 - 1. Run raceways larger than metric designator 27 (trade size 1) below concrete slab.
 - 2. Arrange raceways to cross building expansion joints with expansion fittings at right angles to the joint.
 - 3. Arrange raceways to ensure that each is surrounded by a minimum of 1 inch of concrete without voids.
 - 4. Do not embed threadless fittings in concrete unless locations have been specifically approved by Architect.
 - 5. Change from ENT to ERMC IMC before rising above floor.
- E. Stub-ups to Above Recessed Ceilings:
 - 1. Provide EMT, IMC, or ERMC for raceways.
 - 2. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- F. Raceway Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.
 - 1. EMT: Provide setscrew compression, steel fittings. Comply with NEMA FB 2.10.
 - 2. Flexible Conduit: Provide only fittings listed for use with flexible conduit type. Comply with NEMA FB 2.20.
- G. Expansion-Joint Fittings:

- 1. Install in runs of aboveground PVC that are located where environmental temperature change may exceed 30 deg F and that have straight-run length that exceeds 25 ft. Install in runs of aboveground ERMC and EMT conduit that are located where environmental temperature change may exceed 100 deg F and that have straight-run length that exceeds 100 ft.
- 2. Install type and quantity of fittings that accommodate temperature change listed for the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
- 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
- 4. Install expansion fittings at locations where conduits cross building or structure expansion joints.
- 5. Install expansion-joint fitting with position, mounting, and piston setting selected in accordance with manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- H. Raceways Penetrating Rooms or Walls with Acoustical Requirements:
 - 1. Seal raceway openings on both sides of rooms or walls with acoustically rated putty or firestopping.

3.4 INSTALLATION OF SURFACE RACEWAYS

- A. Install surface raceways only where indicated on Drawings.
- B. Install surface raceway with a minimum 2 inch radius control at bend points.
- C. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inch and with no less than two supports per straight raceway section. Support surface raceway in accordance with manufacturer's written instructions. Tape and glue are unacceptable support methods.

3.5 INSTALLATION OF BOXES AND ENCLOSURES

- A. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.
- B. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to top of box unless otherwise indicated.
- C. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box, whether installed indoors or outdoors.
- D. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- E. Locate boxes so that cover or plate will not span different building finishes.
- F. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
- G. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.
- H. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
- I. Set metal floor boxes level and flush with finished floor surface.
- J. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
- K. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.
- L. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.
- M. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:
 - 1. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.
 - 2. Provide gaskets for wall-plates and covers.

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

3.7 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

3.8 CLEANING

A. Boxes: Remove construction dust and debris from device boxes, outlet boxes, and floor-mounted enclosures before installing wall-plates, covers, and hoods.

END OF SECTION

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Labels.
 - 2. Tapes and stencils.
- B. Related Requirements:
 - 1. Section 26 00 10 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 26 00 11 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1.
- B. Comply with 29 CFR 1910.144 for color identification of hazards; 29 CFR 1910.145 for danger, caution, warning, and safety instruction signs and tags; and the following:
 - 1. Fire-protection and fire-alarm equipment, including raceways, must be finished, painted, or suitably marked safety red.
 - 2. Ceiling-mounted hangers, supports, cable trays, and raceways must be finished, painted, or suitably marked safety yellow where less than 7.7 ft above finished floor.

- C. Signs, labels, and tags required for personnel safety must comply with the following standards:
 - 1. Safety Colors: NEMA Z535.1.
 - 2. Facility Safety Signs: NEMA Z535.2.
 - 3. Safety Symbols: NEMA Z535.3.
 - 4. Product Safety Signs and Labels: NEMA Z535.4.
 - 5. Safety Tags and Barricade Tapes for Temporary Hazards: NEMA Z535.5.
- D. Comply with NFPA 70Erequirements for arc-flash warning labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, must comply with UL 969.
- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 1000 V or Less:
 - 1. Legend: Indicate voltage and system or service type.
- B. Color-Coding for Phase- Identification, 1000 V or Less: Use colors listed below for ungrounded conductors.
 - 1. Color must be factory applied or field applied for sizes larger than 8 AWG if authorities having jurisdiction permit.
- C. Warning Label Colors:
 - 1. Identify system voltage with black letters on orange background.
- D. Warning labels and signs must include, but are not limited to, the following legends:
 - 1. Workspace Clearance Warning: "WARNING OSHA REGULATION -AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 3 FEET MINIMUM."
- E. Equipment Identification Labels:
 - 1. Black letters on white

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 1000 V: Identification must completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
 - 1. Secure tight to surface of conductor, cable, or raceway.
- H. System Identification for Raceways and Cables over 1000 V: Identification must completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
 - 1. Secure tight to surface of conductor, cable, or raceway.
- I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- J. Emergency Operating Instruction Signs: Install instruction signs with white legend on red background with minimum 3/8 inch high letters for emergency instructions at equipment used for power transfer.
- K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from floor.
- L. Accessible Fittings for Raceways: Identify cover of junction and pull box of the following systems with wiring system legend and system voltage. System legends must be as follows:

- 1. "EMERGENCY POWER."
- 2. "STANDBY POWER"
- 3. "POWER."
- 4. "UPS."
- M. Snap-Around Color-Coding Bands: Secure tight to surface at location with high visibility and accessibility.
- N. Heat-Shrink, Preprinted Tubes: Secure tight to surface at location with high visibility and accessibility.
- O. Write-on Tags:
 - 1. Place in location with high visibility and accessibility.
 - 2. Secure using cable ties.

END OF SECTION

SECTION 26 09 43 - NETWORK LIGHTING CONTROLS

PART 1 - GENERAL

- 1.1 WORK INCLUDED
 - A. The Section specifies the requirements necessary to furnish and install an expansion of the existing space lighting control system in room 330A and 350A
 - B. This Section specifies the requirements necessary to furnish and install a new replacement lighting control system in rooms 330B.
 - 1. Control equipment and enclosures.
 - 2. Switches.

1.2 RELATED REQUIREMENTS

- A. Use this Section in conjunction with the following other Section and related Contract Documents to establish the total requirements for low-voltage lighting control systems:
 - 1. Section 26 00 11, Facility Performance Requirements for Electrical
 - 2. Section 26 05 19, Low-Voltage Electrical Power Conductors and Cables

1.3 DIGITAL LIGHTING CONTROL SYSTEM DESCRIPTION

- A. Wireless Lighting Control System
 - 1. All new lighting shall be controlled via a wireless lighting control.
 - 2. All luminaires that are part of the wireless lighting control system shall have embedded controls, occupancy sensors, photocells, and wireless receivers that shall communicate wirelessly with the wireless low voltage switch station or be provided with power pack and stand alone occupancy sensor that shall communicate wirelessly with the wireless low voltage switch station.
 - 3. All luminaires in the wireless lighting control system must be able to speak natively to the wireless lighting control system.
 - 4. Exterior site lighting shall be controlled wirelessly via the low voltage lighting relay control panel. Lighting relay control panel shall be provided with a NECY controller to allow time of day, day of week and astronomical timeclock controls.
- B. Sequence of Operations
 - 1. The output of all new exterior light fixtures shall be set to 70% of their reated output.
 - 2. All new light fixtures shall be synchronized so that their light levels turn of/off and raise /lower their dimming levels in unison.

- 3. Light fixtures shall dim to 50% of their programmed output when the integrated sensors do not sense motion.
- 4. Light fixtures shall be programmed to automatically turn on/off based on the astronomical time clock control in the system controller on a time of day/day of the week basis.
 - a. Coordinate the exact times for automatic on/off control with the OWNER.
- 5. Coordinate all output levels and timing with the OWNER during commissioning.
 - a. Adjust the output level of individual light fixtures as directed by the OWNER to compensate for security camera surveillance performance or based on feedback on glare/illumination levels form neighbors.
- C. The new system shall be capable of turning lighting loads on/off as well as dimming lights (if lighting load is capable of being dimmed)
- D. All new system devices shall be networked together enabling digital communication and shall be individually addressable.
- E. The new system architecture shall be capable of enabling stand-alone groups (rooms) of devices to function in some default capacity even if network connectivity to the greater system is lost.
- F. The new system shall not require any centrally hardwired switching equipment.
- 1.4 SUBMITTALS
 - A. Product Datasheets (general device descriptions, dimensions, wiring details, nomenclature)
 - B. Riser Diagrams typical per room type (detailed drawings showing device interconnectivity of devices)
 - C. Other Diagrams as needed for special operation or interaction with other system(s)
 - D. Example Contractor Startup/Commissioning Worksheet must be completed prior to factory start-up
 - E. Hardware and Software Operation Manuals
 - F. Other operational descriptions as needed
- 1.5 QUALITY ASSURANCE

- A. All steps in sensor manufacturing process shall occur in the USA; including population of all electronic components on circuit boards, soldering, programming, wiring, and housing.
- B. All components and the manufacturing facility where product was manufactured must be ROHS compliant.
- C. All applicable products must be UL / CUL Listed or other acceptable national testing organization.

1.6 COORDINATION

- A. Coordinate lighting control components to form an integrated interconnection of compatible components.
- B. The installing contractor shall be responsible for a complete and functional system in accordance with all applicable local and national codes.

1.7 WARRANTY

A. All devices in lighting control system shall have a 5 year warranty.

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS
 - A. This specification is based on the nLight[®] Network Control System from Sensor Switch, an Acuity Brands Company (800-727-7483, www.sensorswitch.com).
- 2.2 SYSTEM REQUIREMENTS
 - A. System shall have an architecture that is based upon two main concepts;
 - 1. Intelligent lighting control devices
 - 2. Standalone lighting control zones.
 - B. Intelligent lighting control devices shall consist of one or more basic lighting control components; occupancy sensors, photocell sensors, relays, dimming outputs, manual switch stations, and manual dimming stations. Combining one or more of these components into a single device enclosure should be permissible so as to minimize overall device count of system.
 - C. Intelligent lighting control devices shall communicate digitally, require ~3 mA of current to function (Graphic WallPod excluded), and posses at least two T568B connectors.
 - D. Lighting control zones shall consist of one or more intelligent lighting control components, be capable of stand-alone operation, and be capable of being connected to a future higher level network backbone.

- E. Devices within a lighting control zone shall be connected with CAT-6 low voltage cabling, in a daisy-chain fashion, and in any order.
- F. Lighting control zone shall be capable of automatically configuring itself for default operation without any start-up labor required.
- G. Individual lighting zones must continue to provide a user defined default level of lighting control in the event of a system communication failure with the backbone network or the management software becoming unavailable.
- H. Power for devices within a lighting control zone shall come from either resident devices already present for switching (relay device) or dimming purposes, or from the network backbone. Standalone "bus power supplies" shall not be required in all cases.
- I. All switching and dimming for a specific lighting zone shall take place within the devices located in the zone itself (i.e. not in a remotely located devices such as panels) to facilitate system robustness and minimize wiring requirements. Specific applications that require centralized or remote switching shall be capable of being accommodated.
- J. System shall have a primary wall mounted network control "gateway" device that is capable of accessing and controlling connected system devices.
- K. System shall use "bridge" devices that route communication and distribute power for up to 8 lighting zones together for purposes of decreasing system wiring requirements.
- L. System shall be capable of a future upgrade to a web-based software management program. That future system will enable remote system control, status monitoring, and creation of lighting control profiles.
- M. Individual lighting zones shall be capable of being segmented into several channels of occupancy, photocell, and switch functionality for more advanced configurations and sequences of operation.
- N. System shall be capable of operating a lighting control zone according to several sequences of operation. Note operating modes should be utilized only in manners consistent with local energy codes.
 - 1. Auto-On / Auto-Off (via occupancy sensors)
 - 2. Manual-On / Auto-Off
 - 3. Auto-to-Override On
 - 4. Manual-to-Override On
 - 5. Auto On/Predictive Off
 - 6. Multi-Level On (multiple lighting levels per manual button press)

2.3 INDIVIDUAL DEVICE SPECIFICATIONS

- A. Networked System Occupancy Sensors
 - 1. Occupancy sensors system shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.
 - 2. Sensors shall utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state; thus preventing false on conditions.
 - 3. For applications where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions), a sensor with an additional "dual" technology shall be used.
 - 4. Sensors shall be have programmable time delays, multiple lens options which are customized for specific applications.
 - 5. Every sensor parameter shall be available and configurable remotely from the software and locally via the device push-button.
 - 6. Sensors shall be able to function together with other sensors in order to provide expanded coverage areas by simply daisy-chain wiring together the units with CAT-6 cabling.
 - 7. Sensors shall be available in Wall Switch, Surface Ceiling, Fixture Mounted, Recessed Ceiling, & corner mounted versions.
- B. Networked System Daylight (Photocell and or Dimming) Sensors
 - 1. Photocell shall provide for an on/off set-point, and a deadband to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.
 - 2. Photocell and dimming sensor's set-point and deadband shall be automatically calibrated through the sensor's microprocessor by initiating an "Automatic Set-point Programming" procedure. Min and max dim settings as well as set-point may be manually entered.
 - 3. Deadband setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).
 - 4. Combination units that have all features of on/off photocell and dimming sensors shall also be available.
 - 5. A dual zone option shall be available for On/Off Photocell, Automatic Dimming Control Photocell, or Combination units. The second zone shall be capable of being controlled as an "offset" from the primary zone.
- C. Combination Motion Sensor / Photocell units
 - 1. Any of the above motion sensors and/or Photocell units shall be able to combine both motion sensing as well as daylight sensing into a single unit to reduce ceiling clutter.
- D. Lighting Control Relays and Dimmers
 - 1. Power Packs shall accept 120 or 277 VAC, be plenum rated, and provide Class 2 power to the system.

- 2. Every Power Pack parameter shall be available and configurable remotely from the software and locally via the device push-button.
- Power Pack shall securely mount to junction location through a threaded ¹/₂ inch chase nipple. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads.
- 4. Relays and Dimmers shall provide UL924 listing and operation where required for the switching of legally required life safety egress lighting.
- 5. Power Packs shall be available in the following types to match the loads required to be controlled:
 - a. Single Pole 120 through 277 VAC
 - b. Two Pole 208, 240, & 480 VAC
 - c. Dry contact up to 1 amp at less than 42 V DC or AC
 - d. 0-10V with Single Pole relay
 - e. Phase Control Dimming for Incancdesent, Magnetic Low Voltage Transformers, Electronic Low Voltage Transformers, 2 Wire Flourescent dimming ballasts, Neon, or Cold Cathode as required
 - f. 3 Wire dimming for Lutron or similar Dimming Ballasts
- E. Networked System Wall Switches & Dimmers
 - 1. Devices shall recess into single-gang switch box and fit a standard GFI opening and shall be gangable with other compatible devices.
 - 2. Devices shall be White.
 - 3. Devices with capacitive touch buttons shall provide audible user feedback with different sounds for on/off, raise/lower, start-up, and communication offline.
 - 4. Devices with mechanical push-buttons shall provide tactile and LED user feedback.
 - 5. Devices with mechanical push-buttons shall be made available with custom button labeling
 - 6. Single Pole, Two Pole, and Four Pole switches shall be available.
 - 7. Single and two pole Dimmers shall be available
 - 8. Preset Control shall be available in 2 and four buttons per single gang device.
- F. Networked Auxiliary Input / Output (I/O) Devices
 - 1. Devices shall be plenum rated and be inline wired, screw mountable, or have an extended chase nipple for mounting to a ½" knockout.
 - 2. Devices shall have two RJ-45 ports
 - 3. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
 - 4. Specific I/O devices shall have a dimming control output that can control 0-10 VDC dimmable ballasts or LED drivers by sinking up to 20 mA of current (typically 40 or more ballasts).

- 5. Specific I/O devices shall have an input that read a 0-10 VDC signal from an external device.
- 6. Specific I/O devices shall have a switch input that can interface with either a maintained or momentary switch and run a switch event, run a local/remote control profile, or raise/lower a dimming output
- 7. Specific I/O devices shall sense state of low voltage outdoor photocells
- G. Specific I/O devices shall enable RS-232 communication between lighting control system and Touch Screen based A/V control systems.
- H. Networked System Graphic Wall Station
 - 1. Device shall have a 3.5" full color touch screen for selecting up to 8 programmable lighting control presets or acting as up to 16 on/off/dim control switches.
 - 2. Device shall enable configuration of lighting presets, switched, and dimmers via password protected setup screens.
 - 3. Device shall surface mount to single-gang switch box.
- I. Communication Bridges
 - 1. Device shall be capable of aggregating communication from multiple lighting control zones for purposes of minimizing backbone wiring requirements back to Control Gateway.
 - 2. Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply or delivered via a CAT-6 cabled connection.
 - 3. Device shall report back over network (accessible at gateway or software) the number of devices connected and their activity on each port.
- J. Networked LED Luminaires
 - 1. Networked LED luminaire shall have a mechanically integrated control device
 - 2. Networked LED luminaire shall have two RJ-45 ports
 - 3. Networked LED luminaire shall be able to digitally network directly to other network control devices (sensors, photocells, switches, dimmers)
 - 4. Networked LED luminaire shall provide low voltage power to other networked control devices
 - 5. System shall be able to turn on/off LED luminaire without using a relay
 - 6. System shall be able to maintain constant lumen output over the specified life of the LED luminaire (also called lumen compensation) by varying the input control power (and thus saving up to 20% power usage).
 - 7. System shall indicate (via a blink warning) when the LED luminaire has reached its expected life (in hrs).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate, receive, mount, connect, and place into operation all equipment.
- B. Install equipment in accordance with manufacturer's installation instructions.
- C. Provide complete installation of system in accordance with Contract Documents.
- D. Maintain performance criteria stated by the manufacturer without defects, damage, or failure.
- E. Provide equipment at locations and in quantities indicated on Drawings. Provide any additional equipment required to provide control intent.
- F. As specified in Article 3.1, Paragraph F, interior sensors work mainly with diffused light and have a much higher lighting gain than exterior sensors. Electric light sources can affect these sensors unless the sensors are shielded from the light given off by electric light sources.
- G. Ensure that daylight sensor placement minimizes sensors view of electric light sources; ceiling mounted and fixture-mounted daylight sensors shall not have direct view of luminaries.
- H. Furnish all conduit, wire, connectors, hardware, and other incidental items necessary for a properly functioning lighting control and relay system as described herein and shown on the plans. The Electrical Contractor shall maintain performance criteria stated by the manufacturer without defects, damage, or failure.
- I. Compliance: Contractor shall comply with manufacturer's product data, including shop drawings, technical bulletins, product catalog installation instructions, and product carton instructions for installation.
- J. Circuit Testing: The contractor shall test that all branch load circuits are operational before connecting loads to system load terminals, and then deenergize all circuits before installation.
- K. Application of Power: Power shall not be applied to the relay system during construction and prior to turn-on unless specifically authorized by written instructions from the manufacturer.
- L. Terminate and test all network cable assemblies. Each field installed RJ45 connection must be tested prior to system interconnection. A test report must be furnished to factory-certified service engineer prior to scheduling commissioning activity.

3.2 SITE VERIFICATION

A. Verify that wiring conditions, which have been previously installed under other sections or at a previous time, are acceptable for product installation in accordance with manufacturer's instructions.

3.3 FIELD MEASUREMENTS

- A. The electrical contractor shall be responsible for field measurements and coordinating the physical size of all equipment with the architectural requirements of the spaces into which they are to be installed.
- 3.4 INSPECTION
 - A. Inspect all material included in this contract prior to installation. Manufacturer shall be notified of unacceptable material prior to installation.

3.5 SITE PROTECTION

A. Contractor shall protect installed product and finished surfaces from damage during all phases of installation including storage, preparation, testing, and cleanup.

END OF SECTION 26 09 43