

**Project: South Battery Park City Resiliency Project:  
Pier A Plaza / Battery Site Work and Near  
Surface Isolation (“NSI”) Construction Services  
(the “Project”) Request for Proposals (“RFP”)**

**Date: February 7, 2023**

**RE: Addendum #10  
# of Pages: 127**

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**REVISIONS/CLARIFICATIONS TO RFP:**

- The following revised Project Specifications are hereby formally incorporated into the RFP’s *Exhibit B-1 – Construction Documents (Project Drawings & Specifications)*. The below-listed revised Specifications replace and supersede all prior versions issued with the RFP. Note that the changes to the below-listed revised Specifications, which are yellow-highlighted, make note of the selected Proposer’s option to use an approved-equal where applicable. In doing so, the selected Proposer must submit manufacturer drawings that meet the requirements of the Drawings and Specifications for review and approval.
- **Revised Plumbing Specifications – Attachment #1:**
  - 220519 – Meters and Gages for Plumbing Piping*
  - 220523 – General-Duty Valves for Plumbing System*
  - 221116 – Domestic Water Piping*
  - 221119 – Domestic Water Piping Specialties*
- **Revised Electrical Specifications – Attachment #2:**
  - 260519 – Low-Voltage Electrical Power Conductors and Cables*
  - 260526 – Grounding and Bonding for Electrical Systems*
  - 260533 – Raceways and Boxes for Electrical Systems*
  - 260923 – Lighting Control Devices*
- **Revised Lighting Specification – Attachment #3:**
  - 260943 – Digital Network Lighting Controls*
  - 265613 – Lighting Poles*
- **Revised Landscape Specification – Attachment #4:**
  - 055301 – Metal Gratings for Park Areas*

**CLARIFICATIONS:**

The following information is intended to provide clarifications to specific Drawings and Specifications provided with the RFP as *Exhibit B-1 – Construction Documents (Project Drawings and Specifications)*.

- Regarding the 83”x53” elliptical sewer and the 54”-diameter sewer that will receive tide gate chambers:
  - Pipe materials based on record information are identified on Drawings C902 and C907.
  - For a potential work approach for the sequence of the Project’s tide gate construction, please refer to the notes on Drawings C422 and C431. The selected Proposer will be responsible for providing an adequate work environment that will enable the construction of the tide gates, and for maintaining a conveyance system for upstream flows that will be disrupted. BPCA has coordinated with New York City Department of Environmental Protection (“NYCDEP”) and has obtained approvals of the tide gate chamber designs/documents. However, please note that the construction approach and method for creating/maintaining an adequate work environment is contractor means and methods and will include elements that need to be approved by the NYCDEP.

- Based on the NYCDEP drainage maps, the existing flow rate for the 83"x53" elliptical CSO overflow pipe is 129.8 cubic feet per second ("CFS"); and the existing flow rate for the 54" diameter storm drain pipe in Rector Place is 69.2 CFS. Flows will vary depending on storm events that will occur during the Project's construction. The selected Proposer is responsible for confirming with NYCDEP the bypass flow capacity that will be required.

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*By signing the line below, I am acknowledging that all pages of this Addendum #10 have been received, reviewed and understood, and will be incorporated into the Proposal submitted. This document must be attached to the Proposal for consideration.*

\_\_\_\_\_  
Print Name (Above)

\_\_\_\_\_  
Signature (Above)

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Date (Above)

Number of pages received: \_\_\_\_\_ <fill in>

*Distributed to: All prospective Proposers*

*[NO FURTHER TEXT ON THIS PAGE]*

**ATTACHMENT #1**

**REVISED PLUMBING SPECIFICATIONS**

*220519 – Meters and Gages for Plumbing Piping*

*220523 – General Duty Valves for Plumbing System*

*221116 – Domestic Water Piping*

*221119 – Domestic Water Piping Specialties*

*[ATTACHED]*

## SECTION 22 05 19

### METERS AND GAGES FOR PLUMBING PIPING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Liquid-in-glass thermometers.
  - 2. Thermowells
  - 3. Dial-type pressure gages.
  - 4. Gage attachments.
  - 5. Test plugs.
  - 6. Test-plug kits.
- B. Related Requirements:
  - 1. Section 22 11 19 "Domestic Water Piping Specialties" for water meters.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

##### 1.3 REFERENCE STANDARD

- A. All Plumbing Equipment, piping, valves, fittings and ancillaries shall be manufactured, designed and tested in accordance with the latest industry standards and compliant with building codes and reference standards including the following:
  - 1. NYC Building Code
  - 2. NYC Plumbing Code
  - 3. ASTM – American Society for Testing and Materials
  - 4. ASSE – American Society of Sanitary Engineers
  - 5. NSF – National Standard Plumbing
  - 6. AWWA – American Water Works Association
  - 7. ANSI B16.22 and B16.3

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of meter and gage.

##### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 LIQUID-IN-GLASS THERMOMETERS

#### A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, **provide products by one of the following, or approved equal:**
  - a. Miljoco Corporation.
  - b. Trerice, H. O. Co.
  - c. Weksler Glass Thermometer Corp.
2. Standard: ASME B40.200.
3. Case: Cast aluminum 7-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F
7. Window: Glass or plastic
8. Stem: Aluminum and of length to suit installation.
  - a. Design for Thermowell Installation: Bare stem.
9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

### 2.2 THERMOWELLS

#### A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI
4. Material for Use with Steel Piping: CRES.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

#### B. Heat-Transfer Medium: Mixture of graphite and glycerin.

### 2.3 PRESSURE GAGES

#### A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
    - a. Ashcroft Inc.
    - b. Miljoco Corporation.
    - c. Weksler Glass Thermometer Corp.
  2. Standard: ASME B40.100.
  3. Case: Sealed, Solid-front, pressure relief type(s); cast aluminum 4-1/2-inch nominal diameter.
  4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
  5. Pressure Connection: Brass, with NPS 1/4 ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
  6. Movement: Mechanical, with link to pressure element and connection to pointer.
  7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi
  8. Pointer: Dark-colored metal.
  9. Window: Glass or plastic
  10. Ring: Metal
  11. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.
- 2.4 GAGE ATTACHMENTS
- A. Snubbers: ASME B40.100, brass; with NPS 1/4ASME B1.20.1 pipe threads and piston or porous-metal-type surge-dampening device. Include extension for use on insulated piping.
  - B. Valves: Brass ball, with NPS 1/4ASME B1.20.1 pipe threads.
- 2.5 TEST PLUGS
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
    1. Miljoco Corporation.
    2. Terice, H. O. Co.
    3. Weksler Glass Thermometer Corp.
  - B. Description: Test-station fitting made for insertion into piping tee fitting.
  - C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
  - D. Thread Size: NPS 1/4, ASME B1.20.1 pipe thread.
  - E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F
  - F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.
- 2.6 TEST-PLUG KITS
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:

1. Miljoco Corporation.
  2. Terice, H. O. Co.
  3. WATTS.
- B. Furnish one test-plug kit(s) containing two thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
- C. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F
- D. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch diameter dial and probe. Dial range shall be at least 0 to 200 psig
- E. Carrying Case: Metal or plastic, with formed instrument padding.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
- G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- H. Install remote-mounted pressure gages on panel.
- I. Install valve and snubber in piping for each pressure gage for fluids.
- J. Install test plugs in piping tees.
- K. Install thermometers in each Hot Water Return Branch:
1. Inlet and outlet of each water heater.
  2. Where indicated on drawings.
- L. Install pressure gages in the following locations:
1. Where indicated on drawings.

3.2 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

- A. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F.
- B. Scale Range for Domestic Hot-Water Piping: 30 to 150 deg F

3.5 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Water Piping: 0 to 160 psi

END OF SECTION



## SECTION 22 05 23

### GENERAL-DUTY VALVES FOR PLUMBING PIPING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Ball Valves.
  - 2. Gate Valves
  - 3. Check Valves

##### 1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. NRS: Non-rising stem.
- C. OS&Y: Outside screw and yoke.
- D. RS: Rising stem.
- E. EPDM: Ethylene propylene-diene terpolymer rubber.
- F. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

##### 1.3 REFERENCE STANDARD

- A. All Plumbing Equipment, piping, valves, fittings and ancillaries shall be manufactured, designed and tested in accordance with the latest industry standards and compliant with building codes and reference standards including the following:
  - 1. NYC Building Code
  - 2. NYC Plumbing Code
  - 3. ASTM – American Society for Testing and Materials
  - 4. ASSE – American Society of Sanitary Engineers
  - 5. NSF – National Standard Plumbing
  - 6. AWWA – American Water Works Association
  - 7. ANSI B16.22 and B16.3

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve.
  - 1. Certification that products comply with NSF 61 Annex G and NSF 372.

## 1.5 DELIVERY, STORAGE, AND HANDLING

### A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and soldered ends.
3. Set ball valves open to minimize exposure of functional surfaces.
4. Set gate valves closed to prevent rattling.
5. Set check valves in either closed or open position.

### B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

### C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR VALVES

#### A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

#### B. Acceptable Manufacturers, provide products by one of the following, or approved equal: Watts, Apollo, Febco, Zurn, Milwaukee, Crane

#### C. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.5 for flanges on steel valves.
4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
5. ASME B16.18 for solder-joint connections.
6. ASME B31.9 for building services piping valves.

#### D. NSF Compliance: NSF 61 Annex G and NSF 372 for valve materials for potable-water service.

#### E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

#### F. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

#### G. Valve Sizes: Same as upstream piping unless otherwise indicated.

#### H. Valve Bypass and Drain Connections: MSS SP-45.

### 2.2 BALL VALVES (Piping 2" and smaller)

#### A. Valves in Insulated Piping:

1. Include 2-inch stem extensions.
2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

B. Bronze Ball Valves, Two-Piece or Three-Piece with Full Port and Stainless-Steel Trim:

1. Description:
  - a. Standard: MSS SP-110.
  - b. CWP Rating: 600 psig
  - c. Body Design: Two piece or three piece.
  - d. Body Material: Bronze.
  - e. Ends: Threaded.
  - f. Seats: PTFE.
  - g. Stem: Stainless steel.
  - h. Ball: Stainless steel, vented.
  - i. Port: Full.

2.3 GATE VALVES (Piping 2-1/2" and larger)

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

B. Iron Gate Valves, OS&Y, Class 125:

1. Description:
  - a. Standard: MSS SP-70, Type I.
  - b. CWP Rating: 150 psig
  - c. Body & Bonnet Material: ASTM A126 class B gray iron
  - d. Ends: Flanged.
  - e. Trim: Bronze.
  - f. Disc: Solid Cast iron.
  - g. Packing and Gasket: Asbestos free.
  - h. Design shall allow packing under pressure.
  - i. Wheel Material: Malleable iron

C. Iron Gate Valves, OS&Y, Class 250:

1. Description:
  - a. Standard: MSS SP-70, Type I.
  - b. CWP Rating: 500 psig
  - c. Body & Bonnet Material: ASTM A126 class B gray iron
  - d. Ends: Flanged.
  - e. Trim: Bronze.
  - f. Disc: Solid Cast iron.
  - g. Packing and Gasket: Asbestos free.
  - h. Design shall allow packing under pressure.
  - i. Wheel Material: Malleable iron

D. Check Valves (2" and smaller)

1. Bronze, Y Pattern Lift Check Valves with Bronze Disc, Class 200:
  2. Description:
    - a. Standard: MSS SP-80, Type 1.
    - b. CWP Rating: 400 psig
    - c. Body Material: ASTM B 61 or ASTM B 62, bronze.
    - d. Ends: Threaded
    - e. Disc: Bronze.
- E. Check Valves (2-1/2" and larger)
1. Bronze, Y Pattern Lift Check Valves with Bronze Disc, Class 150:
  2. Description:
    - a. Standard: MSS SP-125.
    - b. CWP Rating: 300 psig
    - c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
    - d. Style: Globe, spring loaded.
    - e. Ends: Flanged.
    - f. Seat: Bronze.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

#### 3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

- E. Install valve tags. Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

END OF SECTION

## 221116 - DOMESTIC WATER PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

A. Section Includes:

1. Copper tube and fittings.
2. Ductile-iron pipe and fittings.
3. Galvanized-steel pipe and fittings.
4. Piping joining materials.
5. Encasement for piping.
6. Transition fittings.
7. Dielectric fittings.

B. Related Requirements:

1. Division 01 and other general front end specifications.
2. Section 220523 - "Valves and Gages for Plumbing Systems."
3. Section 220529 - "Hangers and Support for Plumbing Piping and Equipment."
4. Section 220719 - "Plumbing Piping Insulation"
5. Section 331700 - "Water Distribution."

#### 1.3 REFERENCE STANDARD

- A. All Plumbing Equipment, piping, valves, fittings and ancillaries shall be manufactured, designed and tested in accordance with the latest industry standards and compliant with building codes and reference standards including the following:
1. NYC Building Code
  2. NYC Plumbing Code
  3. ASTM – American Society for Testing and Materials
  4. ASSE – American Society of Sanitary Engineers
  5. NSF – National Standard Plumbing
  6. AWWA – American Water Works Association
  7. ANSI B16.22 and B16.3

#### 1.4 ACTION SUBMITTALS

- A. Submit shop drawings according to General specifications, indicating systems designed conforming to the project requirements, documents & design criteria; coordinate layouts of piping and equipment with architectural, structural, mechanical, electrical and fire protection plans, avoiding conflicts with all trades & general construction, positioning equipment, backflow preventers, meters, valves, strainers, filters, gauges and thermometers with adequate space for normal testing, adjusting and maintenance activities. Indicate layouts that make piping connections in such a manner as to provide for shut-down and complete drainage, and to eliminate undue stress and strain on piping systems. Indicate layouts that fully consider and provide for, the expansion, contraction and structural settlement against of piping systems based on manufacturer's published recommendations, that includes calculations, hangers and bracing, expansion loops and or expansion fittings, consistent with the seismic zone of the project's location, established in the NFC Standards.
- B. Product Data:
  - 1. Pipe and tube.
  - 2. Fittings.
  - 3. Joining materials.
  - 4. Transition fittings.
- C. Sustainable Design Submittals: Refer to sustainability requirements section

#### 1.5 QUALITY ASSURANCE

- A. All equipment and materials furnished provided shall be approved for use in New York City and shall be UL listed and tested in accordance with a Nationally Recognized Laboratory.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Coordinated shop Drawings: Piping layout, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- B. System purging and disinfecting activities report.
- C. Field quality-control reports.

#### 1.7 FIELD CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of water service.
2. Do not interrupt water service without the Construction Manager's written permission.

#### 1.8 WARRANTY

- A. Polypropylene Piping (PP-R) Manufacturer's Warranty: Manufacturer agrees to repair or replace PP-R pipe and fittings that fail in materials or workmanship within 10 years from date of Substantial Completion.
  1. Warranty is to cover labor and material costs of repairing and/or replacing defective materials and repairing any incidental damage caused by failure of the piping system due to defects in materials or manufacturing.
  2. Warranty is to be in effect only upon submission by the Contractor to the manufacturer of valid pressure/leak documentation indicating that the system was tested and passed the manufacturer's pressure/leak test.

### PART 2 - PRODUCTS

#### 2.1 PIPING MATERIALS

- A. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372. Include marking "NSF-pw" on piping.

#### 2.2 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tube: ASTM B88, Type K or ASTM B88, Type L.
- B. Annealed-Temper Copper Tube: ASTM B88, Type K or ASTM B88, Type L.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Cast Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
- G. Wrought Copper Unions: ASME B16.22.

#### 2.3 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe:
  1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.



2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Standard-Pattern, Mechanical-Joint Fittings:
1. AWWA C110/A21.10, ductile or gray iron.
  2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- C. Compact-Pattern, Mechanical-Joint Fittings:
1. AWWA C153/A21.53, ductile iron.
  2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- D. Push-on-Joint, Ductile-Iron Pipe:
1. AWWA C151/A21.51.
  2. Push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
- E. Standard-Pattern, Push-on-Joint Fittings:
1. AWWA C110/A21.10, ductile or gray iron.
  2. Gaskets: AWWA C111/A21.11, rubber.
- F. Compact-Pattern, Push-on-Joint Fittings:
1. AWWA C153/A21.53, ductile iron.
  2. Gaskets: AWWA C111/A21.11, rubber.
- G. Plain-End, Ductile-Iron Pipe: AWWA C151/A21.51.
- H. Appurtenances for Grooved-End, Ductile-Iron Pipe:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal::
    - a. Shurjoint-Apollo Piping Products USA Inc.
    - b. Smith-Cooper International.
    - c. Star Pipe Products.
    - d. Victaulic Company.
  2. Fittings for Grooved-End, Ductile-Iron Pipe: ASTM A47/A47M, malleable-iron castings or ASTM A536, ductile-iron castings with dimensions that match pipe.
  3. Mechanical Couplings for Grooved-End, Ductile-Iron-Piping:
    - a. AWWA C606 for ductile-iron-pipe dimensions.
    - b. Ferrous housing sections.
    - c. EPDM-rubber gaskets suitable for hot and cold water.
    - d. Bolts and nuts.
    - e. Minimum Pressure Rating: 150 psig

- I. Standard-Pattern, Push-on-Joint Fittings:
  - 1. AWWA C110/A21.10, ductile or gray iron.
  - 2. Gaskets: AWWA C111/A21.11, rubber.
- J. Compact-Pattern, Push-on-Joint Fittings:
  - 1. AWWA C153/A21.53, ductile iron.
  - 2. Gaskets: AWWA C111/A21.11, rubber.

#### 2.4 PVC PIPE AND FITTINGS (For Interconnection to Irrigation System Only):

- A. PVC Pipe: ASTM D1785, with wall thickness as indicated in "Piping Applications" Article.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, provide products by one of the following, or approved equal:
    - a. Charlotte Pipe and Foundry Company.
    - b. IPEX USA LLC.
    - c. Spears Manufacturing Company.
- B. PVC Socket Fittings: ASTM D2466 for Schedule 40 and ASTM D2467 for Schedule 80.

#### 2.5 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials:
  - 1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
  - 2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B32, lead-free alloys.
- D. Flux: ASTM B813, water flushable.
- E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- F. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F493.
- G. Solvent Cements for Joining PVC Piping: ASTM D2564. Include primer according to ASTM F656.
- H. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

## 2.6 TRANSITION FITTINGS

### A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

### B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

### C. Plastic-to-Metal Transition Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
  - a. Aquatherm.
  - b. Charlotte Pipe and Foundry Company.
  - c. Harvel Plastics, Inc.
  - d. Sioux Chief Manufacturing Company, Inc.
  - e. Spears Manufacturing Company.
2. Description:
  - a. PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
  - b. One end with threaded brass insert and one solvent-cement-socket end.

### D. Plastic-to-Metal Transition Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
  - a. Aquatherm.
  - b. NIBCO INC.
  - c. Spears Manufacturing Company.
2. Description:
  - a. Brass threaded end.
  - b. Solvent-cement-joint plastic end.
  - c. Rubber O-ring.
  - d. Union nut.

## 2.7 DIELECTRIC FITTINGS

### A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

### B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
    - a. A.Y. McDonald Mfg. Co.
    - b. Jomar Valve.
    - c. WATTS.
    - d. Wilkins.
    - e. Zurn Industries, LLC.
  2. Standard: ASSE 1079.
  3. Pressure Rating: 150 psig.
  4. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
    - a. WATTS.
    - b. Wilkins.
    - c. Zurn Industries, LLC.
  2. Standard: ASSE 1079.
  3. Factory-fabricated, bolted, companion-flange assembly.
  4. Pressure Rating: 150 psig.
  5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
    - a. Calpico, Inc.
    - b. Central Plastics Company.
    - c. Pipeline Seal and Insulator, Inc.
  2. Non-conducting materials for field assembly of companion flanges.
  3. Pressure Rating: 150 psig.
  4. Gasket: Neoprene or phenolic.
  5. Bolt Sleeves: Phenolic or polyethylene.
  6. Washers: Phenolic with steel backing washers.

## 2.8 ENCASEMENT FOR PIPING

- A. Standard: ASTM A674 or AWWA C105/A21.5.
- B. Form: Sheet or tube.
- C. Color: Black or natural

## PART 3 - EXECUTION

### 3.1 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building-service piping, NPS 1-1/2" and smaller shall be one of the following:
  - 1. Annealed-temper copper tube, ASTM B88, Type K or ASTM B88, Type L; wrought-copper, solder-joint fittings; and brazed joints. Joints shall be avoided below the slab as much as practicable. Connections to trap primers can use threaded fittings or as necessary to match drain trap primer connection.
- E. Under-building-slab, domestic water, building-service piping, NPS 4 and larger shall be one of the following:
  - 1. Mechanical-joint, ductile-iron pipe; standard or compact pattern, mechanical-joint fittings; and mechanical joints.
  - 2. Push-on-joint, ductile-iron pipe; standard or compact pattern, push-on-joint fittings; and gasketed joints.
- F. Aboveground domestic water piping, NPS 2-1/2" and smaller, shall be the following:
  - 1. Drawn-temper copper tube, ASTM B88, Type L cast- or wrought- copper, solder-joint fittings; and brazed or soldered joints.
- G. Aboveground domestic water piping, NPS 3 to NPS 4, shall be one of the following:
  - 1. Drawn-temper copper tube, ASTM B88, Type L cast- or wrought-copper, solder-joint fittings; and brazed or soldered joints.
  - 2. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
- H. Aboveground, fire-service-main piping, NPS 3 and above, shall be one of the following:
  - 1. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
  - 2. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
  - 3. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.

### 3.2 EARTHWORK

- A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

### 3.3 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install underground ductile-iron pipe in PE encasement according to ASTM A674 or AWWA C105/A21.5.
- E. Install valves according to the following:
  - 1. Section 220523 – "General duty valves for plumbing System."
- F. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
- G. Rough-in domestic water piping for water-meter installation according to utility company's requirements and NYC DEP requirements.
- H. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- I. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- J. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- K. Install piping to permit valve servicing.
- L. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- M. Install piping free of sags and bends.
- N. Install fittings for changes in direction and branch connections.
- O. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

- P. Install pressure gauges on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gauges in Section 220519 "Meters and Gages for Plumbing Piping."
- Q. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."
- R. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."
- S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

### 3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B828 or CDA's "Copper Tube Handbook." Joints shall be made with a lead-free solder alloy (95/5) consisting of tin-antimony and shall conform to ASTM Specification B-32, minimum 250 psi WWP.
- F. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints according to AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.

- G. Joint Construction for Grooved-End Steel Piping: Make joints according to AWWA C606. Roll groove ends of pipe as specified. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- H. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- I. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
  - 2. CPVC Piping: Join according to ASTM D2846/D2846M Appendix.
  - 3. PVC Piping: Join according to ASTM D2855.
- J. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

### 3.5 INSTALLATION OF TRANSITION FITTINGS

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Aboveground Domestic Water Piping NPS 2-1/2" and Smaller: Plastic-to-metal transition fittings.

### 3.6 INSTALLATION OF DIELECTRIC FITTINGS

- A. Dielectric Fittings:
  - 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
  - 2. Dielectric Fittings for NPS 1-1/4 and smaller: Use brass dielectric fittings.
  - 3. Dielectric Fittings for NPS 1-1/2 to NPS 2: Use dielectric unions.
  - 4. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

### 3.7 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- C. Install hangers for copper, ductile iron and galvanized steel tube or pipe, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, 2014 NYC Building codes, and authorities having jurisdiction requirements, whichever are most stringent.



- D. Install vinyl-coated hangers for PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Support horizontal piping within 24" of each fitting.
- F. Support vertical runs of copper, ductile iron and galvanized steel tube or pipe, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- G. Support vertical runs of PVC piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

### 3.8 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
  - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
  - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
  - 3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
  - 4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 (DN 65) and larger.

### 3.9 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.10 ADJUSTING

- A. Perform the following adjustments before operation:
  - 1. Close drain valves, hydrants, and hose bibbs.
  - 2. Open shutoff valves to fully open position.
  - 3. Open throttling valves to proper setting.
  - 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

- a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
- b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

### 3.11 FIELD QUALITY CONTROL

#### A. Perform the following tests and inspections:

1. Piping Inspections:
  - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
  - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
    - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
    - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
  - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
  - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
2. Piping Tests:
  - a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
  - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
  - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  - d. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

- e. Hydrostatic testing and documentation of test results for polypropylene piping to be in accordance with the manufacturer's instructions and submitted to the manufacturer upon successful completion per warranty requirements.
  - f. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
  - g. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.12 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
- 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Fill and isolate system according to either of the following:
      - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.
      - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
    - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    - d. Repeat procedures if biological examination shows contamination.
    - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Clean non-potable domestic water piping as follows:
- 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  - 2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION 221116

## SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Automatic water shutoff valve systems.
5. Balancing valves.
6. Temperature-actuated, water mixing valves.
7. Strainers for domestic water piping.
8. Hose bibbs.
9. Ground Hydrants
10. Drain valves.
11. Water-hammer arresters.
12. Trap-seal primer device.
13. Trap-seal primer systems.
14. Flexible connectors.
15. Water meters.

B. Related Requirements:

1. Division 01 and other general front end specifications.
2. Section 220523 - "Valves and Gages for Plumbing Systems."
3. Section 220529 - "Hangers and Support for Plumbing Piping and Equipment."
4. Section 220719 - "Plumbing Piping Insulation"
5. Section 221116 - "Domestic Water Piping."

#### 1.3 REFERENCE STANDARD

- A. All Plumbing Equipment, piping, valves, fittings and ancillaries shall be manufactured, designed and tested in accordance with the latest industry standards and compliant with building codes and reference standards including the following:
1. NYC Building Code
  2. NYC Plumbing Code
  3. ASTM – American Society for Testing and Materials

4. ASSE – American Society of Sanitary Engineers
5. NSF – National Standard Plumbing
6. AWWA – American Water Works Association
7. ANSI B16.22 and B16.3

#### 1.4 DEFINITIONS

- A. AMI: Advanced Metering Infrastructure.
- B. AMR: Automatic Meter Reading.
- C. FKM: A family of fluoroelastomer materials defined by ASTM D1418.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For domestic water piping specialties.
  1. Include diagrams for power, signal, and control wiring.
  2. Include “Application for Approval of Backflow Prevention Devices” to the New York City Department of Environmental Protection for RPZ backflow preventers and double check valves.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Test and inspection reports.
- B. Field quality-control reports.

#### 1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Domestic water piping specialties intended to convey or dispense water for human consumption are to comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or to be certified in compliance with NSF 61 and NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 150 psig unless otherwise indicated.

## 2.3 HOSE BIBB P-15

- A. Anti-siphon, vacuum breaker protected wall hydrant
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
    - a. Woodford
    - b. FEBCO, A WATTS Brand.
    - c. Zurn Industries, LLC.
  2. Enclosed in a flush mounted wall box

## 2.4 WALL HYDRANT P-16

- A. Freezeless hydrant features with self-draining, anti-siphon and two backflow check valves.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
    - a. Priemer Products
    - b. FEBCO, A WATTS Brand.
    - c. Zurn Industries, LLC.
  2. Vacuum breaker/ backflow preventer

## 2.5 ROOF HYDRANT P-17

- A. Recessed Hose Box for floor installation.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
    - a. Acorn
    - b. FEBCO, A WATTS Brand.
    - c. Zurn Industries, LLC.
  2. Recessed Hose Box for floor installation.
  3. Box fabricated from 18 gage, type 304 stainless steel with satin finish interior.

4. Valve cartridge-operated type with vandal-resistant lockshield bonnets and removable wheel handle.

5. Hose box shall be installed flush with roof

6. with ASSE 1011 vacuum breaker

## 2.6 EMERGENCY EYE WASH P-19

### A. Wall Mounted, Stainless Steel Bowl

1. Two spray heads.

2. Flip top dust cove

3. Internal flow control and filter

## 2.7 VACUUM BREAKERS

### B. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:

a. Apollo Valves

b. FEBCO, A WATTS Brand.

c. Zurn Industries, LLC.

2. Standard: ASSE 1001.

3. Size: NPS 1/4 to NPS 3. as required to match connected piping.

4. Body: Bronze.

5. Inlet and Outlet Connections: Threaded.

6. Finish: Rough bronze.

### C. Hose-Connection Vacuum Breakers

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:

a. Apollo Valves

b. FEBCO, A WATTS Brand.

c. Zurn Industries, LLC.

d. MIFAB, Inc.

2. Standard: ASSE 1011.

3. Body: Bronze, nonremovable, with manual drain.

4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.

5. Finish: Rough bronze.



D. Pressure Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
  - a. Apollo Valves
  - b. FEBCO, A WATTS Brand.
  - c. Zurn Industries, LLC.
2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle third of flow range.
5. Size: as indicated on the plans.
6. Design Flow Rate: as indicated on the plans.
7. Pressure Loss at Design Flow Rate: 5 psig.
8. Accessories:
  - a. Valves: Ball type, on inlet and outlet.

E. Spill-Resistant Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
  - a. Apollo Valves
  - b. FEBCO, A WATTS Brand.
  - c. Zurn Industries, LLC.
2. Standard: ASSE 1056.
3. Operation: Continuous-pressure applications.
4. Size: NPS 3/8 through NPS 1.
5. Accessories:
  - a. Valves: Ball type, on inlet and outlet.

2.8 BACKFLOW PREVENTERS

F. Intermediate Atmospheric-Vent Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
  - a. Apollo Valves
  - b. WATTS Brand.
  - c. Zurn Industries, LLC.
2. Standard: ASSE 1012.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/2 & NPS 3/4.
5. Body: Bronze.
6. End Connections: Union, solder joint.
7. Finish: Rough bronze.

G. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
  - a. Apollo Valves
  - b. FEBCO WATTS Brand.
  - c. Zurn Industries, LLC.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 10 psig maximum, through middle third of flow range.
5. Size: as indicated on plans.
6. Design Flow Rate: as indicated on plans.
7. Body: Bronze or cast silicon copper alloy for NPS 2 and smaller; ductile or cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
8. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
9. Configuration: Designed for as indicated on the plans.
10. Accessories:
  - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
  - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
  - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer drain connection.

H. Double-Check, Backflow-Prevention Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
  - a. Apollo Valves
  - b. WATTS Brand.
  - c. Zurn Industries, LLC.
2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle third of flow range.
5. Size: as indicated on the plans.
6. Body: Bronze or cast silicon copper alloy for NPS 2 and smaller; ductile or cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
8. Configuration: Designed for as indicated on the plans.
9. Accessories:
  - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
  - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

I. Beverage-Dispensing-Equipment Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
    - a. Apollo Valves
    - b. WATTS Brand.
    - c. Zurn Industries, LLC.
  2. Standard: ASSE 1022.
  3. Operation: Continuous-pressure applications.
  4. Size: NPS 1/4 or NPS 3/8.
  5. Not all manufacturers offer option in "Body" Subparagraph below. Consult manufacturers.
  6. Body: Bronze Stainless steel or non-metallic.
  7. End Connections: Threaded or flare.
- J. Dual-Check-Valve Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
    - a. Apollo Valves
    - b. WATTS Brand.
    - c. Zurn Industries, LLC.
  2. Standard: ASSE 1024.
  3. Operation: Continuous-pressure applications.
  4. Size: NPS 1/2 through NPS 1-1/4.
  5. Body: Bronze with union inlet.

## 2.9 WATER PRESSURE-REDUCING VALVES

- K. Water Regulators:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
    - a. Apollo Valves
    - b. WATTS Brand.
    - c. Zurn Industries, LLC.
  2. Standard: ASSE 1003.
  3. Pressure Rating: Initial working pressure of 150 psig.
  4. Size: as shown on plans
  5. Body: Bronze for NPS 2 and smaller; bronze or cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
  6. Valves for Booster Heater Water Supply: Include integral bypass.
  7. End Connections: Threaded or solder for NPS 2 and smaller; flanged or solder for NPS 2-1/2 and NPS 3.

## 2.10 BALANCING VALVES

- L. Copper-Alloy Calibrated Balancing Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
    - a. Bell & Gossett.
    - b. WATTS Brand.
    - c. IMI Hydronic Engineering
  2. Type: Ball valve with two readout ports and memory-setting indicator.
  3. Body: Brass or bronze.
  4. Size: Same as connected piping, but not larger than NPS 2.
  5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.
- M. Memory-Stop Balancing Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
    - a. Apollo Valves
    - b. NIBCO Inc.
    - c. Milwaukee Valve Company.
  2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
  3. Pressure Rating: 150-psig minimum CWP.
  4. Size: NPS 2 or smaller.
  5. Body: Copper alloy.
  6. Port: Standard or full port.
  7. Ball: Chrome-plated brass or stainless steel.
  8. Seats and Seals: Replaceable.
  9. End Connections: Solder joint or threaded.
  10. Handle: Vinyl-covered steel with memory-setting device.

## 2.11 TEMPERATURE-ACTUATED, WATER MIXING VALVES

- N. Water-Temperature Limiting Devices:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
    - a. Apollo Valves
    - b. WATTS Brand.
    - c. Zurn Industries, LLC.
    - d. Taco Comfort Solutions
  2. Standard: ASSE 1070.
  3. Pressure Rating: 125 psig.
  4. Type: Thermostatically controlled, water mixing valve.
  5. Material: Bronze body with corrosion-resistant interior components.
  6. Connections: Threaded inlets and outlet.

7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
  8. Tempered-Water Setting: 110 deg F max adjustable.
  9. Tempered-Water Design Flow Rate: as indicated on the plans
  10. Valve Finish: Chrome plated or Rough bronze.
- O. Primary, Thermostatic, Water Mixing Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
    - a. Apollo Valves
    - b. WATTS Brand.
    - c. Zurn Industries, LLC.
    - d. Acorn engineering.
  2. Standard: ASSE 1017.
  3. Pressure Rating: 125 psig minimum unless otherwise indicated.
  4. Type: Exposed-mounted Cabinet-type, thermostatically controlled, water mixing valve.
  5. Material: Bronze body with corrosion-resistant interior components.
  6. Connections: Threaded union inlets and outlet.
  7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
  8. Tempered-Water Setting: 120 F Adjustable Max.
  9. Tempered-Water Design Flow Rate: as indicated on plans.
  10. Cabinet: Factory fabricated, stainless steel, for surface mounting and with hinged, stainless steel door.
- P. Primary, Electronic, Water Mixing Valve Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
    - a. Acorn Engineering Company
    - b. WATTS Brand.
    - c. Leonard Valve Company.
    - d. Caleffi.
  2. Standard: ASSE 1017.
  3. Pressure Rating: 125 psig minimum unless otherwise indicated.
  4. Type: Exposed, electronically controlled, water mixing valve.
  5. Material: Bronze body with corrosion-resistant interior components.
  6. Connections: Threaded or solder joint inlets and outlet.
  7. Accessories: Manual temperature override control, check stops on hot- and cold-water supplies, and automatic hot- and cold-water shutoff upon inlet supply failure.
  8. Tempered-Water Setting: 120 deg. F.
  9. Valve Finish: Bronze.
  10. Digital temperature control and monitoring module.
    - a. Controls temperature within plus or minus 2 deg F.
    - b. User programmable at module or through BAS.
    - c. ASHRAE 188 compliance.

- d. Local and remote monitoring.
- e. BACNet protocol language(s).
- f. 115 V ac, 60 Hz.
- g. Battery backup.

Q. Individual-Fixture, Water Tempering Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
  - a. Acorn Engineering Company
  - b. WATTS Brand.
  - c. Leonard Valve Company.
  - d. Zurn Industries, LLC
- 2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
- 3. Pressure Rating: 125 psig minimum unless otherwise indicated.
- 4. Material: Bronze body with corrosion-resistant interior components.
- 5. Temperature Control: Adjustable.
- 6. Connections: Threaded inlets and outlet.
- 7. Finish: Chrome plated.
- 8. Tempered-Water Setting: 80 deg F.
- 9. Tempered-Water Design Flow Rate: 1gpm.

## 2.12 STRAINERS FOR DOMESTIC WATER PIPING

R. Y-Pattern Strainers:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
  - a. Titan Flow Control, Inc.
  - b. WATTS Brand.
  - c. Zurn Industries, LLC
- 2. Pressure Rating: 125 psig minimum unless otherwise indicated.
- 3. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
- 4. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
- 5. Screen: Stainless steel with round perforations unless otherwise indicated.
- 6. Perforation Size:
  - a. Strainers NPS 2 and Smaller: 0.033 inch.
  - b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
  - c.
- 7. Drain: Pipe plug.

## 2.13 HOSE BIBBS

### S. Hose Bibbs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
  - a. Jay R. Smith Mfg.
  - b. Mifab, Inc.
  - c. WATTS Brand.
  - d. Zurn Industries, LLC
2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Bronze.
4. Seat: Bronze, replaceable.
5. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig.
8. Vacuum Breaker: Integral, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
10. Finish for Service Areas: Chrome or nickel plated.
11. Finish for Finished Rooms: Chrome or nickel plated.
12. Operation for Equipment Rooms: Wheel handle or operating key.
13. Operation for Service Areas: Wheel handle.
14. Operation for Finished Rooms: Operating key.
15. Include operating key with each operating-key hose bibb.
16. Include integral wall flange with each chrome- or nickel-plated hose bibb.

### T. Hose Bibbs (Freeze Resistant Zurn Z1345-08):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
  - a. Jay R. Smith Mfg.
  - b. Mifab, Inc.
  - c. WATTS Brand.
  - d. Zurn Industries, LLC
2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Bronze.
4. Seat: Bronze, replaceable.
5. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig.
8. Vacuum Breaker: Integral, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
10. Finish for Service Areas: Chrome or nickel plated.
11. Finish for Finished Rooms: Chrome or nickel plated.
12. Operation for Equipment Rooms: Wheel handle or operating key.
13. Operation for Service Areas: Wheel handle.
14. Operation for Finished Rooms: Operating key.
15. Include operating key with each operating-key hose bibb.

16. Include integral wall flange with each chrome- or nickel-plated hose bibb.

## 2.14 GROUND HYDRANTS

### U. Non freeze Ground Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
  - a. Jay R. Smith Mfg.
  - b. Mifab, Inc.
  - c. WATTS Brand.
  - d. Zurn Industries, Llc
  - e. Murdock Mfg.
2. Standard: ASME A112.21.3M.
3. Type: Nonfreeze, concealed-outlet ground hydrant with box.
4. Operation: Loose key.
5. Casing and Operating Rod: Of at least length required for burial of valve below frost line.
6. Inlet: NPS 3/4.
7. Outlet: Garden-hose thread complying with ASME B1.20.7.
8. Drain: Designed with hole to drain into ground when shut off.
9. Box: Standard pattern with cover.
10. Box and Cover Finish: To be selected by Architect.
11. Operating Key(s): Two with each ground hydrant.
12. Vacuum Breaker: ASSE 1011.

## 2.13 DRAIN VALVES

### V. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 150 psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

## 2.15 WATER-HAMMER ARRESTERS

### W. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
  - a. Jay R. Smith Mfg.



- b. Mifab, Inc.
- c. WATTS Brand.
- d. Zurn Industries, LLC
- 2. Standard: ASSE 1010 or PDI-WH 201.
- 3. Type: Piston.
- 4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

## 2.16 TRAP-SEAL PRIMER DEVICE

### X. Supply-Type, Trap-Seal Primer Device:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
  - a. Jay R. Smith Mfg.
  - b. Mifab, Inc.
  - c. WATTS Brand.
  - d. Zurn Industries, LLC
- 2. Standard: ASSE 1018.
- 3. Pressure Rating: 125 psig minimum.
- 4. Body: Bronze.
- 5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
- 6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
- 7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

## 2.16 TRAP-SEAL PRIMER SYSTEMS

### Y. Trap-Seal Primer Systems:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
  - a. Precision Plumbing Products
  - b. Sioux Chief Mfg.
  - c. Zurn Industries, LLC
- 2. Standard: ASSE 1044.
- 3. Inlet Size: NPS 3/4, ASTM B88, Type L; copper, water tubing.
- 4. Cabinet: Surface-mounted steel box with stainless steel cover.
- 5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120 V ac power.
  - a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- 6. Vacuum Breaker: ASSE 1001.
- 7. Number Outlets: Four
- 8. Size Outlets: NPS 1/2.

## 2.17 FLEXIBLE CONNECTORS

9. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
  - a. Flex-Hose Co., Inc
  - b. Mason Industries, Inc.
  - c. Metraflex Company.
- Z. Stainless Steel-Hose Flexible Connectors: Corrugated-stainless steel tubing with stainless steel wire-braid covering and ends welded to inner tubing.
  1. Working-Pressure Rating: Minimum 200 psig.
  2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
  3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

## 2.18 WATER METERS

- AA. Provide water meters from the approved list of NYC DEP meters and follow All NYC DEP Guidelines.

# PART 3 - EXECUTION

## 3.1 INSTALLATION OF PIPING SPECIALTIES

- A. Backflow Preventers: Install in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
  1. Locate backflow preventers in same room as connected equipment or system.
  2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
  3. Do not install bypass piping around backflow preventers.
- B. Water Regulators: Install with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gauges on inlet and outlet.
- C. Water Control Valves: Install with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gauges on inlet and outlet.
- D. Automatic Water Shutoff Valves: Test for signal strength before valve installation. Install automatic shutoff valve downstream from main domestic water shutoff valve. Install valve controller in an accessible location with sensors in areas where water is likely to accumulate.
- E. Balancing Valves: Install in locations where they can easily be adjusted. Set at indicated design flow rates.

- F. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.
  - 1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- G. Y-Pattern Strainers: For water, install on supply side of each control valve, water pressure-reducing valve, and pump.
- H. Non freeze, Draining-Type Roof Hydrants: Install with drain connection piped to nearest floor drain or to the exterior.
- I. Water-Hammer Arresters: Install in water piping in accordance with PDI-WH 201.
- J. Supply-Type, Trap-Seal Primer Device: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- K. Drainage-Type, Trap-Seal Primer Device: Install as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.
- L. Trap-Seal Primer Systems: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

### 3.2 PIPING CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

### 3.3 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

### 3.4 CONTROL CONNECTIONS

- A. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

### 3.5 IDENTIFICATION

- A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
  - 1. Vacuum breakers.
  - 2. Backflow preventers.
  - 3. Water pressure-reducing valves.
  - 4. Automatic water shutoff valve systems.
  - 5. Balancing valves.
  - 6. Temperature-actuated, water mixing valves.
  - 7. Ground hydrants.
  - 8. Trap-seal primer device.
  - 9. Trap-seal primer systems.
  - 10. Water meters.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.6 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.
- D. Adjust each pressure vacuum breaker, reduced-pressure-principle backflow preventer, double-check, backflow-prevention assembly and double-check, detector-assembly backflow preventer in accordance with manufacturer's written instructions, authorities having jurisdiction and the device's reference standard.

### 3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative.
  - 1. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer, double-check, backflow-prevention assembly and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.

2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  3. Operational Test: After electrical circuitry has been energized, start units to confirm unit operation.
  4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 221119

**ATTACHMENT #2**

**REVISED ELECTRICAL SPECIFICATIONS**

*260519 – Low-Voltage Electrical Power Conductors and Cables*

*260526 – Grounding and Bonding for Electrical Systems*

*260533 – Raceways and Boxes for Electrical Systems*

*260923 – Lighting Control Devices*

*[ATTACHED]*

## SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

### 1.1 RELATED DOCUMENTS

- A. See electrical drawings for the electrical scope of work.

### 1.2 SUMMARY

- A. Section Includes:
  - 1. Building wires and cables rated 600 V and less.
  - 2. Connectors, splices, and terminations rated 600 V and less.
  - 3. Copper building wire.
  - 4. Fire-alarm wire and cable.
  - 5. Connectors and splices.

### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
  - 1. Product data for low voltage electrical power conductors and cables.
  - 2. Manufacturer's specification sheets inclusive of materials ratings and listings for intended applications and installation instructions.
- C. Product Schedule: Indicate type, use, location, and termination locations.

### 1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA.
  - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by UL and marked for intended use.
- C. Comply with ASTM, UL 44, 83, and 486, NFPA 70.E and Comply with most current edition of the Northwestern University Design Standards.

## 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: provide products by one of the following, or approved equal:
  - 1. Encore Wire Corporation.
  - 2. Southwire Company.
  - 3. LS Cable & System USA.
- 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 NM: Comply with UL 83 and UL 719.
  - 2. Type RHH and Type RHW-2: Comply with UL 44.
  - 3. Type THHN and Type THWN-2: Comply with UL 83.
  - 4. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.

## 2.2 FIRE-ALARM WIRE AND CABLE

- A. Manufacturers: provide products by one of the following, or approved equal:
  - 1. Allied Wire & Cable Inc.
  - 2. CommScope, Inc.
  - 3. West Penn Wire.
  - 4. Comtran Corporation.
- B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
- C. Signaling Line Circuits: Twisted, shielded pair, shall be NYC approved cable.
  - 1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.
- D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.
  - 1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
  - 2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.



## 2.3 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
  - 1. Hubbell Power Systems, Inc.
  - 2. O-Z/Gedney; EGS Electrical Group LLC.
  - 3. Polaris Electrical Connectors.
  - 4. Ideal Wire Connectors.
  - 5. ILSCO
  - 6. Tyco Electronics
  - 7. Raychem

## 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 for feeders No. 4 AWG and larger. Conductors shall 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 and smaller; stranded for No. 8 AWG and larger.
- C. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.
- D. PV Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

### 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type XHHW-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway and Metal-clad cable, Type MC.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: 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: Metal-clad cable, Type MC.
- G. Exposed Branch Circuits, Including in Crawlspace: 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 and Metal-clad cable, Type MC.
- I. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- J. Branch Circuits Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway Branch Circuits in Cable Tray: Metal-clad cable, Type MC.

### 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 260533 "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 260529 "Hangers and Supports for Electrical Systems."

### 3.4 INSTALLATION OF FIRE-ALARM WIRE AND CABLE

- A. Comply with NECA 1 and NFPA 72.
  - 1. Install plenum cable in environmental airspaces, including plenum ceilings.
  - 2. Fire-alarm circuits and equipment control wiring associated with fire-alarm system shall be installed in a dedicated pathway system.
    - a. Cables and pathways used for fire-alarm circuits, and equipment control wiring associated with fire-alarm system, may not contain any other wire or cable.
  - 3. Fire-Rated Cables: Use of two-hour, fire-rated fire-alarm cables, NFPA 70, Types MI and CI, is not permitted.
  - 4. Signaling Line Circuits: Power-limited fire-alarm cables [shall not be installed in the same cable or pathway as signaling line circuits.

- B. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- C. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes; cabinets; or equipment enclosures where circuit connections are made.
- D. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.
- E. Risers: Install at least two vertical cable risers to serve the fire-alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent receipt or transmission of signals from other floors or zones.
- F. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the fire-alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

### 3.5 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- 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 6 inches slack.
- D. Comply with requirements in Section 284621.11 "Addressable Fire-Alarm Systems" for connecting, terminating, and identifying wires and cables.

### 3.6 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor and identify as spare conductor.

3.7 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.8 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 078413 "Penetration Firestopping."

3.9 FIELD QUALITY CONTROL

- A. Administrant for Tests and Inspections:

- 1. Owner will engage qualified testing agency to administer and perform tests and inspections.
- 2. Engage qualified testing agency to administer and perform tests and inspections.
- 3. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
- 4. Administer and perform tests and inspections.

- B. 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 feeding the following 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.
- C. Cables will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports to record the following:
  - 1. Procedures used.
  - 2. Results that comply with requirements.
  - 3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

## SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Grounding and bonding conductors.
2. Grounding and bonding clamps.
3. Grounding and bonding bushings.
4. Grounding and bonding hubs.
5. Grounding and bonding connectors.
6. Intersystem bonding bridge grounding connector.
7. Grounding and bonding busbars.
8. Signal reference grids.
9. Grounding (earthing) electrodes.

#### 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. Field Quality-Control Submittals:

1. Field quality-control reports.

#### 1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. 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 grounding connections for separately derived systems 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:

1. General Characteristics: 600 V, THHN/THWN-2, wire or cable, green color, in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

#### B. ASTM - Bare Copper Grounding and Bonding Conductor:

1. Manufacturers: Subject to compliance with requirements, **provide products by one of the following, or approved equal:**
  - a. ERICO; brand of nVent Electrical plc.
  - b. Harger Lightning & Grounding; business of Harger, Inc.
2. 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.

#### C. UL KDER - Armored Grounding Wire:

1. Description: Single corrosion-resistant copper, aluminum, or copper-clad aluminum conductor within helically formed steel armor.
2. Manufacturers: Subject to compliance with requirements, **provide products by one of the following, or approved equal:**
  - a. LS Cable & System USA; subsidiary of LS Corp.
  - b. Southwire Company, LLC.
  - c. Superior Essex Inc.; subsidiary of LS Corp.
  - d. Viakon; brand of Conductores Monterrey S.A. de C.V.; a subsidiary of Xignux.
  - e. Or approved equal.

3. 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.
4. Listing Criteria:
  - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

D. UL KDSH - Protector Grounding Conductor:

1. Description: Conductors intended to be used for grounding primary protector or metallic members of cable sheath in accordance with Chapters 7 and 8 of NFPA 70.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
  - a. Superior Essex Inc.; subsidiary of LS Corp.
3. 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.
4. Listing Criteria:
  - a. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.
5. Options:
  - a. Color: green.

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; see Section 270526 "Grounding and Bonding for Communications Systems," for selection and installation guidelines.
- 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.
- D. UL KDER and KDSH - Hex-Fitting-Type Pipe and Rod Grounding and Bonding Clamp:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
    - a. Cooper B-line; brand of Eaton, Electrical Sector.
    - b. Crouse-Hinds; brand of Eaton, Electrical Sector.
    - c. ERICO; brand of nVent Electrical plc.
    - d. Harger Lightning & Grounding; business of Harger, Inc.
    - e. ILSCO.
    - f. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
    - g. Panduit Corp.
  2. General Characteristics:
    - a. Two pieces with zinc-plated bolts.
    - b. Clamp Material: Die-cast zinc alloy.
    - c. Listed for outdoor use.
- E. UL KDER and KDSH - U-Bolt-Type Pipe and Rod Grounding and Bonding Clamp:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
    - a. Cooper B-line; brand of Eaton, Electrical Sector.
    - b. Crouse-Hinds; brand of Eaton, Electrical Sector.
    - c. ERICO; brand of nVent Electrical plc.
    - d. Harger Lightning & Grounding; business of Harger, Inc.
    - e. ILSCO.
    - f. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
    - g. Panduit Corp.
  2. General Characteristics:
    - a. Clamp Material: Aluminum.
    - b. Listed for outdoor use.
- F. UL KDER and KDSH - Strap-Type Pipe and Rod Grounding and Bonding Clamp:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
    - a. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

- b. Crouse-Hinds; brand of Eaton, Electrical Sector.
    - c. ERICO; brand of nVent Electrical plc.
    - d. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
    - e. Panduit Corp.
  - 2. General Characteristics:
    - a. Clamp Material: Galvanized steel.
    - b. Listed for outdoor use.
- G. UL KDER - Beam Grounding and Bonding Clamp :
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
    - a. Anderson; brand of Hubbell Utility Solutions; Hubbell Incorporated.
    - b. Panduit Corp.
    - c. Penn-Union Corp.; subsidiary of Nesco, Inc.
  - 2. General Characteristics: Mechanical-type, terminal, ground wire access from four directions; with dual, tin-plated or silicon bronze bolts.
- H. UL KDER - Exothermically Welded Connection:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
    - a. ALLTEC LLC.
    - b. Continental Industries; brand of Hubbell Utility Solutions; Hubbell Incorporated.
    - c. Crouse-Hinds; brand of Eaton, Electrical Sector.
    - d. ERICO; brand of nVent Electrical plc.
    - e. Harger Lightning & Grounding; business of Harger, Inc.
  - 2. General Characteristics: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

## 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.
  - D. UL KDER - Bonding Bushing :
    - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
      - a. Arlington Industries, Inc.
      - b. Crouse-Hinds; brand of Eaton, Electrical Sector.
      - c. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
      - d. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
      - e. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    - 2. General Characteristics: Threaded bushing with insulated throat.
  - E. UL KDER - Grounding Bushing:
    - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
      - a. Arlington Industries, Inc.
      - b. Crouse-Hinds; brand of Eaton, Electrical Sector.
      - c. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
      - d. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
      - e. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    - 2. General Characteristics: Threaded bushing with insulated throat and mechanical-type wire terminal.
- 2.4 GROUNDING AND BONDING HUBS
- A. Description: Hubs with certified grounding or bonding locknut.
  - 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.

D. UL KDER - Grounding and Bonding Hub:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
  - a. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - b. Crouse-Hinds; brand of Eaton, Electrical Sector.
  - c. Greaves Corp.; Essex Products Group, Inc.
  - d. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
  - e. Penn-Union Corp.; subsidiary of Nesco, Inc.
- 2. General Characteristics: Insulated, gasketed, watertight hub with mechanical-type wire terminal.

2.5 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.

C. UL KDER - Pressure-Type Grounding and Bonding Busbar Cable Connector:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
  - a. ABB, Electrification Business.
  - b. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
- 2. General Characteristics: Copper or copper alloy, for compression bonding of one or more conductor directly to copper busbar. Listed for direct burial.

D. UL KDER - Lay-In Lug Mechanical-Type Grounding and Bonding Busbar Terminal:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
    - a. Chatsworth Products, Inc.
    - b. Greaves Corp.; Essex Products Group, Inc.
    - c. ILSCO.
  2. General Characteristics: Mechanical-type, aluminum terminal with set screw.
- E. UL KDER - Crimped Lug Pressure-Type Grounding and Bonding Busbar Terminal:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
    - a. ABB, Electrification Business.
    - b. Harger Lightning & Grounding; business of Harger, Inc.
    - c. ILSCO.
  2. General Characteristics: Cast silicon bronze, solderless compression-type wire terminals; with long barrel and two holes spaced on 5/8 or 1 inch (16 or 25 mm) centers for two-bolt connection to busbar.
- F. UL KDER - Split-Bolt Service-Post Pressure-Type Grounding and Bonding Busbar Terminal:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
    - a. Panduit Corp.
  2. General Characteristics: Bolts that surround cable and bond to cable under compression when nut is tightened after assembly is screwed into busbar opening.
- G. UL KDER - Crimped Pressure-Type Grounding and Bonding Cable Connector:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
    - a. ABB, Electrification Business.
    - b. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    - c. ILSCO.
    - d. allG Fabrication (formerly ALT).
  2. General Characteristics: Crimp-and-compress connectors that bond to conductor when connector is compressed around conductor.
    - a. Copper, C and H shaped.
- H. UL KDER - Split-Bolt Pressure-Type Grounding and Bonding Cable Connector:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:

- a. ABB, Electrification Business.
  - b. ERICO; brand of nVent Electrical plc.
  - c. Greaves Corp.; Essex Products Group, Inc.
  - d. allG Fabrication (formerly ALT).
2. General Characteristics: Bolts that surround cable and bond to cable under compression when nut is tightened.
  - a. Copper.

## 2.6 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.
- C. UL KDSH - One-Piece Intersystem Bonding Bridge Grounding Connector:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
    - a. Galvan Industries, Inc.; Electrical Products Division, LLC.
    - b. Madison Electric Products; business of Southwire Company, LLC.
  2. General Characteristics: Zinc-alloy one-piece construction; six terminating points; gangable.
- D. UL KDSH - Two-Piece Intersystem Bonding Bridge Grounding Connector:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
    - a. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    - b. Crouse-Hinds; brand of Eaton, Electrical Sector.
    - c. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

2. General Characteristics: Zinc-alloy body and polycarbonate cover; four terminating points.

## 2.7 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.
- D. UL KDER - Equipment Room Grounding and Bonding Busbar:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
    - a. Chatsworth Products, Inc.
    - b. Continental Industries; brand of Hubbell Utility Solutions; Hubbell Incorporated.
    - c. Cooper B-line; brand of Eaton, Electrical Sector.
    - d. ERICO; brand of nVent Electrical plc.
    - e. Harger Lightning & Grounding; business of Harger, Inc.
    - f. Hoffman; brand of nVent Electrical plc.
    - g. ILSCO.
    - h. Panduit Corp.
  2. General Characteristics:
    - a. Bus: Rectangular bar of annealed copper.
    - b. Mounting Stand-Off Insulators: Lexan or PVC.
      - 1) Comply with UL 891 for use in 600 V switchboards, impulse tested at 5000 V.
  3. Options:
    - a. Dimensions: 1/4 by 4 inch (6.3 by 100 mm) in cross section; length as indicated on Drawings.
    - b. Predrilled Hole Pattern: Suitable for installing specified grounding and bonding connectors.

- c. Mounting Hardware: Stand-off brackets that provide 2 inch (50 mm) clearance to access rear of bus. Brackets and bolts must be stainless steel.
- E. UL KDER - Rack and Cabinet Bonding Busbar:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
    - a. Chatsworth Products, Inc.
    - b. Cooper B-line; brand of Eaton, Electrical Sector.
    - c. Harger Lightning & Grounding; business of Harger, Inc.
    - d. Hoffman; brand of nVent Electrical plc.
    - e. Panduit Corp.
  - 2. General Characteristics:
    - a. Bus: Rectangular bar of hard-drawn solid copper.
    - b. Horizontal Mounting Dimensions: Designed for mounting in 19 inch (483 mm) wide equipment racks or cabinets.
    - c. Vertical Mounting Dimensions: Designed for mounting in 72 inch (1827 mm) high equipment racks or cabinets.
    - d. Predrilled Hole Pattern: Accepts connectors for grounding and bonding conductor sizes 14 AWG to 2/0 AWG.
    - e. Mounting Hardware: Stainless steel or copper-plated, for attachment to rack.

## 2.8 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.
- D. UL KDER - Rod Electrode:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
    - a. ABB, Electrification Business.



- b. Continental Industries; brand of Hubbell Utility Solutions; Hubbell Incorporated.
  - c. ERICO; brand of nVent Electrical plc.
  - d. Galvan Industries, Inc.; Electrical Products Division, LLC.
  - e. Harger Lightning & Grounding; business of Harger, Inc.
  - f. allG Fabrication (formerly ALT).
2. General Characteristics: Copper-clad steel; 3/4 inch by 10 ft (19 mm by 3 m).

## 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 (50 mm) minimum from wall, 6 inch (150 mm) 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 (6 mm) 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 (41 mm) wide and 1/16 inch (1.6 mm) thick.

- F. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch (41 mm) wide and 1/16 inch (1.6 mm) thick.
- G. Underground Grounding Conductors: Install bare tinned-copper conductor, 500 KCMIL minimum.
  - 1. Bury at least 30 inch (750 mm) below grade.
  - 2. Duct-Bank Grounding Conductor: Bury 12 inch (300 mm) 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:
  - 1. 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 tinned 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 (18 m) apart.
3. Electrodes:
- a. Ground Rods: Drive rods until tops are 2 inch (50 mm) 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 are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and must be at least 12 inch (300 mm) deep, with cover.
  - 1) 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 500 KCMIL for ring electrode and for taps to building steel.
  - 2) Bury ring electrode not less than 24 inch (600 mm) from building's foundation.
- e. Concrete-Encased Electrode (Ufer Ground):
  - 1) Fabricate in accordance with NFPA 70; use minimum of 20 ft (6 m) of bare copper conductor not smaller than 4 AWG.
    - a) If concrete foundation is less than 20 ft (6 m) 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 (6.0 m) 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 Underground Distribution System Components:
  - a. Duct-Bank Grounding Conductor: Bury 12 inch (300 mm) 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 (100 mm) 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 (50 mm) above to 6 inch (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.

- d. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with 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.

6. 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.
- 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, tinned 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.
7. Fence Grounding: Install at maximum intervals of 1500 ft (450 m) except as follows:
- a. Fences within 100 ft (30 m) of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 ft (225 m).
    - 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 (460 mm) 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 (45 m) on each side of crossing.
  - c. Grounding Method: At each grounding location, drive grounding rod vertically until top is 6 inch (150 mm) 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.

### 3.6 FIELD QUALITY CONTROL

#### A. 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.
- B. 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.
- C. 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  $\Omega$ .
    - b. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5  $\Omega$ .
    - c. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3  $\Omega$ .
    - d. Manhole Grounds: 10  $\Omega$ .

### 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 260526

## SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Metal conduits and fittings.
  - 2. Metal wireways and auxiliary gutters.
  - 3. Boxes, enclosures, and cabinets.
  - 4. Handholes and boxes for exterior underground cabling.

- B. Related Requirements:

- 1. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior duct banks, manholes, and underground utility construction.

#### 1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
  - 1. Structural members in paths of conduit groups with common supports.



2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Qualification Data: For professional engineer.

## PART 2 - PRODUCTS

### 2.1 METAL CONDUITS AND FITTINGS

#### A. Metal Conduit:

1. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, provide products by one of the following, or approved equal:
  - a. AFC Cable Systems, Inc.
  - b. Alflec Inc.
  - c. Allied Tube & Conduit; a Tyco International Ltd. Co.
  - d. Anamet Electrical, Inc.; Anaconda Metal Hose.
  - e. Electri-Flex Co.
  - f. Manhattan/CDT/Cole-Flex.
  - g. Maverick Tube Corporation.
  - h. O-Z Gedney; a unit of General Signal.
  - i. Wheatland Tube Company.
2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. GRC: Comply with ANSI C80.1 and UL 6.
4. IMC: Comply with ANSI C80.6 and UL 1242.
5. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
  - a. Comply with NEMA RN 1.
  - b. Coating Thickness: 0.040 inch (1 mm), minimum.
6. EMT: Comply with ANSI C80.3 and UL 797.

#### B. Metal Fittings:

1. Comply with NEMA FB 1 and UL 514B.
2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Fittings, General: Listed and labeled for type of conduit, location, and use.
4. Fittings for EMT:
  - a. Material: steel.
  - b. Type: compression.
5. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

6. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
- C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## 2.2 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal::
  1. Cooper B-Line, Inc.
  2. Hoffman.
  3. Square D; Schneider Electric.
- C. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated
- D. 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.
- E. Wireway Covers: Screw-cover type or as indicated on drawings.
- F. Finish: Manufacturer's standard enamel finish.

## 2.3 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with Snap-On covers. Manufacturer's standard enamel finish in color selected by Architect.
  1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, provide products by one of the following, or approved equal:
    - a. Thomas & Betts Corporation.
    - b. Walker Systems, Inc.; Wiremold Company (The).
    - c. Wiremold Company (The); Electrical Sales Division.
- C. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, provide products by one of the following, or approved equal:
  - a. Butler Manufacturing Company; Walker Division.
  - b. Enduro Systems, Inc.; Composite Products Division.
  - c. Hubbell Incorporated; Wiring Device-Kellems Division.
  - d. Lamson & Sessions; Carlon Electrical Products.
  - e. Panduit Corp.
  - f. Walker Systems, Inc.; Wiremold Company (The).
  - g. Wiremold Company (The); Electrical Sales Divisio

## 2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, provide products by one of the following, or approved equal:
  1. Hoffman; a brand of Pentair Equipment Protection.
  2. Hubbell Incorporated.
  3. RACO; Hubbell.
  4. Thomas & Betts Corporation; A Member of the ABB Group.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, Type FD, with gasketed cover.
- D. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- E. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb. shall be listed and marked for the maximum allowable weight.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.
- H. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- I. Device Box Dimensions: 4 inches by 2-1/8 inches by 2-1/8 inches deep.
- J. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 4X with continuous-hinge cover with flush latch unless otherwise indicated.
  1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

2. Nonmetallic Enclosures: Fiberglass.
3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

K. Cabinets:

1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

## 2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.

1. Manufacturers: provide products by one of the following, or approved equal:
  - a. AC Miller Concrete Products.
  - b. Armor cast Products Company.
  - c. Carson Industries LLC.
  - d. CDR Systems Corporation.
  - e. New Basis.
  - f. Rotunda Precast.
  - g. Quasit.

## 2.6 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC.
  2. Concealed Conduit, Aboveground: GRC.
  3. Underground Conduit: Type EPC-40-PVC, concrete encased.
  4. Underground Service Entrance Conduit: GRC, concrete encased.
  5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  6. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R, Type 4.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
  2. Exposed, Not Subject to Severe Physical Damage: EMT
  3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
    - a. Loading dock.
    - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - c. Mechanical rooms.
  4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
  6. Damp or Wet Locations: GRC.
  7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
  3. EMT: Use fittings. Comply with NEMA FB 2.10.
  4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass-through concrete, install in nonmetallic sleeve.

- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- G. Install surface raceways only where indicated on Drawings.
- H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

### 3.2 INSTALLATION

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
- D. Do not fasten conduits onto the bottom side of a metal deck roof.
- E. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- F. Complete raceway installation before starting conductor installation.
- G. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- I. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- J. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- K. Support conduit within 12 inches of enclosures to which attached.
- L. Raceways Embedded in Slabs:
  - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
  - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
  - 3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.

4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
  5. Change from ENT to RNC, Type EPC-40-PVC, GRC before rising above floor.
- M. Stub-Ups to Above Recessed Ceilings:
1. Use EMT, IMC, or RMC for raceways.
  2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- O. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- P. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- Q. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- R. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- S. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- T. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- U. Surface Raceways:
1. Install surface raceway with a minimum 2-inch radius control at bend points.
  2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- V. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- W. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Conduit extending from interior to exterior of building.
4. Conduit extending into pressurized duct and equipment.
5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
6. Where otherwise required by NFPA 70.

- X. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

### 3.3 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.
- E. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

### 3.4 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.5 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.

END OF SECTION 260533



## SECTION 260923 - LIGHTING CONTROL DEVICES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Electronic time switches.
2. Outdoor photoelectric switches, solid state, flexible mounting.
3. Outdoor photoelectric switches, solid state, luminaire mounted.
4. Outdoor photoelectric switches, low voltage.
5. Indoor occupancy and vacancy sensors.
6. Switchbox-mounted occupancy sensors.
7. Outdoor motion sensors.
8. Lighting contactors.
9. Emergency shunt relay.
10. Conductors and cables.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings:

1. Show installation details for the following:
  - a. Occupancy sensors.
  - b. Vacancy sensors.
2. Interconnection diagrams showing field-installed wiring.
3. Include diagrams for power, signal, and control wiring.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and elevations, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which equipment will be attached.

3. Items penetrating finished ceiling, including the following:

- a. Luminaires.
- b. Air outlets and inlets.
- c. Speakers.
- d. Sprinklers.
- e. Access panels.
- f. Control modules.

B. Field quality-control reports.

C. Sample Warranty: For manufacturer's warranties.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in operation and maintenance manuals.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: Provide names, versions, and website addresses for locations of installed software.
3. Device address list.
4. Printout of software application and graphic screens.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

- a. Faulty operation of lighting control software.
- b. Faulty operation of lighting control devices.

2. Warranty Period: 2 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ELECTRONIC TIME SWITCHES

A. Manufacturers: provide products by one of the following, or approved equal:

1. Honeywell RPLS541A1001/U Light Switch.
2. Aube Electronic Timer Switch.
3. Aube by Honeywell TI035/U Programmable Timer Switch.
4. Intermatic EI600LAC Time Switch.
5. Honeywell RPLS741B1007/U Programmable Timer.

6. Leviton DW15S-1BZ Decora Smart Wi-Fi Switch.
7. Intermatic EJ600 In-Wall Timer.
8. Intermatic ST01 Timer Switch for Lights.

B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.

1. Listed and labeled as defined in NFPA 70 and marked for intended location and application.
2. Automatic daylight savings time changeover.
3. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

## 2.2 OUTDOOR PHOTOELECTRIC SWITCHES, SOLID STATE, FLEXIBLE MOUNTING

A. Manufacturers: Subject to compliance with requirements: provide products by one of the following, or approved equal:

1. Area Lighting Research, Inc.; Tyco Electronics.
2. Grasslin Controls Corporation; a GE Industrial Systems Company.
3. Intermatic, Inc.
4. Lithonia Lighting; Acuity Lighting Group, Inc.
5. Novitas, Inc.
6. Paragon Electric Co.; Invensys Climate Controls.
7. Square D; Schneider Electric.
8. TORC.
9. Touch-Plate, Inc.
10. Watt Stopper (The).
11. Listed and labeled as defined in NFPA 70, by NRTL, and marked for intended location and application.
12. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
13. Time Delay: Fifteen-second minimum, to prevent false operation.
14. Surge Protection: Metal-oxide varistor.
15. Mounting: Twist lock complies with ANSI C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure from same source and manufacturer as switch.
16. Failure Mode : Luminaire stays ON.

## 2.3 OUTDOOR PHOTOELECTRIC SWITCHES, SOLID STATE, LUMINAIRE-MOUNTED

A. Description: Solid state, with dry contacts rated for, to operate connected load, complying with UL 773, and compatible with CFL and LED lamps.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Light-Level Monitoring Range: 1.5 to 10 fc with an adjustment for turn-on and turn-off levels within that range.
3. Time Delay: Thirty-second minimum, to prevent false operation.
4. Lightning Arrester: Air-gap type.

5. Mounting: Twist lock complying with ANSI C136.10, with base from manufacturer as switch.
6. Failure Mode : Luminaire stays ON.

## 2.4 INDOOR OCCUPANCY AND VACANCY SENSORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide products by one of the following, or approved equal:

1. Hubbell Lighting
2. Leviton Mfg. Company Inc.
3. Lithonia Lighting; Acuity Lighting Group, Inc.
4. Novitas, Inc.
5. RAB Lighting, Inc.
6. Sensor Switch, Inc.
7. TORK.
8. Watt Stopper (The).
9. Lutron Electronics, Inc

B. General Requirements for Sensors:

1. Wall or Ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
2. Dual technology.
3. Separate power pack.
4. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
5. Operation:
  - a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time, delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  - b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time, delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  - c. Combination Sensor: Unless otherwise indicated, sensor shall be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
6. Power Pack: Dry contacts rated for 20-A LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
7. Mounting:
  - a. Sensor: Suitable for mounting in any position on a standard outlet box.
  - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
  - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
8. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.

9. Bypass Switch: Override the "on" function in case of sensor failure.
  10. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc turn lights off when selected lighting level is present.
- C. PIR Type: wall or ceiling mounted; detect occupants in coverage area by their heat and movement.
1. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. .
  2. Detection Coverage (Room, Ceiling Mounted): Detect occupancy anywhere in a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
  3. Detection Coverage (Corridor, Ceiling Mounted): Detect occupancy within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling.
  4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of [1000 square feet (110 square meters)] [2000 square feet (220 square meters)] [3000 square feet (330 square meters)] when mounted 48 inches (1200 mm) above finished floor.
- D. Dual-Technology Type: wall and ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
  2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
  3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
  4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of [1000 square feet (110 square meters)] [2000 square feet (220 square meters)] [3000 square feet (330 square meters)] when mounted 48 inches (1200 mm) above finished floor.

## 2.5 EMERGENCY SHUNT RELAY

- A. Description: NC, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.
1. Coil Rating: 120V.

## 2.6 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION OF SENSORS

- A. Comply with NECA 1.
- B. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- C. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

### 3.3 INSTALLATION OF CONTACTORS

- A. Comply with NECA 1.
- B. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

### 3.4 INSTALLATION OF WIRING

- A. Comply with NECA 1.
- B. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 3/4 inch (13 mm).
- C. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors in accordance with conductor manufacturer's written instructions.
- D. Size conductors in accordance with lighting control device manufacturer's written instructions unless otherwise indicated.
- E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

### 3.5 IDENTIFICATION

- A. Identify components and power and control wiring in accordance with Section 260553 "Identification for Electrical Systems."
  - 1. Identify controlled circuits in lighting contactors.
  - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency, a qualified testing agency to evaluate lighting control devices and perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections:
  - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Lighting control devices will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

### 3.7 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to 2 visits to Project during other-than-normal occupancy hours for this purpose.
  - 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
  - 2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
  - 3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

### 3.8 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for 2 years.

- B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within 2 years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
  - 1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

### 3.9 DEMONSTRATION

- A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control systems

END OF SECTION 260923



**ATTACHMENT #3**  
**REVISED LIGHTING SPECIFICATION**  
*260943 – Digital Network Lighting Controls*  
*265613 – Lighting Poles*

*[ATTACHED]*

## SECTION 260943 - DIGITAL NETWORK LIGHTING CONTROLS

### PART 1 GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Digital-Network Lighting Control System.

B. Related Sections:

1. Applicable requirements of the Contract Documents apply to the work of this section.
2. Read and understand all specifications, schedules, manufacturer's product data and requirements in this and all related specification documents.
3. Any discrepancies, omissions or inaccuracies are to be brought to the attention of the Designer prior to bid time.
4. Read and comply with all applicable sections of the General Requirements, General Conditions, Invitation to Bidders, General Provisions for Electrical Work and Electrical Specifications as a part of this section. REFERENCES

C. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE)

1. C62.41-1991 – Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
2. ANSI C12.20 Accuracy Standards

D. ASTM International (ASTM)

1. D4674 -02a Standard Test Method for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Fluorescent Lighting and Window-Filtered Daylight.
2. G21-96 (2002) - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
3. G22-76 (1996) - Standard Practice for Determining Resistance of Plastics to Bacteria.

E. National Electrical Manufacturers Association (NEMA)

1. WD1 (R2005) - General Color Requirements for Wiring Devices.

2. WD6 – Dimensional Specifications.

F. Underwriters Laboratories, Inc. (UL)

1. 94 – Flammability Rating
2. 489 (2002) - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
3. UL498 – Standard for Attachment Plugs and Receptacles.
4. 508 (1999) - Standard for Industrial Control Equipment.
5. UL514C – Standard for Non-metallic Outlet Boxes, Flush Device Boxes, and Covers.
6. 916 – Energy Management Equipment.
7. 924 (2003) - Emergency Lighting and Power Equipment
8. 1310 – Class 2 Power Units.
9. 1472 (1996) - Solid-State Dimming Controls.

G. National Fire Protection Association (NFPA) 701 (2004) - Standard Methods of Fire Tests for Flame Propagation.

1.2 SYSTEM DESCRIPTION

A. Quantum includes computer-based software that provides control, configuration, monitoring and reports. System includes:

1. Lighting Management Panel
2. Quantum Manager - light management computer
3. Q-Admin - light management computer software.
4. Low voltage control stations

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Minimum [10] years of experience in manufacture of lighting management systems.
2. Quality System: Registered to ISO 9001:2000 Quality Standard, including in-house engineering for product design activities.
3. Furnish electrical control equipment for complete installation and single source responsibility of lighting control.

4. Qualified to supply specified products and to honor claims against product presented in accordance with warranty.
- B. Lighting control system components:
  1. Listed by UL specifically for the required loads. Provide evidence of compliance upon request.

#### 1.4 SUBMITTALS

- A. Submit under provisions of Section [013300.]
- B. Specification Conformance Document: Indicate whether the submitted equipment:
  1. Meets specification exactly as stated.
  2. Meets specification via an alternate means and indicate the specific methodology used.
- C. Shop Drawings; include:
  1. Schematic (one-line diagram) of system.
- D. Product Data: Catalog cut sheets with performance specifications demonstrating compliance with specified requirements.
- E. Sequence of Operation to describe how each area operates and how any building wide functionality is described.
- F. Quality Control Submittals:
  1. Test Reports: Indicating compliance with specified fabric properties.
  2. Certification: Morton International Laboratory Report for PVC coated fabrics and bacterial and mildew resistance.

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Make ordering of new equipment for expansions, replacements, and spare parts available to end-user, qualified dealer or installer.
- B. Make new replacement parts available for minimum of 10 years from date of manufacture.

## 1.6 WARRANTY

- A. Provide Manufacturer's Warranty from substantial completion:
  - 1. Standard 2-year warranty, Includes:
    - a. 100 Percent Replacement Parts for Manufacturer Lighting System Components
    - b. 100 Percent Manufacturer Labor Coverage to Troubleshoot and Diagnose a Lighting Issue
    - c. First –Available Onsite or Remote Response Time
    - d. 24 Hours Per Day, 7 Days Per Week Telephone Technical Support, Excluding Manufacturer Holidays
- B. Quantum Manager is covered by a 1-year parts and labor warranty from substantial completion.
- C. Quantum Software is covered by a 1-year warranty from substantial completion.
- D. Provide manufacturer's warranty covering 5 years with factory startup on ballasts, ballast modules, and drivers from date of purchase.
- E. SUBSTITUTIONS:
  - 1. All proposed substitutions (clearly delineated as such) must be submitted in writing for approval by the design professional a minimum of 10 working days prior to the bid date and must be made available to all bidders. Proposed substitutes must be accompanied by a review of the specification noting compliance on a line-by-line basis.
  - 2. Any substitutions provided by the contractor shall be reviewed at the contractor's expense by the electrical engineer at a rate of [\$200.00] per hour.
  - 3. By using pre-approved substitutions, the contractor accepts responsibility and associated costs for all required modifications to circuitry, devices, and wiring. The contractor shall provide complete engineered shop drawings (including power wiring) with deviations for the original design highlighted in an alternate color to the engineer for review and approval prior to rough-in.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Include installation, programming, and maintenance instructions.

## 1.8 PROJECT CONDITIONS

- A. Do not install equipment until following conditions can be maintained in spaces to receive equipment:
  - 1. Ambient temperature:
    - a. Q-Manager, system computer: 10 degrees to 35 degrees C (50 degrees to 90 degrees F) Relative humidity: Maximum 90 percent, non-condensing.
  - 2. Lighting control system must be protected from dust during installation.
- B. Do not install products under environmental conditions outside manufacturer's absolute limits.

## PART 2 PRODUCTS

### 2.1 GENERAL

- A. Lighting Controls: Ten-year operational life while operating continually at any temperature in an ambient temperature range of 0 degrees C (32 degrees F) to 40 degrees C (104 degrees F) and 90 percent non-condensing relative humidity.
- B. Designed and tested to withstand discharges without impairment of performance when subjected to discharges of 15,000 volts per IEC 801-2.

### 2.2 ACCEPTABLE MANUFACTURERS

- A. Acceptable Manufacturer: Lutron Electronics Co., Inc. – System: Lutron Quantum (or approved equal)
- B. Basis of design product: Lutron Quantum or subject to compliance and prior approval with specified requirements of this section, one of the following:
  - 1. Lutron Quantum (or approved equal)

## 2.3 DIMMING / RELAY PERFORMANCE REQUIREMENTS

- A. Electrolytic capacitors to operate at least 20 degrees C below the component manufacturer's maximum temperature rating when device is under fully-loaded conditions in 40 degrees C (104 degrees F) ambient temperature.
- B. Load Handling Thyristors (SCRs and triacs), Field Effect Transistors (FETs), and Isolated Gate Bipolar Transistors (IGBTs): The component's maximum current rating to be at least two times the dimmer's/relay's rated operating current.
- C. Capable of withstanding repetitive inrush current of 50 times operating current without impacting lifetime of dimmer/relay.
- D. Design and test dimmers/relays to withstand line-side surges without impairment to performance.
  - 1. Panels: Withstand surges without impairment of performance when subjected to surges of 6,000 volts, 3,000 amps per ANSI/IEEE C62.41 and per IEC 61000-4-5 surge requirements.
  - 2. Other power handling devices: Withstand surges without impairment of performance when subjected to surges of 6,000 volts, 200 amps per ANSI/IEEE C62.41.
- E. Power failure memory and dimmer/relay recovery:
  - 1. When power is interrupted and subsequently returned, within 3 seconds lights will automatically return to same levels (dimmed setting, full on, or off) prior to power interruption.
- F. Dimmers:
  - 1. Provide real-time cycle-by-cycle compensation for incoming line voltage variations including changes in RMS voltage (plus or minus 2 percent change in RMS voltage/cycle), frequency shifts (plus or minus 2 Hz change in frequency/second), dynamic harmonics, and line noise.
  - 2. Systems not providing cycle-by-cycle compensation to include external power conditioning equipment as part of dimming system.
  - 3. Each dimmer to incorporate electronic "soft-start" default at initial turn-on that smoothly ramps lights up to the appropriate levels within 0.5 seconds.
  - 4. Utilize air gap off to disconnect the load from line supply.

5. Control all light sources in smooth and continuous manor. Dimmers with visible steps are not acceptable.
6. Each dimmer to be assigned a load type that will provide a proper dimming curve for the specific light source.
7. Possess ability to have load types assigned per circuit, configured in field.
8. Minimum and maximum light levels user adjustable on circuit-by-circuit basis.

G. Non-dim circuits to meet the following requirements:

1. Rated life of relay at full load: Minimum 1,000,000 cycles.
2. Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
3. Fully rated output continuous duty for inductive, capacitive, and resistive loads.

## 2.4 POWER PANELS

A. Product: Lutron XP (or approved equal)

B. Mechanical:

1. Listed to UL 508 as industrial control equipment. CSA certified, or NOM approved as applicable.
2. Delivered and installed as a UL/CSA listed factory assembled panel.
3. Field wiring accessible from front of panel without need to remove dimmer assemblies or other components.
4. Panels passively cooled via free-convection, unaided by fans or other means.
5. Ship panels with each dimmer in mechanical bypass position by means of jumper bar inserted between input and load terminals. Jumpers to carry full rated load current and be reusable at any time. Mechanical bypass device to allow for switching operation of connected load with dimmer removed by means of circuit breaker.

C. Electrical:

1. Panels contain branch circuit protection for each input circuit unless the panel is a dedicated feed-through type panel or otherwise indicated on the drawings.



2. Branch circuit breakers; meet following performance requirements:
    - a. Listed to UL 489 as molded case circuit breaker for use on lighting circuits.
    - b. Contain visual trip indicator; rated at 10,000 AIC, 120 V Dimming.
    - c. Thermal-magnetic construction for overload, short-circuit, and over-temperature protection. Use of breakers without thermal protection requires dimmers/relays to have integral thermal protection to prevent failures when overloaded or ambient temperature is above rating of panel.
    - d. Accept tag-out/lock-out devices to secure circuit breakers in off position when servicing loads.
    - e. Replaceable without moving or replacing dimmer/relay assemblies or other components in panel. UL listed as switch duty (SWD) so that loads can be switched on and off by breakers.
  3. Minimum UL listed Short Circuit Current Rating (SCCR) of 25,000A/ 45,000A/ 65,000A.
  4. Utilize air gap off to disconnect the load from line supply.
- D. Lutron GP Series Grafik Panel (or approved equal)/Architectural Lighting Control Panel:
1. Dimmers designed and tested to specifically control incandescent/tungsten, magnetic low voltage, electronic low voltage, neon/cold cathode, fluorescent dimming ballasts, and non-dim loads.
  2. Utilize universal 16A continuous-use UL listed dimmer.
  3. Limit current rise time to minimum 350  $\mu$ sec as measured from 10-90 percent of load current waveform and minimum 525  $\mu$ sec as measured from 0-100 percent of load current waveform at 50 percent rated dimmer capacity at a 90 degree conduction angle. Current rise to be minimum 400  $\mu$ sec as measured from 10-90 percent of load current waveform and minimum 600  $\mu$ sec as measured from 0-100 percent of load current waveform at 100 percent rated dimmer capacity at a 90 degree conduction angle.
  4. Load faults only affect the given circuit.
- E. Lutron LP/CCP Series Light Duty Commercial Lighting Control Panel (or approved equal)/ Custom Combination Panel:
1. Utilize multiple load type 16A feed continuous-use UL listed dimming/switching modules.
  2. For switching only circuits, utilize 1,000,000 cycle relay.

3. Utilize multiple load type low voltage dimming module.
- F. Lutron XP Softswitch Series Switching Panels (or approved equal) [Switching Panels]:
1. Flush into wall/Surface mounted (to be coordinated by contractor).
  2. Rated life of relay: Minimum 1,000,000 cycles.
  3. Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
  4. Fully rated output continuous duty for inductive, capacitive, and resistive loads.
- G. Lutron Circuit Selector (or approved equal) [Panel Processor]:
1. Provide following capabilities:
    - a. Operate circuits directly from panel processor for system diagnostics and provide feedback of system operation.
    - b. Electronically assign each circuit to any zone in lighting control system.
    - c. Determine normal/emergency function of panel and set emergency lighting levels.
  2. Where indicated on Drawings, panels to provide two control links. Each circuit to be capable of transferring control based on independent programming between architectural control system and theatrical controls utilizing the USITT DMX-512 1990 or ESTA DMX-512A protocol.
  3. React to changes from control within 20 milliseconds.
- H. Diagnostics and Service:
1. Replacing dimmer/relay does not require re-programming of system or processor.
  2. Dimmers/relays: Include diagnostic LEDs to verify proper operation and assist in system troubleshooting.
  3. Dimming/relay panels: Include tiered control scheme for dealing with component failure that minimizes loss of control for occupant.
    - a. If lighting control system fails, lights to remain at current level. Panel processor provides local control of lights until system is repaired.
    - b. If panel processor fails, lights to remain at current level. Circuit breakers can be used to turn lights off or to full light output, allowing non-dim control of lights until panel processor is repaired.
    - c. If dimmer fails, factory-installed mechanical bypass jumpers to allow each dimmer to be mechanically bypassed. Mechanical bypass device

to allow for switching operation of connected load with dimmer removed by means of circuit breaker.

## 2.5 LIGHTING MANAGEMENT HUB

- A. Provide Lighting Management Hub in a pre-assembled NEMA listed enclosure with terminal blocks listed for field wiring.
- B. Enables [Q-Admin] Light Management software to control and monitor EcoSystem dimming ballast, EcoSystem modules, Power Panels, GRAFIK Eye QS, and Sivoia QS window treatments (or approved equal).
  - 1. Lighting Management Hub utilizes Ethernet connectivity to Q-Manager server utilizing one of the following methods:
    - a. Dedicated network
    - b. Dedicated VLAN
    - c. Shared network with Building Management System (BMS)
    - d. Corporate network where managed switches are configured to allow multicasting and use of IGMP
- C. Integrates control station devices, power panels, shades, preset lighting controls, and external inputs into a single customizable lighting control system with:
  - 1. Multiple failsafe mechanisms
    - a. Power failure detection via LUT-ELI
    - b. Miswire protection - lights go to full on if EcoSystem ballast wires are shorted
    - c. Distributed architecture provides fault containment. Single hub failure or loss of power does not compromise lights and shades connected to other Light Management Hubs.
  - 2. Manual overrides
  - 3. Automatic control
  - 4. Central computer control and monitoring
  - 5. Integration with BMS via BACnet
- D. Astronomical time clock.
- E. Maintains a backup of the programming in a non-volatile memory capable of lasting more than ten years without power.

## 2.6 LIGHT MANAGEMENT SYSTEM COMPUTER [Q-MANAGER]

A. No Computer

1. Lighting Control System Manufacturer Field Service Representative will perform system start-up without on-site computer.

2.7 LIGHTING MANAGEMENT SYSTEM SOFTWARE

A. Provide system software license and hardware that is designed, tested, manufactured, and warranted by a single manufacturer.

B. Configuration Setup – Q-Design

1. Used to make system programming and configuration changes
2. Windows based, capable of running on either central server or a remote client over TCP/IP connection
3. Allow to:
  - a. Capture system design.
    - i Geographical Layout
    - ii Load Schedule Zoning
    - iii Equipment Schedule
    - iv Equipment assignment to lighting management panels
  - b. Start-up
    - i Addressing

C. Control and Monitor – Q-Admin

1. Basic System View
  - a. The Q-Admin system navigation and status reporting is performed using a tree view of the building.
2. Control of Lights:
  - a. Area lights can be monitored for on/off status.
  - b. All lights in an area can be turned on/off or sent to a specific level.
  - c. For areas that have been zoned, these areas may be sent to a predefined lighting scene, and individual zones may be controlled.
  - d. Area lighting scenes can be modified in real-time, changing the levels zones go to when a scene is activated.
  - e. High and Low end of area lighting can be tuned/trimmed
  - f. Area occupancy can be disabled to override occupancy control or in case of occupancy sensor problems.

- g. Area occupancy settings including level lights turn on to when area is occupied, and level lights turn off to when area is unoccupied can be changed in real-time.
- 3. Scheduling
  - a. Schedule time of day and astronomic timeclock events to automate functions for lights and shades.
- 4. Diagnostics
  - a. Diagnostics allows the building manager to check on the status of all equipment in the lighting control system. Devices will be listed with a reporting status of OK, missing, or unknown.
- 5. Administration
  - a. Users – Allows new user accounts to be created and existing user accounts to be edited.
  - b. Back-up Project Database – Allows admin user to backup the project database. The project database holds all the configuration information for the system, including keypad programming, area scenes, daylighting, occupancy programming, emergency levels, night lights, and timeclock. The Control and Monitor tool can be used to adjust some of these settings, and thus it is important to back-up the project database prior to changing settings in the Design and Setup tool.
- 6. Publish Project Database – Allows the admin user to send a new project database to the server and download the new configuration to the system. The project database holds all the configuration information for the system, including keypad programming, area scenes, daylighting, occupancy programming, emergency levels, night lights, and timeclock.

## 2.8 CONTROL STATIONS

## 2.9 LOW VOLTAGE CONTROL INTERFACES

- A. Contact Closure Interface; Lutron Model QSE-IO (or approved equal):
  - 1. The contact closure input device will accept both momentary and maintained contact closures.
  - 2. The contact closure output device can be configured for maintained or pulsed outputs.
- B. Contact Closure Input Interface; Lutron QS seeTouch keypads Model QSWS2

(or approved equal):

1. The contact closure input device will accept both momentary and maintained contact closures.
- C. RS232 and Ethernet Interface; Lutron Model QSE-CI-NWK-E (or approved equal)
1. Provide ability to communicate via ethernet or RS232 to audiovisual equipment, touchscreens, etc.
  2. Provide control of:
    - a. Lights scene selections.
    - b. Simulate system wall station button presses and releases.
  3. Provide status monitoring of:
    - a. Light scene-status.
  4. Communicate sensor information to wired QS link for use by compatible devices.

## 2.10 SOURCE QUALITY CONTROL

- A. Perform full-function testing on all completed assemblies at end of line. Statistical sampling is not acceptable.
- B. Perform full-function testing on 100 percent of all ballasts at the factory.
- C. Audit burn-in at 40 degrees C (104 degrees F) ambient temperature of dimming assemblies and panels at full load for two hours.
- D. Perform burn-in at 40 degrees C (104 degrees F) ambient temperature on 100 percent of all ballasts at the factory.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install equipment in accordance with manufacturer's installation instructions.
- B. Provide complete installation of system in accordance with Contract Documents.
- C. Provide dedicated network between Q-Manager computer and Quantum

Lighting Management Panels.

- D. Provide equipment at locations and in quantities indicated on Drawings. Provide any additional equipment required to provide control intent.
- E. Define each dimmer's/relay's load type, assign each load to a zone, and set control functions.
- F. Systems Integration:
  - 1. Equipment Integration Meeting Visit (LSC-INT-VISIT)
    - a. Facility Representative to coordinate meeting between Facility Representative, Lighting Control System Manufacturer and other related equipment manufacturers to discuss equipment and integration procedures.

### 3.2 SERVICE AND SUPPORT

- A. Startup and Programming
  - 1. Provide factory certified field service engineer to make minimum of three site visits to ensure proper system installation and operation under following parameters
    - a. Qualifications for factory certified field service engineer:
      - i Minimum experience of 2 years training in the electrical/electronic field.
      - ii Certified by the equipment manufacturer on the system installed.
    - b. Make first visit prior to installation of wiring. Review:
      - i Low voltage wiring requirements.
      - ii Separation of power and low voltage/data wiring.
      - iii Wire labeling.
      - iv Lighting Management Panel locations and installations.
      - v Control locations.
      - vi Computer jack locations.
      - vii Load circuit wiring.
      - viii Network wiring requirements.

- ix Connections to other equipment and other Lutron equipment.
    - x Installer responsibilities.
    - xi Power Panel locations.
  - c. Make second visit upon completion of installation of Network Lighting Control System:
    - i Verify connection of power wiring and load circuits.
    - ii Verify connection and location of controls.
    - iii Energize Lighting Management Panels and download system data program.
    - iv Address devices.
    - v Verify proper connection of panel links (low voltage/data) and address panel.
    - vi Download system panel data to dimming/switching panels
    - vii Check dimming panel load types and currents and supervise removal of by-pass jumpers.
    - viii Verify system operation control by control.
    - ix Verify proper operation of manufacturers interfacing equipment.
    - x Verify proper operation of manufacturers supplied PC and installed programs.
    - xi Obtain sign-off on system functions.
  - d. Make third visit to demonstrate and educate Owner's representative on system capabilities, operation and maintenance.
- 2. Startup
  - a. Q-Admin configuration
    - i Naming and association of areas and lighting zones.
- B. Tech Support
  - 1. Provide factory direct technical support hotline 24 hours per day, 7 days per week.

### 3.3 FIELD QUALITY CONTROL



A. Manufacturer Services

1. Aim and Focus Visit (LSC-AF-VISIT)
  - a. Facility Representative to coordinate on-site meeting with Lighting Control System Manufacturer and Lighting Design Consultant to make required lighting adjustments to the system for conformance with the Lighting Design Consultant's original design intent.

3.4 CLOSEOUT ACTIVITIES

A. Training Visit (LSC-TRAINING)

1. Lighting Control System Manufacturer to provide [1] day additional on-site system training to site personnel.

B. On-site Walkthrough (LSC-WALK)

1. Lighting Control System Manufacturer to provide a factory certified Field Service Engineer to demonstrate system functionality to the Commissioning Agent.

3.5 DEMONSTRATION

- A. Demonstrate proper operation and maintenance of window shade system to Owner.

3.6 MAINTENANCE

- A. Lighting control manufacturer should be capable of providing on-site service support within 24 hours anywhere in continental United States.
- B. Lighting control manufacturer should offer renewable service contract on yearly basis, to include parts, factory labor, and annual training visits. Make service contracts available up to ten years after date of system startup.

APPENDIX 1

CONTROL SCHEDULE ATTACHED

APPENDIX 2

ONELINE DIAGRAM ATTACHED

T I L L O T S O N   D E S I G N   A S S O C I A T E S

South Battery Park City  
Lighting Control schedule 2022-10-20 Conformed Set

**Sequence of operations**

**Sequence 1 (S1):**

3- button wall control (2-scene + OFF) with raise/lower button; Occupancy sensor; Daylight sensor;

Scene 1 - Normal Condition

Scene 2 - Presentation

(light levels to be confirmed on-site, allow for re-programming if required)

**Sequence 2 (S2):**

Occupancy sensor; Time clock

Control Zone	Control Panel	Fixture Type	Quantity	Load		Dimmer Type (source)	Control Sequence	Fixture Description
				unit load (lamp wattage only)	total zone Load (kWatts)			
Museum of Jewish Heritage								
DOT		TA	15 ea	38 W	0.570 Kw	non-dim	Time clock	New Historical pole luminaire
M02		TF-1	101 ln.ft.	2 W	0.182 Kw	non-dim	Time clock	Bench lighting
M03		TX	20 ea	13 W	0.250 Kw	non-dim	Time clock	Wall Light
M04		TX	2 ea	13 W	0.025 Kw	non-dim	Time clock	Wall Light
Total					1.027 Kw			
Battery Wagner Park								
W01		TJ	142 ln.ft.	2 W	0.213 Kw	non-dim	Time clock	Handrail lighting
W02		TJ	94.5 ln.ft.	2 W	0.142 Kw	non-dim	Time clock	Handrail lighting
W03		TF-1	308 ln.ft.	2 W	0.554 Kw	non-dim	Time clock	Bench lighting
W04		TB	1 ea	150 W	0.150 Kw	ELV	Time clock	38' pole with (6) light heads
W05		TB	1 ea	150 W	0.150 Kw	ELV	Time clock	38' pole with (6) light heads
W06		TF-1	55.5 ln.ft.	2 W	0.100 Kw	non-dim	Time clock	Bench lighting
W07		TF	813 ln.ft.	2 W	1.463 Kw	non-dim	Time clock	Bench lighting
W08		TJ	235.75 ln.ft.	2 W	0.354 Kw	non-dim	Time clock	Handrail lighting
W09		TF-1	34 ln.ft.	2 W	0.061 Kw	non-dim	Time clock	Bench lighting
W10		TJ-1	27.25 ln.ft.	2 W	0.041 Kw	non-dim	Time clock	Handrail lighting
W11		TT	4 ea	6 W	0.024 Kw	non-dim	Time clock	Step Light
W14		TC	60 ea	10 W	0.600 Kw	0-10V	Time clock	Ingrade tree uplight
W15		TD	8 ea	7 W	0.056 Kw	0-10V	Time clock	Catenary cylinder downlight
W16		TC	64 ea	10 W	0.640 Kw	0-10V	Time clock	Ingrade tree uplight
W17		TD	8 ea	7 W	0.056 Kw	0-10V	Time clock	Catenary cylinder downlight
W18		TJ	197 ln.ft.	2 W	0.296 Kw	non-dim	Time clock	Handrail lighting
W19		TH-4	1 ea	52 W	0.052 Kw	ELV	Time clock	16' pole with (4) light heads
W20		TH-4	1 ea	52 W	0.052 Kw	ELV	Time clock	16' pole with (4) light heads
W21		TH-4	1 ea	52 W	0.052 Kw	ELV	Time clock	16' pole with (4) light heads
W22		TH-4	1 ea	52 W	0.052 Kw	ELV	Time clock	16' pole with (4) light heads
W23		TN	1 ea	7 W	0.007 Kw	MLV	Time clock	Pole mounted flood light
W24		TH-4	1 ea	52 W	0.052 Kw	ELV	Time clock	16' pole with (4) light heads
W25		TN	1 ea	7 W	0.007 Kw	MLV	Time clock	Pole mounted flood light
W26		TH-4	1 ea	52 W	0.052 Kw	ELV	Time clock	16' pole with (4) light heads
W27		TF-1	121 ln.ft.	2 W	0.218 Kw	non-dim	Time clock	Bench lighting
W28		TK	4 ea	14 W	0.056 Kw	0-10V	Time clock	Ingrade wall-washer
W29		TK	2 ea	14 W	0.028 Kw	0-10V	Time clock	Ingrade wall-washer
DOT		TA	11 ea	38 W	0.418 Kw	non-dim	Time clock	New Historical pole luminaire
DOT		TA-2	7 ea	38 W	0.266 Kw	non-dim	Time clock	New Historical pole LED fixture head at esplanade
W33		TK	4 ea	14 W	0.056 Kw	0-10V	Time clock	Ingrade wall-washer

T I L L O T S O N   D E S I G N   A S S O C I A T E S

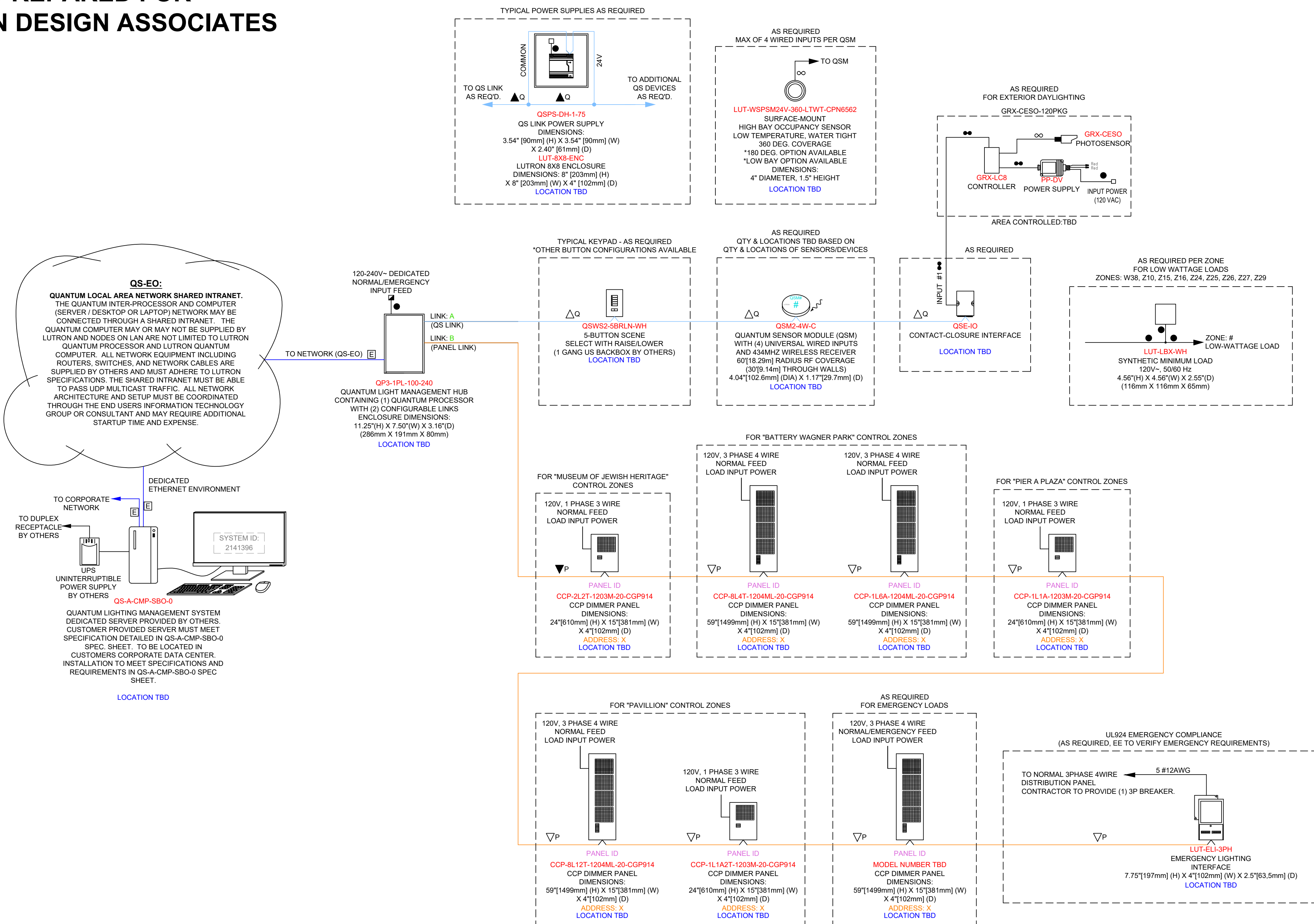
W34		TN	2 ea	7 W	0.014 Kw	MLV	Time clock	Pole mounted flood light
W35		TJ-1	23.5 ln.ft.	2 W	0.035 Kw	non-dim	Time clock	Handrail lighting
W36		TJ	23.5 ln.ft.	2 W	0.035 Kw	non-dim	Time clock	Handrail lighting
W37		TH-3	1 ea	39 W	0.039 Kw	ELV	Time clock	16' pole with (3) light heads
W38		TF-2	9.1 ln.ft.	2 W	0.016 Kw	non-dim	Time clock	Bench lighting
W39		TF-2	19 ln.ft.	2 W	0.034 Kw	non-dim	Time clock	Bench lighting
W40		TF-2	17.5 ln.ft.	2 W	0.032 Kw	non-dim	Time clock	Bench lighting
W42		TN	1 ea	7 W	0.007 Kw	MLV	Time clock	Pole mounted flood light
W44		TN	1 ea	7 W	0.007 Kw	MLV	Time clock	Pole mounted flood light
W45		TH-2	1 ea	26 W	0.026 Kw	ELV	Time clock	16' pole with (2) light heads
W46		TH-2	1 ea	26 W	0.026 Kw	ELV	Time clock	16' pole with (2) light heads
W47		TH-3	1 ea	39 W	0.039 Kw	ELV	Time clock	16' pole with (3) light heads
W48		TH-2	1 ea	26 W	0.026 Kw	ELV	Time clock	16' pole with (2) light heads
W49		TD-1	16 ea	7 W	0.112 Kw	0-10V	Time clock	Catenary cylinder downlight
W50		TD-1	16 ea	7 W	0.112 Kw	0-10V	Time clock	Catenary cylinder downlight
dal								
dal				Total		6.828 Kw		
Pier A Plaza								
P01		TB	1 ea	150 W	0.150 Kw	ELV	Time clock	38' pole with (6) light heads
P02		TB	1 ea	150 W	0.150 Kw	ELV	Time clock	38' pole with (6) light heads
P03		TB	1 ea	150 W	0.150 Kw	ELV	Time clock	38' pole with (6) light heads
P05		TB	1 ea	150 W	0.150 Kw	ELV	Time clock	38' pole with (6) light heads
P06		TB	1 ea	150 W	0.150 Kw	ELV	Time clock	38' pole with (6) light heads
P04		TF	188 ln.ft.	2 W	0.338 Kw	non-dim	Time clock	Bench lighting
DOT		TA	3 ea	38 W	0.114 Kw	non-dim	Time clock	New Historical pole luminaire
Total								
				1.202 Kw				
Battery Bikeway								
DOT		TA	12 ea	38 W	0.456 Kw	non-dim	Time clock	New Historical pole luminaire
Total								
				0.456 Kw				
PAVILLION								
Z01		TU	8 ea	31 W	0.244 Kw	0-10V	S1	Pendant spot light
Z02		TU	14 ea	31 W	0.427 Kw	0-10V	S1	Pendant spot light
Z03		TU	15 ea	31 W	0.458 Kw	0-10V	S1	Pendant spot light
Z04		TU	9 ea	31 W	0.275 Kw	0-10V	S1	Pendant spot light
Z05		TS	3 ea	15 W	0.045 Kw	0-10V	S2	Downlight
Z06		TQ	7 ln.ft.	9 W	0.062 Kw	0-10V	S2	Perimeter linear lens fixture
Z07		TS	5 ea	15 W	0.075 Kw	0-10V	S2	Downlight
Z08		TQ	57 ln.ft.	9 W	0.503 Kw	0-10V	S2	Perimeter linear lens fixture
Z09		TS	2 ea	15 W	0.030 Kw	0-10V	S2	Downlight
Z10		TS	1 ea	15 W	0.015 Kw	0-10V	S2	Downlight
Z11		TQ	5 ln.ft.	9 W	0.044 Kw	0-10V	S2	Perimeter linear lens fixture
Z12		TS	5 ea	15 W	0.075 Kw	0-10V	S2	Downlight
Z13		TQ	38 ln.ft.	9 W	0.336 Kw	0-10V	S2	Perimeter linear lens fixture
Z14		TS	5 ea	15 W	0.075 Kw	0-10V	S2	Downlight
Z15		TS	2 ea	15 W	0.030 Kw	0-10V	Time clock	Downlight
Z16		TQ	1.5 ln.ft.	9 W	0.013 Kw	0-10V	Time clock	Perimeter linear lens fixture
Z17		TT	101 ea	6 W	0.606 Kw	non-dim	Time clock	Step Light
Z18		TT	28 ea	6 W	0.168 Kw	non-dim	Time clock	Step Light
Z19		TT	29 ea	6 W	0.174 Kw	non-dim	Time clock	Step Light
Z21		TS	3 ea	15 W	0.045 Kw	0-10V	Time clock	Downlight
Z22		TQ	3.5 ln.ft.	9 W	0.031 Kw	0-10V	S2	Perimeter linear lens fixture
Z23		TQ	3.5 ln.ft.	9 W	0.031 Kw	0-10V	S2	Perimeter linear lens fixture
Z24		TQ	2.5 ln.ft.	9 W	0.022 Kw	0-10V	S2	Perimeter linear lens fixture

T I L L O T S O N   D E S I G N   A S S O C I A T E S

Z25		TS-1	2	ea	15 W	0.030 Kw	0-10V	S2	Downlight
Z26		TS	2	ea	15 W	0.030 Kw	0-10V	Time clock	Downlight
Z27		EMPTY						Time clock	
Z28		TS	2	ea	15 W	0.030 Kw	0-10V	Time clock	Downlight
Z29		TT	4	ea	6 W	0.024 Kw	non-dim	Time clock	Step Light
Z30		TS	2	ea	15 W	0.030 Kw	0-10V	Time clock	Downlight
					Total				
					3.927 Kw				



**DRAWING PREPARED FOR  
TILLOTSON DESIGN ASSOCIATES**



**WIRING LEGEND:**

- | <b>▲ Q3 QS CONTROL LINK (SEE WIRE DESCRIPTION BELOW)</b><br><b>▲ Q3 QS CONTROL LINK (SEE WIRE DESCRIPTION BELOW)</b><br>(CONNECT WIRES 1, 3 AND 4. DO NOT CONNECT WIRE # 2)   |   |  |  |
|---|---|--|--|
| <b>QS WIRING AS REQUIRED BY CONTROL LINK LENGTH</b><br>(REFER TO QS SMART PANEL POWER SUPPLY WIRING GUIDE FOR SHADE WIRING NOTES):  |   |  |  |
| TOTAL CONTROL LINK LENGTH   | WIRE GAUGE  | AVAILABLE FROM LUTRON IN ONE CABLE:                              |  |
| <b>LESS THAN 500ft (153 m)</b>  | POWER (TERMINALS 1&2):<br>1 PAIR 18 AWG (1.0 mm <sup>2</sup> )                      | GRX-CBL-346S<br>OR<br>GRX-CBL-346S                               |  |
|   | DATA (TERMINALS 3&4):<br>1 PAIR 22 AWG (0.5 mm <sup>2</sup> ) TWISTED AND SHIELDED* |  |  |
| <b>500ft (153 m) TO 2,000ft (600 m)**</b>   | POWER (TERMINALS 1&2):<br>1 PAIR 12 AWG (4 mm <sup>2</sup> )                        | GRX-CBL-46L<br>OR<br>GRX-CBL-46L                                 |  |
|   | DATA (TERMINALS 3&4):<br>1 PAIR 22 AWG (0.5 mm <sup>2</sup> ) TWISTED AND SHIELDED* |  |  |
| *ALTERNATE DATA-ONLY CABLE: USE APPROVED DATA LINK CABLE (22 AWG [0.5 mm <sup>2</sup> ] TWISTED/SHEILED) FROM BELDEN (MODEL #9461).   |   |  |  |
| <b>**TOTAL LENGTH OF THE QS LINK MUST NOT EXCEED 2,000 ft (600 m).</b>  |   |  |  |
| <input checked="" type="checkbox"/> INPUT POWER (NORMAL-EMERGENCY)  |   |  |  |
| <input type="checkbox"/> INPUT POWER (NORMAL)   |   |  |  |
| <input checked="" type="radio"/> 2 #12AWG (4 mm <sup>2</sup> )  |   | <input checked="" type="radio"/> 2 #18AWG (1.0 mm <sup>2</sup> ) |  |
| <input type="radio"/> 3 #12AWG (4 mm <sup>2</sup> )   |   | <input type="radio"/> 3 #18AWG (1.0 mm <sup>2</sup> )            |  |
| <input type="checkbox"/> CAT5E OR BETTER CABLE FOR LUTRON NETWORK TERMINATED WITH RJ45 CONNECTORS (TO BE PROVIDED BY OTHERS), 328 ft (100 m) MAXIMUM RUN.   |   |  |  |
| <b>▽ P PANEL LINK (SEE WIRE DESCRIPTION BELOW)</b>  |   |  |  |
| <b>▽ P PANEL LINK (SEE WIRE DESCRIPTION BELOW)</b><br>(CONNECT WIRES 1, 2, 3 AND 4. DO NOT CONNECT WIRE # 5)  |   |  |  |
| LUTRON CABLE GRX-CBL-46L (5 CONDUCTOR NON-PLENUM) OR GRX-CBL-46L (5 CONDUCTOR PLENUM RATED). OTHERS USE 2 #12 AWG (4 mm <sup>2</sup> ), 1 BELDEN #9461 AND BELDEN PANELS CABLE #1 #18 AWG (1.0 mm <sup>2</sup> ) FOR EMERGENCY SENSING CABLE BY OTHERS. |   |  |  |

### WIRING NOTES:

- ## QS LINK RULES
- THE FOLLOWING LINK RULES MUST BE OBSERVED FOR PROPER OPERATION:
- THIS IS A TOPOLOGY-FREE LINK (T-TAP, HOME-RUN, ETC. IS OK). REFER TO TABLE BELOW FOR WIRE RUN LIMITS.
    - WIRED DIFFERENTLY THAN WHAT IS SHOWN. POWER, DRAW UNIT AND SIGNALING NEED TO BE CONFIRMED. SEE POWER DRAW UNIT (PDU) REQUIREMENT SHEET INCLUDED IN THIS SUBMITTAL.
  - MAXIMUM OF 512 OUTPUTS (BALLASTS, SHADES, CONTACT CLOSURES, ETC.)
  - MAXIMUM OF 20 OCCUPANCY SENSORS, 100 DAYLIGHT SENSING/RETRO SHADOW SENSORS AND 100 KEYPADS.
  - MAXIMUM OF 100 QS DEVICES (SUCH AS A GRAFIX EVERE, QS, SEETOUCHEO QS, KEYPAD, SMART PANEL POWER SUPPLY (SPS/P-1040), ESN, OR SIVIOA QS SHADE / DRAPERY DRIVE UNIT). QUANTUM PROCESSOR CANNOT AS 1 DEVICE PER LINK.
  - MAXIMUM OF 100 ZONES - SUCH AS A SIVIOA QS SHADE / DRAPERY DRIVE UNIT, OR A LIGHTING SCENE ON A QS-PCP-1040 DOES NOT APPLY TO QUANTUM SYSTEMS).
  - THE 10 OUTPUTS ON A QS-PCP-1040 CANNOT EXCEED A COMBINED LENGTH OF 2,000 FT (600 m).
- ## PANEL LINK RULES
- THE FOLLOWING LINK RULES MUST BE OBSERVED FOR PROPER OPERATION:
- PANELS ARE DAISY-CHAINED ON ONE OF THE CONFIGURABLE LINKS PER LUTRON'S DRAWING, HOWEVER IT IS NOT NECESSARY TO HAVE MORE THAN ONE LINK.
  - DO NOT HOME-RUN OR T-TAP THIS WIRING LINK. ALL CIRCUITS NEED TO BE LANDED IN THESE PANELS PER LUTRON'S PANEL SCHEDULES.
  - THE MAXIMUM WIRE LENGTH OF A PANEL LINK IS 2,000 ft (600 m). A MAX-IPSTR IS USED TO EXTEND THE LENGTH OF A LINK ANOTHER 2,000 FT (600 m). A MAXIMUM OF (3) MAX-IPSTRS MAY BE USED PER LINK FOR MAXIMUM LENGTH OF 8,000 FT (2,430 m) PER LINK.
  - IF A LINK IS MOVED TO ANOTHER LINK, OR THE LOADS ARE NOT WIRED AS SHOWN IN LUTRON PANEL SCHEDULES, LUTRON MUST BE NOTIFIED. THIS INFORMATION IS IMPORTANT FOR PROGRAMMING THE SYSTEM.
  - UP TO 32 CIRCUIT SELECTORS PER LINK
  - UP TO 512 SWITCH LEGS OR ZONES PER LINK
  - LT-1 LINK TERMINATORS NEEDED ON EACH END OF THE LINK
- PANEL(S) BASED 2021-06-29 SOUTH BATTERY PARK CITY LIGHTING CONTROL ZONE SCHEDULE - 100%G2 - DATED 08-29-2021 FROM TILLOTSON DESIGN ASSOCIATES

## QUANTUM NETWORK

WHEN A LIGHTING MANAGEMENT NETWORK (LMN) IS REQUIRED TO ENABLE COMMUNICATIONS BETWEEN INDIVIDUAL LIGHT MANAGEMENT HUBS (LMH) AND BETWEEN LMH AND THE SYSTEM SERVER/DESKTOP/LAPTOP (C-MANAGER), THE LMN REQUIRES A DEDICATED LAN OR VLAN. IT IS THE RESPONSIBILITY OF THE NETWORK PROVIDER TO ENSURE THE RELIABILITY AND SECURITY OF THE LMN.

CAT5E OR BETTER ETHERNET CABLE TO BE RUN FOR DEDICATED LMN TERMINATED WITH RJ45 CONNECTORS (PROVIDED BY OTHERS), THE NUMBER OF ETHERNET HUB/SEGMENTS BETWEEN THE SERVER/DESKTOP/LAPTOP (C-MANAGER) AND ANY LMN NODE SHALL NOT EXCEED 8. TOTAL LENGTH OF ETHERNET CABLE SHALL NOT EXCEED 328 FT (100M) POINT-TO-POINT.

IF LONGER RUNS ARE REQUIRED, MULTI-MODE FIBER OPTIC CABLE CAN BE USED INSTEAD WITH APPROPRIATE FIBER OPTIC CONNECTORS (PROVIDED BY OTHERS). CONSULT WITH NETWORK PROVIDER FOR STANDARD ETHERNET AND FIBER OPTIC WIRING RULES FOR DISTANCE AND SEPARATION AS WELL AS FOR PLACEMENT OF SWITCHES, ROUTERS, HUBS, ETC.

FOR MORE INFORMATION REGARDING NETWORK EQUIPMENT REQUIREMENTS AND NETWORK CONFIGURATION, PLEASE REFER TO THE QUANTUM LIGHTING MANAGEMENT NETWORK SPECIFICATION SHEET OR CONTACT LUTRON.

CONCEPT DRAWING DRAWING IS PROVIDED FOR CONCEPTUAL PURPOSES ONLY AND IS NOT INTENDED TO REPRESENT THE EXACT EQUIPMENT REQUIREMENTS, INCLUDING LOCATIONS AND LIGHTING CONDITIONS. IT SHOULD BE VERIFIED IN ACCORDANCE WITH THE MOST UP-TO-DATE LIGHTING CALCULATIONS, REPUTED CECILING PLANS, LIGHTING FIXTURE SCHEDULES, PANEL SCHEDULES, CONTROL INTENT AND SPECIFICATIONS. TRADE EQUIPMENT SHOULD BE WINDED IN ACCORDANCE WITH ARCHITECTURAL PLANS, SPECIFICATIONS AND VERIFIED WITH SCHEDULES/DETAILS.

LED DIMMING REQUIRE AN EXACT MATCH BETWEEN THE LED ARRAY, DRIVER AND CONTROL. LUTRON CANNOT GUARANTEE COMPATIBILITY OR PERFORMANCE WITHOUT TESTING THIS COMBINATION.

TO CONFIRM WHAT PRODUCTS LUTRON HAS AVAILABLE OR WHAT INTERFACES MAY BE REQUIRED, PLEASE CONTACT LUTRON OR CHECK LUTRON'S PRODUCT COMPATIBILITY MATRIX ONLINE AT [WWW.LUTRON.COM/LED](http://WWW.LUTRON.COM/LED).

TO REQUEST THE TESTING OF AN LED PRODUCT BY LUTRON MANUFACTURERS CAN FILL OUT AN LED EVALUATION REQUEST FORM ONLINE AT [WWW.LUTRON.COM/LED](http://WWW.LUTRON.COM/LED) OR CONTACT [LED@LUTRON.COM](mailto:LED@LUTRON.COM).

LUTRON CAN GUARANTEE COMPATIBILITY AND PERFORMANCE OF THE HLXLINE A-SERIES LED DRIVER WITH THE APPROPRIATE LUTRON CONTROLS. THE HLXLINE A-SERIES LED DRIVER CAN BE USED ON PRODUCTS UNDER 40 WATTS WITH SUITABLE MOUNTING LOCATIONS. PLEASE REFER TO THE SPECIFICATION SUBMITTAL SHEET FOR FURTHER INFORMATION.

USING UNTESTED, NON-LUTRON LED DRIVERS REQUIRING 0-10V CONTROL, PERFORMANCE AND COMPATIBILITY CANNOT BE GUARANTEED BY LUTRON. PRODUCTS FOLLOWING THE IES STANDARD 60929 ARE MORE LIKELY TO PROVIDE ACCEPTABLE PERFORMANCE RESULTS. DETERMINATION OF RESULT ACCEPTABILITY IS UP TO THE USER'S DISCRETION.

IF USING UNTESTED, NON-LUTRON LED DRIVERS REQUIRING PHASE CONTROL, PERFORMANCE AND COMPATIBILITY CANNOT BE GUARANTEED BY LUTRON. A-SERIES OR ELV PRODUCTS PROVIDING HIGH END AND LOW END TRIM ADJUSTMENTS ARE MORE LIKELY TO PROVIDE ACCEPTABLE PERFORMANCE RESULTS. DETERMINATION OF RESULT ACCEPTABILITY IS UP TO THE USER'S DISCRETION.

**LUTRON NOTES:**

ALL DIMMING BALLASTS TO BE LUTRON ECOSYSTEM, ECOSYSTEM H-SERIES, OR H-LUME 3D TYPE.

ALL DIMMING DRIVERS TO BE LUTRON ECOSYSTEM DRIVER: A-SERIES; H-SERIES; OR S-SERIES OTHERWISE NOTED.

E.E. TO CONFIRM ALL CIRCUITING REQUIREMENTS.

ARCHITECT TO VERIFY QUANTITY, LOCATION & FINISH OF ALL CONTROLS.

ALL FACEPLATES, DIMMERS, SWITCHES, RECEPTACLES & CABLE/PHONE JACKS TO BE LUTRON NOVA T<sup>2</sup>.

LUTRON FIELD SERVICE COMMISSIONING INCLUDED IN ALL SYSTEMS INITIATES AN 2 YEAR LIMITED WARRANTY. THE ELECTRICAL CONTRACTOR MUST CONTACT LUTRON (1-844-588-7661) TO SET UP VISIT WITH 10 DAYS NOTICE.

## LUTRON SERVICES

SERVICE TITLE SERVICE SPECIFIED	SERVICE TITLE (MODEL NUMBER)	SERVICE DESCRIPTION
THE COUNTS OF SERVICES BELOW ARE TO BE INCLUDED AS PART OF THIS PROJECT'S SCOPE OF WORK AND SPECIFIED INTO THE WRITTEN SPEC DOCUMENTS.		
<b>PRE-STARTUP SERVICES</b>		
ON SITE PRE-WIRE VISIT (LSC-PREWIR)		ONSITE VISIT WITH ELECTRICAL CONTRACTOR TO DISCUSS LOGGING/CONSTRUCTION CONSIDERATIONS INCLUDING WIRING A MOUNTING OF SYSTEM DEVICES, CONSTRUCTION SCHEDULE & LITRON DOCUMENTATION. QUANTITY DICTATES THE NUMBER OF VISITS PURCHASED.
SYSTEM & NETWORK EQUIPMENT INSTALLATION (LSC-NETVIBT)		CONSULTATIVE TRAVEL WITH THIRD PARTY INTEGRATORS TO CONFIRM THE SPECIFIED SEGMENTATION AND NETWORK INTEGRATION PROCEDURES NEEDED IN ORDER TO INTEGRATE WITH LITRON EQUIPMENT. QUANTITY DICTATES THE NUMBER OF TRIP/STAYS BMS, BAS, I/O, NON-LITRON DASBES, BAGNET, AV, OR ENERGY MANAGEMENT.
SENSOR LAYOUT & TUNING (LSC-SENS&T)		LITRON WILL TAKE RESPONSIBILITY FOR LITRON-PROVIDED SENSOR PLACEMENT & PERFORMANCE BY CREATING SENSOR LAYOUTS, COORDINATING WITH FACILITY PERSONNEL PRIOR TO EACH INSTALLATION DURING STARTUP. ONCE THE BUILDING IS OCCUPIED, LITRON WILL RETURN UP TO TWO TIMES TO PERFORM SENSOR FINE-TUNING.
<b>STARTUP SUPPORT SERVICES</b>		
AFTER HOURS STARTUP (LSC-AH-SBT)		STARTUP PROVIDED BETWEEN THE HOURS OF 8:00PM - 7:00AM MONDAY THROUGH FRIDAY. SCOPES OF WORK MAY INCLUDE HOLDOUT OR REWORKING WORK ORDER, FEES MAY APPLY FOR WORK TO BE COMPLETED OUTSIDE OF REGULAR BUSINESS HOURS (WEEKENDS (FRIDAY 5:00PM - MONDAY 7:00AM)).
ONSITE SCENE ANALYSIS TUNING (LSC-AT-VISIT)		AN ONSITE VISIT WITH THE SPECIFIER OR CUSTOMER REPRESENTATIVE TO REVIEW DESIGN DOCUMENTS, ON-SITE SCENE LEVEL PROGRAMMING, AND TIMELOCK ADJUSTMENTS.
ONSITE WALKTHROUGH (LSC-WALKO)		ONSITE WALKTHROUGH WITH FACILITY REPRESENTATIVES OR PROJECT MANAGER TO VERIFY THAT THE LITRON SYSTEM MEETS THE SYSTEM FUNCTIONALITY MEETS THE DESIGN INTENT. THIS MAY INCLUDE ANY OF THE FOLLOWING ACTIONS: IDENTIFYING DEFECTS, ADDRESSING DEFECTS, DEMO, FUNCTIONAL TESTING ASSISTANCE, A INVENTORY OF LITRON EQUIPMENT.
SYSTEM PERFORMANCE VERIFICATION DOCUMENTATION (LSC-SPV-DOC)		COMPLETION OF DOCUMENTATION WHICH PROVIDES PERFORMANCE VERIFICATION DATA. DOCUMENTATION HAS BEEN THOROUGHLY TESTED IT SUPPORTS THE DOCUMENTATION REQUIREMENTS OF ALL BUILDING STANDARDS.
ACCEPTANCE TEST TECHNICAL TEST PLAN (LSC-SPV-CCT-724)		ACCEPTANCE TESTING BY AN LITRON CERTIFIED LIGHTING CONTROL TECHNICIAN TEST TECHNIQUE CALL TO FULFILL THE REQUIRED TEST 24 HOUR LIGHTING CONTROL TESTING.
<b>POST-STARTUP SERVICES</b>		
CUSTOMER SITE SOLUTION TRAINING (LSC-TRAINING-SP)		A VISIT TO TEACH SYSTEM USERS HOW TO OPERATE AND MAINTAIN THE LIGHTING CONTROL SYSTEM.
SYSTEM OPTIMIZATION (LSC-SYSTOPT-SP)		ONSITE CONSULTATIVE VISIT TO IDENTIFY & IMPLEMENT LIGHTING CONTROL ADJUSTMENTS TO IMPROVE USER EXPERIENCE & CREATE A MORE PRODUCTIVE WORK ENVIRONMENT.
<b>MAINTENANCE &amp; SUPPORT SERVICES</b>		
SOFTWARE MAINTENANCE SUBSCRIPTION (LSC-SMA-SP)		PROVIDES COMPATIBILITY TESTING FOR OPERATING SYSTEMS PATCHES, WEB-BROWSER UPDATES, AND QUANTUM SOFTWARE VERSIONS. INCLUDES AN EFFECTIVE FREE SOFTWARE UPGRADE LICENSE.
COMMERCIAL SYSTEMS 2-YEAR LIMITED WARRANTY (LSC-SLV-2YR)		COMMERCIAL SYSTEMS 2-YEAR LIMITED WARRANTY – A 2-YEAR WARRANTY PROVIDES 100% REPLACEMENT PARTS AND 100% LITRON DIAGNOSTIC LABOR COVERAGE WITH FIRST-AVAILABLE RESPONSE TIME. SLIVER 1+ PLAN: 5-6: 50% PARTS ONLY COVERAGE. YEARS 6-8: 25% PARTS ONLY COVERAGE.
ENHANCED SILVER COVERAGE (LSC-EBS)		YEARS 1-1: 100% REPLACEMENT PARTS & 100% LITRON DIAGNOSTIC LABOR COVERAGE WITH FIRST-AVAILABLE RESPONSE TIME. SLIVER 1+ PLAN: 5-6: 50% PARTS ONLY COVERAGE. YEARS 6-8: 25% PARTS ONLY COVERAGE.
ENHANCED GOLD COVERAGE (LSC-EGC)		YEARS 1-2: 100% REPLACEMENT PARTS & 100% LITRON LABOR COVERAGE WITH FIRST-AVAILABLE RESPONSE TIME. SLIVER 1+ PLAN: 5-6: 50% PARTS ONLY PREVENTATIVE MAINTENANCE VISIT (GOLD PLAN). YEARS 6-8: 50% PARTS ONLY COVERAGE. YEARS 6-8: 25% PARTS ONLY COVERAGE.
ENHANCED PLATINUM COVERAGE (LSC-EPSP)		YEARS 1-2: 100% REPLACEMENT PARTS & 100% LITRON LABOR COVERAGE WITH FIRST-AVAILABLE RESPONSE TIME. SLIVER 1+ PLAN: 5-6: 50% PARTS ONLY PREVENTATIVE MAINTENANCE VISIT (GOLD PLAN). YEARS 6-8: 50% PARTS ONLY COVERAGE. YEARS 6-8: 25% PARTS ONLY COVERAGE.
SILVER TECHNOLOGY SUPPORT PLAN (LSC-SLV-H)		AN ANNUAL SERVICE PLAN THAT COVERS 100% REPLACEMENT PARTS AND 100% LITRON DIAGNOSTIC LABOR WITH A FIRST-AVAILABLE ONSITE OR REMOTE RESPONSE TIME.
GOLD TECHNOLOGY SUPPORT PLAN (LSC-GLD-H)		AN ANNUAL SERVICE PLAN THAT COVERS 100% REPLACEMENT PARTS AND 100% LITRON DIAGNOSTIC LABOR WITH A 24-HOUR ONSITE OR REMOTE RESPONSE TIME. ALSO INCLUDES AN ANNUAL (1 DAY) SCHEDULED PREVENTATIVE MAINTENANCE VISIT EACH YEAR.
PLATINUM TECHNOLOGY SUPPORT PLAN (LSC-PLAT-H)		AN ANNUAL SERVICE PLAN THAT COVERS 100% REPLACEMENT PARTS AND 100% LITRON DIAGNOSTIC LABOR WITH A 24-HOUR ONSITE OR REMOTE RESPONSE TIME. ALSO INCLUDES AN ANNUAL (1 DAY) SCHEDULED PREVENTATIVE MAINTENANCE VISIT EACH YEAR.
PREVENTIVE MAINTENANCE VISITS (LSC-SMA-MNT)		YEARLY SCHEDULED MAINTENANCE VISIT TO PERFORM PREVENTIVE MAINTENANCE ON THE LITRON SYSTEM. ALSO INCLUDES SYSTEMS TRAININGS. QUANTITY IS IN ADDITION TO ANY YEARLY VISITS SPECIFIED WITH AN ENHANCED WARRANTY OR TECHNOLOGY SUPPORT PLAN.

PLEASE GO TO [WWW.LITRON.COM/SERVICES](http://WWW.LITRON.COM/SERVICES) FOR FURTHER INFORMATION.

## SOUTH BATTERY PARK

**NEW YORK, NY**

**CONCEPT DRAWING  
NOT FOR CONSTRUCTION**

Project Number:	2141396
Drawn By:	TM/CEH/ER
Drawing Revision:	3
Drawing Date:	07.09.21
Sheet:	1 OF 1



SECTION 265613 – LIGHTING POLES

Part 1 - GENERAL

1. Work of this section shall be governed by the Contract Documents. Provide materials, labor, equipment, and services necessary to furnish, deliver, and install all work of this section as shown on the drawings, as specified herein, and/or as required by job conditions.
2. Related Documents:
  - (A) Drawings and general provisions of the contract, including those in Division 01 general conditions, and Section 26 51 00 Architectural Lighting, apply to work of the section.
3. Description of Work:
  - (A) The work shall include but not be limited to the following:
    - i Complete shop fabrication.
    - ii Delivery to job site.
    - iii Installation at designated locations, and controls as noted
    - iv Cleaning and protection
4. Quality Assurance:
  - (A) Manufacturing standards:

Provide each pole as a complete unit produced by a single manufacturer including fittings, accessories, base and anchorage devices.
  - (B) Qualifications
    - i The Manufacturer shall be a specialty lighting firm who has been in the business of designing and manufacturing specialty lighting fixtures for not less than ten (10) years.
    - ii The Installer, if not the manufacturer, shall be a firm having trained personnel who have been in the business of installing specialty lighting for not less than seven (7) years and shall provide a full time field superintendent who shall be a representative of the installer during the installation and testing.
5. Work of this Section includes all labor, materials, equipment and services necessary to complete the work as shown on the drawings and/or specified herein, including but not necessarily limited to the following:
  - (A) Furnish and install a lighting fixture of the type indicated by letter at each location shown on the drawings.



- (B) All materials, accessories, and any other equipment necessary for the complete and proper installation of all lighting fixtures included in this Contract shall be furnished by the Contractor.
  - (C) Conformance: Fixtures shall be manufactured in strict accordance with the Contract Drawings and Specifications.
  - (D) Codes: Materials and installation shall be in accordance with the latest revision of the National Electrical Code and any applicable Federal, State, and local codes and regulations.
  - (E) All components and the completed assembly shall be manufactured in accordance with the appropriate and current requirements of a nationally recognized testing laboratory (NRTL) "Standards for Safety," and others as they may be applicable.
  - (F) Specifications and scale drawings are intended to convey the salient features, function and character of the fixtures only, and do not undertake to illustrate or set forth every item or detail necessary for the work.
  - (G) Minor details, not usually indicated on the drawings nor specified, but that are necessary for the proper execution and completion of the fixtures, shall be included, the same as if they were herein specified or indicated on the drawings.
  - (H) Omissions: The Owner shall not be held responsible for the omission or absence of any detail, construction feature, etc. which may be required in the production of the fixtures. The responsibility of accurately fabricating the fixtures to the fulfillment of this specification rests with the Contractor.
6. Design Criteria:
- (A) Provide pole(s) and installation constructed to withstand 98 mph-wind velocity (minimum.)
  - (B) When catenary suspension system is included in the design, the full assembly including but not limited to poles, suspension, all points of attachment, and the fixtures shall be designed to withstand 98 mph-wind velocity (minimum.)
  - (C) Pipe wall thickness shall be sized as required for pole type, height and site-specific installation conditions.
7. Submittals:
- (A) Product Data submittal for each type of pole and pole components specified to include:
    - i Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
    - ii Details of attaching luminaires and accessories.
    - iii EPA, for use by others, in verification of foundation detail, and installation in site-specific wind conditions.
    - iv Installation and maintenance instructions



- v Warranty: as specified in this section.
  - vi Submit shop drawings, of poles and bases, including connections to structure, general layout, jointing, and complete anchoring and supporting systems, with all pertinent dimensional information in a clear and concise manner.
8. Delivery, Storage and Handling:
- (A) All poles to be shipped to site in one piece.
  - (B) Spiral-wrap each pole with heavy kraft paper and pack in hard fiber cardboard tubing prior to shipment.
  - (C) Deliver pole(s) complete with all accessories and installation instructions clearly identified, and store unwrapped and protected from weather, and moisture.
9. Warranty:
- (A) Warranties stated in this Article are not less than remedies available to Owner under prevailing local laws. Coordinate with Division 01 Section "Product Requirements."
  - (B) Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.
  - (C) Warranty Period for Metal Corrosion: Five years from date of Substantial Completion.
  - (D) Warranty Period for Color Retention: Five years from date of Substantial Completion.

Part 2 - PRODUCTS:

1. Manufacturers:

Subject to compliance with requirements, provide products of the following manufacturer.

(A) Tag "TA"

Sentry Electric LLC - 185 Buffalo Avenue, Freeport, New York 11520-4707  
Tel: 516.379.4660

(B) Tag "TB, TH"

"HEI Technology International GmbH HG Wien, FN 293107s, Ameisgasse 65  
1140 Wien Austria  
Tel: Tel: +43/1/912 13 51-0

(C) Tag "TL" Pole-Tech Co., Inc. - East Setauket, New York 11733

Tel.: 800.633.6733 / 631.689.5525

(D) Or Approved Equal

2. Construction:

(A) All materials, accessories, and other related fixture parts shall be new and free from defects which in any manner may impair their character, appearance, strength, durability and function, and be effectively protected from any damage or injury from the time of fabrication to the time of delivery and until final acceptance of the work.

(B) Tag “TA” (NYC standard type B pole)

Historical DOT (New York Department of Transportation) approved light pole for the support of NYC/DOT type B Luminaire.

i Pole

(i) Pole body is to match existing light poles on site.

(ii) Construction shall be high-strength thick-walled cast iron, in conformance with A.S.T.M. A48, Class 30 cast iron.

(iii) Two (2) Access doors in the base and one (1) hinged access door in the pedestal shall be provided

(iv) All hardware shall be stainless steel.

(v) A grounding lug shall be provided inside one access door.

ii Dimensions:

Luminaire mounting height at 10' and 7', per specification

Base diameter shall have a 18-1/2".

iii Luminaire Mounting:

(i) Luminaire shall be tenon mounted. Provide 3" diameter by 3" tall tenon with undercut. Tenon shall be an integral part of the pole and be provided for post top mounting of luminaire.

iv Installation:

(i) See drawing for specific details

(ii) The lighting pole shall be provided with (4) 3/4" x 24" long "L-type" anchor bolts. Each anchor bolt shall be supplied assembled with (2) nuts, (2) flat washers and (1) splitlock washer. The pole shall have a 12" bolt circle and requires a 3" anchor bolt projection.

(iii) All anchorage hardware shall be fully galvanized.

(C) Tag “TB / TH” Custom Solar Energy Pole:

Solar energy pole, maintenance-free with cylindrical vertically integrated PV element, controlled with smart microcontroller based self-learning algorithm and hybrid solar/ battery / grid supply. Electronics shall be integrated inside the pole. Pole mounted lighting fixtures, security equipment, and other systems to be determined during submittal, and to be provided by others.

i Pole:

- (i) Hot-dip galvanized 12 m steel pole with flange plate
- (ii) Outer diameter Ø 220 mm
- (iii) Includes compartments for CCTV, speaker, WiFi and fixation for 6 luminaires acc. to proposed design
- (iv) Includes foundation/flange plate cover
- (v) Corrosion class: C4
- (vi) Wind class acc. to EN40: 45 m/s (or US equivalent standard)

ii Dimensions:

- (i) Refer to fixture submittal and product data sheets for specifics.

iii PV element:

- (i) Shape: cylindrically shaped PV element
- (ii) Front cover material: highly translucent and abrasion resistive borosilicate glass 3.3
- (iii) Technology: high-efficiency mono-crystalline silicon solar cells
- (iv) Number of solar cells: 48 pcs (4 strings x 12 pcs / string)
- (v) Nominal power of solar cells  $\geq 267$  Wp
- (vi) IP rating: IP66
- (vii) Dimensions: L2,000 x Ø220 mm

iv Battery:

- (i) VRLA or LiFePO4 battery
- (ii) Voltage 24 V, compatible with charge controller
- (iii) Capacity should be calculated according to load, and calculation to prove 3 days autonomy
- (iv) Location: installed in an earth pit next to the pole

v Power control:

- (i) Integrated highly-efficient photovoltaics MPP tracker, battery charger
- (ii) Autonomic day-night detection via the photovoltaic module
- (iii) Self-learning algorithm to ensure energy balance

- (iv) Automatic light level calculation with automatic dimming function for bad weather conditions based on calculated night length and available energy in battery
- (v) Push button for testing with LED feedback
- (vi) Enclosure material: Aluminum
- (vii) Location: integrated inside the pole
- (viii) Safety IEC 61347
- (ix) EMC IEC 55015; IEC 61547
- (x) RoHS 2011/65/EU
- (xi) Protection: reverse polarity, overtemperature, surge protection

vi Hybrid box:

- (i) Grid AC-power back-up
- (ii) Output DC voltage 24 V
- (iii) Input AC voltage range 90-264 VAC
- (iv) Frequency range 47-63 Hz
- (v) IP rating: IP66 or IP67

(D) Tag “TL” Catenary Pole Type

Ground Set (direct burial) mounted stainless steel poles with points for attachment of catenary lighting suspension, pole mounted lighting fixtures, security equipment, and other systems to be determined during submittal, and to be provided by others.

i Material:

- (i) Stainless steel type 316 alloy per ASTM A312.

ii Profile and dimensions:

Tapered poles; uniform straight-line, rate of taper 1" every 7.14 feet.

Length: 18'-3" exposed x 22'-3" overall length.

Butt : 6.625"

Top: 3.625"

Wall: .375"

iii Fittings:

- (i) “D” Plate suspension cable wire attachment with minimum size to be confirmed by manufacturer and reviewed by structural engineer.
- (ii) Access Door – 4" x 6" (confirm driver size) to be located at 20" above finished grade. Height and orientation to be verified during submittal.

- (iii) Driver Mounting Plate – welded to inside pole shaft.
    - (iv) Other appendages for attachment of components to be provided by others (to be determined during submittal.)
  - iv Mounting Classifications:
    - (i) Provide manufacturers standard base system for ground set (direct burial) pole
- 3. Workmanship:
  - (A) Fabricate all joints and seams to be inconspicuous. Grind all exposed welds smooth, and finish to match pole shaft.
- 4. Corrosion Prevention
  - (A) Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
  - (B) Steel Conduits: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.
- 5. Finish
  - (A) General: Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.
  - (B) Painted Surfaces shall be synthetic enamel, with acrylic, alkyd, epoxy, polyester, or polyurethane base, light stabilized, baked on at 350° Fahrenheit minimum, catalytically or photochemically polymerized after application.
  - (C) Selection: Unless otherwise noted, finishes shall be as selected by the Architect.
  - (D) Tag "TA"
    - The pole shall be supplied prime painted with red oxide primer (per NYC/DOT specifications).
  - (E) Tag "TB / TH"
    - Shaft to have paint / powder coated directional textured metallic satin finish (to match AISI #4); provide sample for review and approval.
  - (F) Tag "TL"
    - i Inside coat to prevent corrosion from in-ground dampness and soil minerals.
    - ii Provide fine, directional, medium satin AISI #4 finish; provide sample for review and approval.

### Part 3 - EXECUTION

#### 1. Installation:

- (A) Install all pole(s), base assemblies, and fittings in compliance with approved shop drawings and manufacturer's instructions.
  - (B) Installation shall be done by a crew experienced in this type of pole installation.
  - (C) Provide proper lightning ground for each pole.
2. Adjustments
- (A) Tag "TB / TH"
    - i Check and adjust all installed fittings, components, and sequence of operations for proper performance
  - (B) Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.
  - (C) Inspection
    - i Inspect all installed components at all poles to be stable, secure, plumb and properly oriented, and to be fully functional as designed.
    - ii "Touch-up" any damages to the surface finishes.
    - iii Assure all components are free of any visual or functional damage; replace as necessary
3. Cleanup
- (A) At the time of final acceptance by the Owner, all components shall have been thoroughly cleaned with materials and methods recommended by the manufacturers, all broken parts shall have been replaced, and all lamps shall be operative.
4. Maintenance
- (A) At the time of final acceptance by the Owner, all lighting fixtures shall have been thoroughly cleaned with materials and methods recommended by the manufacturers, all broken parts shall have been replaced, and all lamps shall be operative.
  - (B) Provide to the owner:
    - i 1. Tools required.
    - ii 2. Types of cleaners to be used.
    - iii 3. Replacement parts identification lists.
    - iv 4. Final, as built shop drawings.
5. Attic Stock
- (A) Tag "TB /TH/ TL" (only)

The Contractor shall be responsible for ordering an additional 10% of all electrical components (including LED modules when field replaceable, drivers and power supplies, control interfaces) for Owner's stock.

**ATTACHMENT #4**  
**REVISED LANDSCAPE SPECIFICATION**  
***055301 – Metal Gratings for Park Areas***

*[ATTACHED]*

## SECTION 055301 – METAL GRATINGS FOR PIER A INLET WALKWAY

### PART 1 - GENERAL

#### 1.01 RELATED DOCUMENTS

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

#### 1.02 SUMMARY

- A. Section Includes:

- 1. Stainless steel metal bar gratings at Pier A inlet walkway.
  - 2. Anti-slip surfacing.
  - 3. Slip resistance testing.

- B. Related Requirements:

- 1. Section 018113 "Sustainability Requirements" for documentation of recycled material content of metal grating materials.
  - 2. Section 051200 "Structural Steel" for additional requirements for steel framing and supports for metal gratings.
  - 3. Section 055010 "Miscellaneous Metals" for additional requirements for steel framing and supports for metal gratings.
  - 4. Section 055214.4 "Park Area Railings and Guardrails" for handrails and guardrails attached to the perimeter framing of metal grating surfacing areas.

#### 1.03 PERFORMANCE REQUIREMENTS

- A. Structural Performance of Gratings: Provide gratings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

- 1. Walkways and Elevated Platforms: Uniform load of 100 psf or concentrated load of 300 lbf, whichever produces the greater stress.
  - 2. Limit deflection to L/240 or 1/4 inch, whichever is less.

#### 1.04 REFERENCE STANDARDS

- A. Unless more restrictive criteria or differing requirements are explicitly stated in the Specifications, or mandated by governing codes or regulations, the recommendations,



suggestions, and requirements described in the referenced standards shall be deemed mandatory and applicable to the Work.

- B. The latest edition, as of the date of the executed construction contract, of referenced standards listed below applies to this contract.
  - 1. American Society for Testing Materials (ASTM)
    - a. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.
    - b. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
    - c. ASTM C 633 - Adhesion or Cohesive Strength of Flame-Sprayed Coatings.
    - d. ASTM E 140 - Hardness Conversion Tables for Metals.
    - e. ASTM E303 - Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester.
    - f. ASTM E 384 - Microhardness of Materials.
    - g. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
    - h. ASTM F594 - Standard Specification for Stainless Steel Nuts.
  - 2. American Welding Society (AWS)
    - a. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

#### 1.05 ACTION SUBMITTALS

- A. Product Data:
  - 1. Grating
  - 2. Anti-Slip Surfacing.
- B. Sustainable Design Submittals:
  - 1. Certificates indicating recycled material content for stainless steel materials.
- C. Slip Resistance Evaluation: Test Reports completed in a laboratory prior to fabrication and test reports completed on site after completion of installation.
- D. Shop Drawings: Include plans, elevations, sections, details, attachments, and attachments to other work.
  - 1. Coordinate shop drawings with shop drawing of metal grating support members, edging and attachment of guardrails.
- E. Samples for Initial Selection:
  - 1. Grating: Provide a 12"x24" sample of the grating of the indicated grating member sizing with anti-slip surfacing. Include laboratory test report of slip resistance.

## 1.06 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
  - 1. Grating Manufacturer.
  - 2. Anti-Slip Surfacing Manufacturer.
  - 3. Installer
  - 4. Testing Lab.
- B. Welding certificates.
- C. Mill Certificates: Signed by manufacturers of stainless steel products, certifying that products furnished comply with requirements.

## 1.07 QUALITY ASSURANCE

- A. Qualifications:
  - 1. Grating Manufacturer: A manufacturer with a minimum of five years of experience producing gratings of similar materials and dimensions.
  - 2. Anti-Slip Surfacing Manufacturer: A manufacturer with a minimum of five years of experience producing slip resistant surfacing on metal panels.
  - 3. Installer: An installer with a minimum of five years of experience installing similar grating systems.
  - 4. Testing Laboratory: A third-party, independent ASTM certified testing laboratory not owned or operated by the stone material supplier, contractor or installing contractor.
- B. Welding: Qualify procedures and personnel according to the following:
  - 1. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."
- C. Source Restrictions: Obtain gratings and slip resistant surfacing each from a single manufacturer.
- D. Slip Resistance Evaluation: Metal grating expected to be walked on when wet shall be tested in accordance with ASTM E303 to meet a minimum British Pendulum Number (BPN) of 45.
  - 1. Testing shall be performed on metal grating prepare with non-slip surface in the following locations:
    - a. Laboratory:
      - 1) Test results shall be submitted during the submittal process for material approval.
      - 2) Testing shall be performed by testing laboratory. Reports shall Include identification of the finished samples and test results. Product literature will not be accepted. The cost of testing and reporting shall be paid for by the Contractor.

b. Field:

- 1) At completion of the work, test at least three separate grating unit locations. Include identification of the materials, areas tested with photographs and results.
- 2) The cost of testing for Field testing and any necessary retesting and reporting shall be paid for by the Contractor.

E. Pre-installation Conference: Conduct conference at Project site.

## 1.08 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of support framing, bulkhead walls and other construction contiguous with gratings by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating gratings without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
2. Provide allowance for trimming and fitting at site.
3. Field welding of metal grating materials is not permitted.

## 1.09 COORDINATION

A. Coordinate installation of anchorages for gratings, grating frames, handrails, guardrails and supports. Furnish setting drawings, templates, and directions for installing anchorages. Deliver such items to Project site in time for installation.

B. Coordinate design of grating closure and kick plates with handrails and guard rails.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

A. Subject to meeting the requirements, metal grating materials are available from the following manufacturers:

1. Brown Campbell
2. Nucor Grating
3. AMICO Grating
4. Approved Equal

## 2.02 STAINLESS STEEL GRATING

- A. Recycled content for stainless steel materials: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 20 percent.
- B. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
  - 1. Stainless Steel Sheet, Strip, and Plate: ASTM A240/A240M or ASTM A666, Type 316L.
  - 2. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 316L.
- C. Metal Bar Grating Configuration:
  - 1. Bearing Bar Spacing: 7/16”.
  - 2. Bearing Bar Depth: 2 1/4”.
  - 3. Bearing Bar Thickness: 3/16”.
  - 4. Crossbar Spacing: 4”.
  - 5. Maximum Opening between Bearing Bars: 1/4” (ADA compliant and heel proof)
  - 6. Grating Style: Swaged locked.

## 2.03 FASTENERS

- A. General: Unless otherwise indicated, provide Type 316 stainless steel fasteners for exterior use.
- B. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593 (ASTM F738M); with hex nuts, ASTM F594 (ASTM F836M); and, where indicated, flat washers; Alloy Group 2 (A4).
- C. Furnish threaded bolts with nuts and washers, self-drilling fasteners with washers, or stainless steel flange clamps with stainless steel bolt for securing grating to framing supports.

## 2.04 FABRICATION

- A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

- C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.
- D. Fit exposed connections accurately together to form hairline joints.
- E. Welding: Comply with AWS recommendations and the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
- F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.

## 2.05 STAINLESS STEEL FINISHES

- A. Finish: Commercially cleaned.
  - 1. Finish gratings after grating panels are assembled.

## 2.06 SLIP RESISTANT SURFACE

- A. Basis of Design for Slip Resistant Grating: SlipNOT® Metal Safety Flooring, Division of W.S. Molnar Company, 2545 Beaufait Street, Detroit, Michigan 48207, (800) 754-7668.
- B. Stainless Steel Surface on Stainless Steel Substrate: Abrasive material metallically bonded to stainless steel walking surface.
  - 1. Type: Anti-slip, non-gritted, stainless steel surface on stainless steel substrate.
  - 2. Surface Texture: Grade 2, Medium.
  - 3. Surface: Anti-slip stainless steel surface consisting of a random hatch matrix.
  - 4. Surface Hardness, Rockwell C Scale, ASTM E 140 and E 384: Minimum of 55.
  - 5. Bond Strength, Surface to Substrate, ASTM C 633: Minimum of 4,000 psi.
  - 6. Coefficient of Friction, Anti-Slip Surface: Minimum of 0.6.
  - 7. UL Listed: Slip-resistant.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level metal framing, adjacent pavement finished grade, mounting

surfaces, installation tolerances, and other conditions affecting performance of the Work.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION, GENERAL

- A. Install metal grating in accordance with manufacturer's writing instructions and the approved shop drawings.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
- C. Fit exposed connections accurately together to form hairline joints.
- D. Metal grating shall be mechanically fastened in place. Do not field weld metal gratings.

### 3.03 INSTALLING METAL BAR GRATINGS

- A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.
- B. Attach grating units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.
- C. Attach units to kick plates and supporting members by mechanical methods.
- D. Isolate dissimilar metals to prevent galvanic corrosion.

### 3.04 INSTALLATION TOLERANCES

- A. Surface Tolerance: Do not exceed 1/16-inch unit-to-unit offset from flush (lippage) or 1/8 inch in 10 feet from level, or indicated slope, for finished surface of grating.
- B. Lines and Locations: For location and alignment of units and edging or toe plates in plan, do not vary from straight by more than plus or minus 1/4 inch.

3.05 POST-INSTALLATION TESTING

- A. Complete post-installation slip resistance testing in this location as indicated in Quality Assurance Article of this specification in locations as directed by the Engineer and Landscape Architect.
- B. Submit testing results.

3.06 ADJUSTING AND CLEANING

- A. Adjust grating units to align between rows and edging conditions and to meet indicated tolerances.
- B. Clean grating and edging units to remove stains and scuff marks to match commercially cleaned finish as shown on the approved grating sample.
- C. Remove and legally dispose off-site excess materials and packaging.

END OF SECTION 055301