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DSA Project A#04-109129 / File 30-C5

ADDENDUM A

TO THE CONTRACT DOCUMENTS FOR:

JAMES B. UTT LEARNING RESOURCE CENTER
SOUTH ORANGE COUNTY COMMUNITY COLLEGE
DISTRICT / SADDLEBACK COLLEGE
28000 Marguerite Parkway
Mission Viejo, California 92692.

February 25, 2010

NOTICE TO BIDDERS:

This Addendum forms a part of the Contract and modifies the original bid documents as approved by The Division of the State Architect (DSA) on May 7, 2008. It is intended that all work affected by the following modifications shall conform to related provisions and general conditions of the Contract of the original construction documents. Modify the following items wherever appearing in any drawings or sections of the specifications. Acknowledge receipt of all Addenda by signing in the space provided on the Bid Form. Failure to execute acknowledgements may be subject to bidder disqualification.

GENERAL:

- A. All plans and specifications remain unchanged except sections or parts of sections added to, revised, deleted or clarified by this Addendum.
- B. This Addendum shall be considered part of the Contract Documents for the above-mentioned project as though it had been issued at the same time and shall be incorporated integrally herewith. Where provisions of the following supplementary data differ from those of the original Contract Documents, this Addendum shall govern and take precedence.
- C. Bidders are hereby notified that they shall make any necessary adjustments in their Bids on account of this Addendum. It will be construed that each Bidder's Proposal is submitted with full knowledge of all modifications and supplemental data specified herein.

CHANGES TO SPECIFICATIONS:

1. Builders Risk Insurance: Bidder shall provide Builders Risk Insurance for the cost of construction amount, which is projected by estimate at this time to be between \$16-17million dollars.
2. Prequalification of Bidders: Delete page 23 Prequalification Rating Questionnaire and replace with revised, page 23 Prequalification Rating Questionnaire, dated 2/25/10 (attached).
3. Specification Section 01230:
 - a. Delete this Specification Section. There will be no Alternates.
 - b. Provide the re-slurry and re-stripping of Parking Lot #10 in the Base Bid as opposed to adding it as and Add Alternate.
 - c. Remainder of Work shall be provided as described in Drawings and Specifications.
4. Specification Section 02810 - Landscape Irrigation System: Paragraph 1.03 Quality Assurance and Requirements: The new irrigation system shall comply with the minimum requirements of the Moulton Niguel Water District - Irrigation Schedule for Water Supply Response Level 2, for residential and commercial watering.
5. Specification Section 02900 – Landscape Planting:
 - a. Paragraphs 3.21.A, 3.22.A.5, & 3.22.A.6: Delete "60-day maintenance period" and replace with "90-day maintenance period".
 - b. Paragraph 3.21.H: Delete "60 calendar days" and replace with "90 calendar days".
6. Specification Section 07410 - Manufactured Metal Roofing Panels,
 - a. Paragraph 1.2.A.1: add "etc" after curbs to include any additional items that may be on the roof but not listed in this section.
 - b. Paragraph 1.2, A.3: at the end of the paragraph add the following phrase: "Ponding water shall be terms for rejection".
 1. "Ponding" shall be defined as an accumulation of standing water on the roof, due to inadequate drainage/flat spot(s), for more 4-hours.
 - c. Paragraphs 3.2.G and 3.3.B: Delete "3/8:12 slope" and replace with "1/4:12 slope".
7. Specification Section 16491 - Fuses is hereby incorporated into the Contract Documents.
8. Specification Section 16511 - Interior Lighting is hereby incorporated into the Contract Documents.
9. Specification Section 16521 - Exterior Lighting is hereby incorporated into the Contract Documents.

10. Specification Section 16570 - Dimming Controls is hereby incorporated into the Contract Documents.
11. Specification Section 16715 - Voice and Data Communication Cabling is hereby incorporated into the Contract Documents.
12. Specification Section 16717 - Communications Horizontal Cabling is hereby incorporated into the Contract Documents.

REVISIONS TO DRAWINGS:

1. Drawing A-2.10: Renovation Keynote 2.35 - Concrete splash block shall be placed over a 60 mil PVC sheet.
2. Drawing A-2.10: The minimum slope, anywhere on the roof, shall be 1/4:12.
3. Drawing A-6.04, Detail 11: Provide a self-adhering waterproofing layer, installed underneath the existing 22 gauge, horizontal flashing. Extend waterproofing layer up, underneath the plaster & flashing, a minimum of 8 inches.
4. Drawing A-10.10, Detail 3: Delete reference to "SBS modified bituminous flashing" and replace with "manufactured metal roofing flashing".

END OF ADDENDUM A

PREQUALIFICATION RATING QUESTIONNAIRE

TOTAL POINTS: _____

CONFIDENTIAL
PRIVILEGED
INFORMATION

In order to Pre-qualify to bid on the Project, a Contractor must meet the minimum criteria for each of the following four (4) categories as set forth herein:

- Part I: Essential Requirements;
- Part II: Financial Capacity;
- Part III: Performance/Experience; and
- Part IV: Safety.

PART I. ESSENTIAL REQUIREMENTS.

Contractor is disqualified if the answer to any of questions 1 through 6, and 11 in this section is "No" or the answer to any of questions 7 through 10 in this section is "Yes."

1. Contractor possesses a valid and current California Contractor's license for the Project.
_____ Yes _____ No
2. Contractor has a liability insurance policy with a policy limit of at least \$2,000,000 per occurrence and \$2,000,000 aggregate or has attached a letter from their insurer that such policy limits will be secured in the event that the Bidder is awarded the project for which it submits a bid.
_____ Yes _____ No
3. Contractor has a current workers' compensation insurance policy as required by the Labor Code or is legally self-insured pursuant to Labor Code section 3700 et. seq.
_____ Yes _____ No _____ Contractor is exempt from this requirement, because it has no employees.
4. Have you attached your latest copy of an audited or reviewed financial statement with accompanying notes and supplemental information or completed the attached form of Financial Statement?
_____ Yes _____ No
5. Have you attached a letter from an admitted surety insurer (approved by the California Department of Insurance, NOT by your agent or broker) authorized to issue bonds in the State of California, which states your current available bonding capacity?
_____ Yes _____ No
6. Have you completed within the last 5 years, two or more public works projects of similar nature each with a contract sum of at least 80% of the engineer's estimated cost?
_____ Yes _____ No

SECTION 16491 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Cartridge fuses rated 600 V and less for use in switches and controllers.
 - 2. Spare-fuse cabinets.

1.3 SUBMITTALS

- A. Product Data: Include the following for each fuse type indicated:
 - 1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
- B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NEMA FU 1.
- D. Comply with NFPA 70.

1.5 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Bussman, Inc.
 - 2. Eagle Electric Mfg. Co., Inc.; Cooper Industries, Inc.
 - 3. Ferraz Shawmut, Inc.
 - 4. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Motor Branch Circuits: Class RK1, time delay.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
 - B. Install spare-fuse cabinet(s).
-

3.4 IDENTIFICATION

- A. Install labels indicating fuse replacement information on inside door of each fused switch.

END OF SECTION 16491

SECTION 16511 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Interior lighting fixtures, lamps, and ballasts.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.
5. Retrofit kits for fluorescent lighting fixtures.

- B. Related Sections include the following:

1. Division 16 Section 16845 for manual or programmable control systems with low-voltage control wiring or data communication circuits.
2. Division 16 Section 16410 for manual wall-box dimmers for incandescent lamps.
3. Division 16 Section 16145 for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
4. Division 16 Section 16570 for architectural dimming systems.

1.3 DEFINITIONS

- A. BF: Ballast factor.
- B. CRI: Color-rendering index.
- C. CU: Coefficient of utilization.
- D. HID: High-intensity discharge.
- E. LER: Luminaire efficacy rating.
- F. Luminaire: Complete lighting fixture, including ballast housing if provided.
- G. RCR: Room cavity ratio.

1.4 SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
1. Physical description of lighting fixture including dimensions.
 2. Emergency lighting units including battery and charger.
 3. Ballast.
 4. Energy-efficiency data.
 5. Life, output, and energy-efficiency data for lamps.
 6. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
 - a. For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by the manufacturer.
- B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.
1. Wiring Diagrams: Power and control wiring.
- C. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.
- D. Qualification Data: For agencies providing photometric data for lighting fixtures.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
- G. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 WARRANTY

- A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Emergency Lighting Unit Batteries: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.
2. Warranty Period for Emergency Fluorescent Ballast and Self-Powered Exit Sign Batteries: Seven years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

- B. Special Warranty for Ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Electronic Ballasts: Five years from date of Substantial Completion.
2. Warranty Period for Electromagnetic Ballasts: Three years from date of Substantial Completion.

- C. Special Warranty for T5 and T8 Fluorescent Lamps: Manufacturer's standard form, made out to Owner and signed by lamp manufacturer agreeing to replace lamps that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In Interior Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.
- C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
- D. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.
- E. Metal Parts: Free of burrs and sharp corners and edges.
- F. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- H. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
 - 4. Laminated Silver Metallized Film: 90 percent.
- I. Plastic Diffusers, Covers, and Globes:
 - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least 0.125 inch minimum unless different thickness is indicated.
 - b. UV stabilized.
 - 2. Glass: Annealed crystal glass, unless otherwise indicated.
- J. Electromagnetic-Interference Filters: Factory installed to suppress conducted electromagnetic-interference as required by MIL-STD-461E. Fabricate lighting fixtures with one filter on each ballast indicated to require a filter.

2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

- A. Electronic Ballasts: Comply with ANSI C82.11; instant-start type, unless otherwise indicated, and designed for type and quantity of lamps served. Ballasts shall be designed for full light output unless dimmer or bi-level control is indicated.

1. Sound Rating: A.
 2. Total Harmonic Distortion Rating: Less than 10 percent.
 3. Transient Voltage Protection: IEEE C62.41, Category A or better.
 4. Operating Frequency: 20 kHz or higher.
 5. Lamp Current Crest Factor: 1.7 or less.
 6. BF: 0.85 or higher.
 7. Power Factor: 0.98 or higher.
- B. Electronic Programmed-Start Ballasts for T5 and T5HO Lamps: Comply with ANSI C82.11 and the following:
1. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
 2. Automatic lamp starting after lamp replacement.
 3. Sound Rating: A.
 4. Total Harmonic Distortion Rating: Less than 20 percent.
 5. Transient Voltage Protection: IEEE C62.41, Category A or better.
 6. Operating Frequency: 20 kHz or higher.
 7. Lamp Current Crest Factor: 1.7 or less.
 8. BF: 0.95 or higher, unless otherwise indicated.
 9. Power Factor: 0.98 or higher.
- C. Electromagnetic Ballasts: Comply with ANSI C82.1; energy saving, high-power factor, Class P, and having automatic-reset thermal protection.
1. Ballast Manufacturer Certification: Indicated by label.
- D. Single Ballasts for Multiple Lighting Fixtures: Factory-wired with ballast arrangements and bundled extension wiring to suit final installation conditions without modification or rewiring in the field.
- E. Ballasts for Low-Temperature Environments:
1. Temperatures 0 Deg F and Higher: Electronic or electromagnetic type rated for 0 deg F starting and operating temperature with indicated lamp types.
 2. Temperatures Minus 20 Deg F and Higher: Electromagnetic type designed for use with indicated lamp types.
- F. Ballasts for Low Electromagnetic-Interference Environments: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for consumer equipment.
- G. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.
1. Dimming Range: 100 to 5 percent of rated lamp lumens.
 2. Ballast Input Watts: Can be reduced to 20 percent of normal.
 3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.
- H. Ballasts for Bi-Level Controlled Lighting Fixtures: Electronic type.
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1. Operating Modes: Ballast circuit and leads provide for remote control of the light output of the associated lamp between high- and low-level and off.
 - a. High-Level Operation: 100 percent of rated lamp lumens.
 - b. Low-Level Operation: 50 percent of rated lamp lumens.
2. Ballast shall provide equal current to each lamp in each operating mode.
3. Compatibility: Certified by manufacturer for use with specific bi-level control system and lamp type indicated.

2.4 BALLASTS FOR COMPACT FLUORESCENT LAMPS

- A. Description: Electronic programmed rapid-start type, complying with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:
 1. Lamp end-of-life detection and shutdown circuit.
 2. Automatic lamp starting after lamp replacement.
 3. Sound Rating: A.
 4. Total Harmonic Distortion Rating: Less than 20 percent.
 5. Transient Voltage Protection: IEEE C62.41, Category A or better.
 6. Operating Frequency: 20 kHz or higher.
 7. Lamp Current Crest Factor: 1.7 or less.
 8. BF: 0.95 or higher, unless otherwise indicated.
 9. Power Factor: 0.98 or higher.
 10. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
 11. Ballast Case Temperature: 75 deg C, maximum.
- B. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.
 1. Dimming Range: 100 to 5 percent of rated lamp lumens.
 2. Ballast Input Watts: Can be reduced to 20 percent of normal.
 3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.

2.5 EMERGENCY FLUORESCENT POWER UNIT

- A. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast. Comply with UL 924.
 1. Emergency Connection: Operate 1 fluorescent lamp(s) continuously at an output of 1100 lumens each. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
 2. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
 - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.

- b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 3. Battery: Sealed, maintenance-free, nickel-cadmium type.
 4. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
 5. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
 6. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.
- B. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one or more fluorescent lamps, remote mounted from lighting fixture. Comply with UL 924.
1. Emergency Connection: Operate one fluorescent lamp continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
 2. Battery: Sealed, maintenance-free, nickel-cadmium type.
 3. Charger: Fully automatic, solid-state, constant-current type.
 4. Housing: NEMA 250, Type 1 enclosure.
 5. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 6. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 7. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
 8. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

2.6 BALLASTS FOR HID LAMPS

- A. Electromagnetic Ballast for Metal-Halide Lamps: Comply with ANSI C82.4 and UL 1029. Include the following features, unless otherwise indicated:
1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
 2. Minimum Starting Temperature: Minus 22 deg F for single-lamp ballasts.
 3. Normal Ambient Operating Temperature: 104 deg F.
 4. Open-circuit operation that will not reduce average life.
 5. Low-Noise Ballasts: Manufacturers' standard epoxy-encapsulated models designed to minimize audible fixture noise.
- B. Electronic Ballast for Metal-Halide Lamps: Include the following features unless otherwise indicated:

-
1. Lamp end-of-life detection and shutdown circuit.
 2. Sound Rating: A.
 3. Total Harmonic Distortion Rating: Less than 15 percent.
 4. Transient Voltage Protection: IEEE C62.41, Category A or better.
 5. Lamp Current Crest Factor: 1.5 or less.
 6. Power Factor: .90 or higher.
 7. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
 8. Protection: Class P thermal cutout.
 9. Retain subparagraph and associated subparagraphs below for bi-level ballasts.
 10. Bi-Level Dimming Ballast: Ballast circuit and leads provide for remote control of the light output of the associated fixture between high- and low-level and off.
 - a. High-Level Operation: 100 percent of rated lamp lumens.
 - b. Low-Level Operation: 50 percent of rated lamp lumens.
 - c. Compatibility: Certified by ballast manufacturer for use with specific bi-level control system and lamp type indicated. Certified by lamp manufacturer that ballast operating modes are free from negative effect on lamp life and color-rendering capability.
 11. Continuous Dimming Ballast: Dimming range shall be from 100 to 35 percent of rated lamp lumens without flicker.
 - a. Ballast Input Watts: Reduced to a maximum of 50 percent of normal at lowest dimming setting.
 - b. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated. Certified by lamp manufacturer that ballast operating modes are free from negative effect on lamp life and color-rendering capability.
- C. Auxiliary Instant-On Quartz System: Factory-installed feature automatically switches quartz lamp on when fixture is initially energized and when power outages occur. System automatically turns quartz lamp off when HID lamp reaches approximately 60 percent light output.
- D. High-Pressure Sodium Ballasts: Electromagnetic type, with solid-state igniter/starter. Igniter-starter shall have an average life in pulsing mode of 10,000 hours at an igniter/starter-case temperature of 90 deg C.
1. Instant-Restrike Device: Integral with ballast, or solid-state potted module, factory installed within fixture and compatible with lamps, ballasts, and mogul sockets up to 150 W.
 - a. Restrike Range: 105- to 130-V ac.
 - b. Maximum Voltage: 250-V peak or 150-V ac RMS.
 2. Minimum Starting Temperature: Minus 40 deg F.
 3. Open-circuit operation shall not reduce average lamp life.

2.7 EXIT SIGNS

- A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size. Exit signs shall be with white face & green letters.
- B. Internally Lighted Signs:
1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.
 2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
 - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
 - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 - f. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
 - g. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.
 3. Master/Remote Sign Configurations:
 - a. Master Unit: Comply with requirements above for self-powered exit signs, and provide additional capacity in LED power supply for power connection to remote unit.
 - b. Remote Unit: Comply with requirements above for self-powered exit signs, except omit power supply, battery and test features. Arrange to receive full power requirements from master unit. Connect for testing concurrently with master unit as a unified system.

2.8 EMERGENCY LIGHTING UNITS

- A. Description: Self-contained units complying with UL 924.
1. Battery: Sealed, maintenance-free, lead-acid type.
 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures.
7. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage.
8. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is announced by an integral audible alarm and flashing red LED.

2.9 FLUORESCENT LAMPS

- A. Low-Mercury Lamps: Comply with EPA's toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.
- B. T5 rapid-start lamps, rated 28 W maximum, nominal length of 45.2 inches, 2900 initial lumens (minimum), CRI 85 (minimum), color temperature 3000 K, and average rated life of 20,000 hours, unless otherwise indicated.
- C. T5HO rapid-start, high-output lamps, rated 54 W maximum, nominal length of 45.2 inches, 5000 initial lumens (minimum), CRI 85 (minimum), color temperature 4100 K, and average rated life of 20,000 hours, unless otherwise indicated.
- D. Compact Fluorescent Lamps: 4-Pin, CRI 80 (minimum), color temperature 3500 K, average rated life of 10,000 hours at 3 hours operation per start, and suitable for use with dimming ballasts, unless otherwise indicated.
 1. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).
 2. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
 3. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
 4. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).
 5. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).
 6. 55 W: T4, triple tube, rated 4300 initial lumens (minimum).

2.10 HID LAMPS

- A. High-Pressure Sodium Lamps: ANSI C78.42, CRI 21 (minimum), color temperature 1900 K, and average rated life of 24,000 hours, minimum.
- B. Metal-Halide Lamps: ANSI C78.1372, with a minimum CRI 65, and color temperature 4000 K.
- C. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and color temperature 4000 K.

- D. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80, and color temperature 4000 K.

2.11 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- B. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- C. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.
- D. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.
- E. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- F. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

2.12 RETROFIT KITS FOR FLUORESCENT LIGHTING FIXTURES

- A. Comply with UL 1598 listing requirements.
 - 1. Reflector Kit: UL 1598, Type I. Suitable for two- to four-lamp, surface-mounted or recessed lighting fixtures by improving reflectivity of fixture surfaces.
 - 2. Ballast and Lamp Change Kit: UL 1598, Type II. Suitable for changing existing ballast, lamps, and sockets.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- B. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.
 - 1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from lighting fixture corners.
 - 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
 - 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.

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4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- C. Suspended Lighting Fixture Support:
1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
- D. Adjust aimable lighting fixtures to provide required light intensities.
- E. Connect wiring according to Division 16 Section "Conductors and Cables."
- 3.2 FIELD QUALITY CONTROL
- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
 - 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.

END OF SECTION 16511

SECTION 16521 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Exterior luminaires with lamps and ballasts.
- B. Related Sections include the following:
 - 1. Division 16 Section "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.3 DEFINITIONS

- A. CRI: Color-rendering index.
- B. HID: High-intensity discharge.
- C. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.4 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

- A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-4.
- B. Live Load: Single load of 500 lbf, distributed as stated in AASHTO LTS-4.

1.5 SUBMITTALS

- A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
 - 2. Details of attaching luminaires and accessories.
 - 3. Details of installation and construction.
 - 4. Luminaire materials.

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5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.
 - a. For indicated luminaires, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
 - b. Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 6. Photoelectric relays.
 7. Ballasts, including energy-efficiency data.
 8. Lamps, including life, output, and energy-efficiency data.
 9. Materials, dimensions, and finishes of poles.
 10. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
 11. Anchor bolts for poles.
 12. Manufactured pole foundations.
- B. Shop Drawings:
1. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
 2. Design calculations, certified by a qualified professional engineer, indicating strength of screw foundations and soil conditions on which they are based.
 3. Wiring Diagrams: Power wiring.
- C. Samples for Verification: For products designated for sample submission in Exterior Lighting Device Schedule. Each sample shall include lamps and ballasts.
- D. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4 and that load imposed by luminaire has been included in design.
- E. Qualification Data: For agencies providing photometric data for lighting fixtures.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For luminaires to include in emergency, operation, and maintenance manuals.
- H. Warranty: Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7.

- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with IEEE C2, "National Electrical Safety Code."
- E. Comply with NFPA 70.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.
 - 1. Warranty Period for Luminaires: Five years from date of Substantial Completion.
 - 2. Warranty Period for Metal Corrosion: Five years from date of Substantial Completion.
 - 3. Warranty Period for Color Retention: Five years from date of Substantial Completion.
 - 4. Warranty Period for Lamps: Replace lamps and fuses that fail within 12 months from date of Substantial Completion; furnish replacement lamps and fuses that fail within the second 12 months from date of Substantial Completion.
 - 5. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than three years from date of Substantial Completion.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps: 1 of each type and rating installed. Furnish at least one of each type.
 - 2. Glass and Plastic Lenses, Covers, and Other Optical Parts 1 of each type and rating installed. Furnish at least one of each type.
 - 3. Ballasts 1 of each type and rating installed. Furnish at least one of each type.
 - 4. Globes and Guards: 1 of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

- B. In Exterior Lighting Device Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 LUMINAIRES, GENERAL REQUIREMENTS

- A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
- B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.
- G. Exposed Hardware Material: Stainless steel.
- H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.
- J. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
1. White Surfaces: 85 percent.
 2. Specular Surfaces: 83 percent.
 3. Diffusing Specular Surfaces: 75 percent.
- K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

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- M. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
 2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
 - a. Color: As selected from manufacturer's standard catalog of colors.
 - b. Color: Match Architect's sample of manufacturer's standard color.
 - c. Color: As selected by Architect from manufacturer's full range.
- N. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
 3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
 4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
 - a. Color: Light bronze.
- O. Ballast Characteristics:
1. Power Factor: 90 percent, minimum.
 2. Sound Rating A, except B for T12/HO ballasts.
 3. Total Harmonic Distortion Rating: Less than 20 percent.
 4. Electromagnetic Ballasts: Comply with ANSI C82.1, energy-saving, high power factor, Class P, automatic-reset thermal protection.
 5. Case Temperature for Compact Lamp Ballasts: 65 deg C, maximum.
 6. Transient-Voltage Protection: Comply with IEEE C62.41 Category A or better.
- P. Low-Temperature Lamp Capability: Rated for reliable starting and operation with ballast provided at temperatures minus 20 deg F and higher.
- Q. High-Pressure Sodium Ballasts: Electromagnetic type with solid-state igniter/starter and capable of open-circuit operation without reduction of average lamp life. Igniter/starter shall have an average life in pulsing mode of 10,000 hours at an igniter/starter-case temperature of 90 deg C.
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1. Instant-Restrike Device: Integral with ballast, or solid-state potted module, factory installed within fixture and compatible with lamps, ballasts, and mogul sockets up to 150 W.
 - a. Restrike Range: 105- to 130-V ac.
 - b. Maximum Voltage: 250-V peak or 150-V ac RMS.
2. Minimum Starting Temperature: Minus 40 deg F.

2.3 HID LAMPS

- A. High-Pressure Sodium Lamps: ANSI C78.42, CRI 21 (minimum), color temperature 1900 K, and average rated life of 24,000 hours, minimum.
 1. Dual-Arc Tube Lamp: Arranged so only one of two arc tubes is lighted at one time and, when power is restored after an outage, the cooler arc tube, with lower internal pressure, lights instantly, providing an immediate 8 to 15 percent of normal light output.

2.4 REQUIREMENTS FOR INDIVIDUAL EXTERIOR LIGHTING DEVICES

- A. Exterior Lighting Device Type "A":
 1. Basis-of-Design Product: Lithonia or a comparable product by one of the following Manufacturers:
 - a. Or equal.
 2. Voltage: 120-V ac.
 3. Nominal Dimensions: 10"H x 11.5"W x 8-15/16"D.
 4. Lamps: High Pressure Sodium.
 5. Ballast Types and Features: High Power Factor Ballast.
 6. Lens: clear UV, stabilized, polycarbonate.
 7. Reflector: One piece, die-formed, diffused aluminum.
 8. See Editing Instruction No. 8 in the Evaluations for discussion of ballast factor.
 9. Ballast Factor: 1
 10. See Editing Instruction No. 9 in the Evaluations for discussion of luminaire efficacy rating.
 11. Minimum Luminaire Efficacy Rating: 54.0%

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

- A. Install lamps in each luminaire.
- B. Fasten luminaire to indicated structural supports.

1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Adjust luminaires that require field adjustment or aiming.

3.2 CORROSION PREVENTION

- A. Steel Conduits: Comply with Division 16 Section "Raceways and Boxes." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.3 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.
- C. 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.

END OF SECTION 16521

SECTION 16570 - DIMMING CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Manual, modular dimming controls.
 - 2. Integrated, multipreset, modular dimming controls.
 - 3. Multichannel, remote-controlled dimmers.
 - 4. Remote-controlled dimming stations.
- B. Related Sections include the following:
 - 1. Section 16140 "Wiring Devices"
 - 2. Section 16145 "Lighting Control Devices"

1.2 SUBMITTALS

- A. Product Data: Include dimensions and data on features, components, and ratings for dimming controls. Include elevation views of front panels of control and indicating devices and control stations. Also include the following:
 - 1. List of ballasts and lamp combinations compatible with dimmer controls, by manufacturer and catalog number.
 - 2. Sound data, including results of operational tests of dimming controls.
 - 3. Operational documentation for software and firmware.
- B. Shop Drawings: Detail assemblies of standard components, custom assembled for specific application on Project. Indicate dimensions, weights, arrangement of components, and clearance and access requirements.
 - 1. Wiring Diagrams: Detail specific systems tailored to this Project and differentiate between manufacturer-installed and field-installed wiring.
- C. Manufacturer Certificates: Signed by manufacturers certifying that they comply with requirements.
- D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- E. Maintenance Data: For dimming controls to include in maintenance manuals specified in Division 1. Include software operating manuals.
- F. Warranties: warranties specified in this Section.

1.3 QUALITY ASSURANCE

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- A. Source Limitations: Obtain dimming controls from a single source with total responsibility for compatibility of lighting control system components specified in this Section.
 - B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, for their indicated use and installation conditions by a testing agency acceptable to authorities having jurisdiction.
 - C. Comply with 47 CFR 15, Subparts A and B, for Class A digital devices.
 - D. Comply with NFPA 70.

1.4 COORDINATION

- A. Coordinate features of devices specified in this Section with systems and components specified in other Sections to form an integrated system of compatible components. Match components and interconnections for optimum performance of specified functions. Include coordination with the following:
 - 1. Section "Lighting Control."

1.5 WARRANTY

- A. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of dimming controls that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Two years from date of Substantial Completion.
- C. Refer to section 01700 for information about the warranty format.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 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. Products: Subject to compliance with requirements, provide products by one of the following:
 - 1. Lutron Electronics Co., Inc.
 - 2. Strand Lighting.
 - 3. Electronic Theatre Controls, Inc
 - 4. Or equal.

2.2 GENERAL DIMMING DEVICE REQUIREMENTS

- A. Line-Voltage Surge Protection: Include in all 120-V solid-state equipment. Comply with UL 1449 and with ANSI C62.41 for Category A locations.

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- B. Compatibility: Dimming control components shall be compatible with other elements of interconnected lighting controls and with connected loads as to communication, signaling, and control functions.
 - C. Dimmers and Dimmer Modules: Comply with UL 508.
 - 1. Audible Noise and Radio-Frequency Interference Suppression: Solid-state dimmers shall operate smoothly over their operating ranges without audible lamp or dimmer noise or radio-frequency interference at any setting. Modules shall include integral or external filters to suppress audible noise and radio-frequency interference.
 - 2. Dimmer or Dimmer-Module Rating: As indicated, but not less than 125 percent of connected load.
 - D. Panic Switch: Include where indicated or required by authorities having jurisdiction. Switch operation overrides dimmer settings and restores lights on connected output circuits to full brightness regardless of settings.

2.3 MANUAL, MODULAR DIMMING CONTROLS

- A. Description: Factory-fabricated equipment providing one to four channels of manual dimming control. Integrate controls and dimmers for mounting in a two- or three-gang wall box under a single wall plate.
- B. Module Dimming Capability: Listed for control of type of lighting unit used.
 - 1. Fluorescent Dimmers, 120-V Circuits: Control lights smoothly over a minimum range of 100 to 20 percent of full brightness.
 - 2. Unit Rating: 1900 W, minimum; with each dimming channel rated 600 W, minimum.
 - 3. Wall-Plate Style and Finish: Coordinated with lighting controls Sections.

2.4 INTEGRATED, MULTIPRESET, MODULAR DIMMING CONTROLS

- A. Description: Microprocessor-based, solid-state controls.
 - 1. Operation: Automatically changes variable dimmer settings of different groups of lights (channels) simultaneously from one preset scene to another when a push button is operated.
 - 2. Each system includes a control panel and one to four dimmer-control modules. Panels and modules are integrally flush mounted in a single wall box.
- B. Control panel adjusts each dimmer channel setting for each scene and commands change from one preset scene to another. Control positions or displays at control panel indicate dimmer settings for each channel for each scene.
- C. Timed cross-fade action occurs when one preset scene is switched to another.

2.5 MULTICHANNEL, REMOTE-CONTROLLED DIMMERS

- A. Description: Microprocessor-based, solid-state controls and low-voltage control signals change dimmer settings of remote dimmer modules.

1. Operation: Dimmer modules change intensities of different groups of lights (channels) from one preset scene to another.
 2. System includes modular dimmer cabinets and separately mounted control panels.
- B. Control panels adjust dimmer channel settings for each scene and command change from one preset scene to another. Displays at control panel indicate dimmer settings for each channel for each scene. Panels are flush mounted with push button and display units and have finish colors as selected by the University's Representative..
- C. Change from one preset scene to another is accomplished by a timed cross-fade action, adjustable over a range of at least 1 to 240 seconds, and is separately programmable for each preset.
- D. Dimmer Cabinet: Factory wired and convection cooled without fans.
- E. Dimmer Modules: Plug-in type, automatically disconnected by an air-gap relay when switched off or set to minimum intensity. Units withstand power-line surges of 6000 V, 3000 A according to ANSI C62.41.
- F. Filtering of each dimmed circuit provides a minimum 350-microsecond current rise time at a 90-degree conduction angle at 50 percent rated dimmer capacity. At any load within rating, rate of current rise does not exceed 30 ma/microsecond, measured from 10 to 90 percent of load current waveform.
- G. System Power-Failure Memory Feature: Retain programming for a minimum of 90 days after power failure. When power is restored, return intensities of dimmed lights for each scene to levels set before failure.
- H. Remote signals from dimming control system turn system on and off and change from one preset scene to another.

2.6 LOW-VOLTAGE WIRING

- A. Digital and Multiplexed Signal Wire: Shielded, twisted-pair cable as specified Section 16740 "Telecommunication and Data Systems."
- B. Low-Voltage Control Cable: Multiple conductor, color-coded, No. 20 AWG copper, minimum.
1. Sheath: PVC, except in plenum-type spaces use sheath listed for plenums.
 2. Ordinary Switch Circuits: Three conductors, unless otherwise indicated.
 3. Switch Circuits with Pilot Lights or Locator Feature: Five conductors, unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install equipment level and plumb and according to manufacturer's written instructions.

- B. Mount control equipment according to manufacturer's written instructions and requirements in Section 16050 "Basic Electrical Materials and Methods."
- C. Mounting heights indicated are to bottom of unit for suspended items and to center of unit for wall-mounting items.

3.2 CONTROL WIRING INSTALLATION

- A. Install wiring as specified in Section 16123 "Building Wires and Cables".
- B. Wiring Method: Install all wiring in raceway as specified in Section 16110 "Raceways" and in Section 16130 "Raceway and Boxes."
- C. Bundle, train, and support wiring in enclosures.
- D. Ground equipment.
- E. Connections: 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.

3.3 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 16050 "Basic Electrical Materials and Methods."
- B. Identify components and power and control wiring according to Section 16195 "Electrical Identification."
- C. Label each system control module and each remote dimmer bank with a unique designation. Make designations on elevated components readable from floor.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Engage a factory-authorized service representative to test, adjust, and program dimming controls.
- B. Schedule visual and mechanical inspections and electrical tests with at least seven days' advance notice.
- C. Inspect control components for defects and physical damage, testing laboratory labeling, and nameplate compliance with the Contract Documents.
- D. Check tightness of electrical connections with torque wrench calibrated within previous six months. Use manufacturer's recommended torque values.
- E. Verify settings of photoelectric devices with photometer calibrated within previous six months.
- F. Electrical Tests: Use particular caution when testing devices containing solid-state components. Perform the following according to manufacturer's written instructions:

1. Continuity tests of circuits.
2. Operational Tests: Set and operate controls to demonstrate their functions and capabilities in a methodical sequence that cues and reproduces actual operating functions.
 - a. Include testing of dimming control equipment under conditions that simulate actual operational conditions. Record control settings, operations, cues, and functional observations.

G. Correct deficiencies, make necessary adjustments, and retest. Verify that specified requirements are met.

H. Test Labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.

I. Reports: Written reports of tests and observations. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments.

3.5 CLEANING

A. Cleaning: Clean equipment and devices internally and externally using methods and materials recommended by manufacturers, and repair damaged finishes.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train University's maintenance personnel as specified below:

1. Train University's maintenance personnel on troubleshooting, servicing, adjusting, and maintaining equipment and schedules. Provide a minimum of two four-hour sessions on separate days for training. Use both classroom training and hands-on exercises.
2. Training Aid: Use the approved final version of maintenance manuals as a training aid.
3. Schedule training with University's Representative, with at least seven days' advance notice.

3.7 ON-SITE ASSISTANCE

A. Occupancy Adjustments: Within one year of date of Substantial Completion, provide up to three Project site visits, when requested, to adjust light levels, make preset scene changes, and adjust controls to suit actual conditions.

END OF SECTION 16570

SECTION 16715 - VOICE AND DATA COMMUNICATION CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following items for wiring systems used as signal pathways for voice and high-speed data transmission:
 - 1. Mounting elements.
 - 2. Unshielded twisted-pair cabling.
 - 3. Fiber-optic cabling.
 - 4. Coaxial cable.
 - 5. Multiuser telecommunications outlet assemblies.
 - 6. Workstation outlets.
 - 7. Backboards.
 - 8. Identification products.

1.3 DEFINITIONS

- A. Backbone: A facility (e.g., pathway, cable, or conductors) between telecommunications rooms or floor distribution terminals, the entrance facilities, and the equipment rooms within or between buildings.
- B. BICSI: Building Industry Consulting Service International.
- C. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- D. EMI: Electromagnetic interference.
- E. Horizontal Cabling: Cabling between and including the telecommunications outlet/connector and the horizontal cross-connect. Also the cabling between and including the building automation system outlet or the first mechanical terminations on the horizontal connection point and the horizontal cross-connect.
- F. IDC: Insulation displacement connector.
- G. LAN: Local area network.
- H. RCDD: Registered Communications Distribution Designer.

- I. RMC: Rigid metallic conduit.
- J. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

- A. Product Data: For features, ratings, and performance of each component specified.
 - 1. For coaxial cable, include the following installation data for each type used:
 - a. Nominal OD.
 - b. Minimum bending radius.
 - c. Maximum pulling tension.
- B. Shop Drawings:
 - 1. Include dimensioned plan and elevation views of telecommunications equipment rooms, labeling each individual component. Show equipment rack assemblies, method of field assembly, workspace requirements, and access for cable connections.
 - 2. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 - 3. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
 - 4. Cabling Administration Drawings.
 - 5. Wiring diagrams to show typical wiring schematics including the following:
 - a. Workstation outlets, jacks, and jack assemblies.
 - b. Patch cords.
 - c. Patch panels.
 - d. Fiber-optic boxes.
 - e. Distribution racks.
 - f. Terminal racks.
- C. Manufacturer Seismic Qualification Certification: Submit certification that distribution racks, patch panels, and their components will withstand seismic forces defined in Division 16 Section "Electrical Supports and Seismic Restraints." Include the following:
 - 1. Basis for Certification: Base certification on the maximum number of components capable of being mounted in each rack type. Identify components on which certification is based. Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity of each rack-mounted component and of each assembled rack type, and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- D. Qualification Data: For Installer.
- E. Source quality-control test reports.
- F. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling installer must have on staff personnel certified by BICSI.
 - 1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field testing program development by an RCDD.
 - 2. Installation Supervision: Installation shall be under the direct supervision of a Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
- B. Source Limitations: Obtain all products except cables through one source from a single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NFPA 70, "National Electrical Code."

1.6 COORDINATION

- A. Coordinate layout and installation of voice and data communication cabling with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
 - 1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
 - 2. Record agreements reached in meetings and distribute to other participants.
 - 3. Adjust arrangements and locations of distribution frames and cross-connect and patch panels in equipment rooms and wiring closets to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Outlet Assemblies: One of each type for every 25 outlets shown on plans, but no fewer than one.
 - 2. Patch-Panel Units: One of each type.
 - 3. Connecting Blocks: One of each type.
 - 4. Device Plates: One of each type.

5. Multiuser Telecommunications Outlet Assemblies: One of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SYSTEM REQUIREMENTS

- A. Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections for optimum future performance.
- B. Expansion Capability: Unless otherwise indicated, provide spare fibers and conductor pairs in cables, positions in cross-connect and patch panels, and terminal strips to accommodate 20 percent future increase in the number of workstations shown on Drawings. This expansion requirement does not apply to horizontal cable from workstation outlet to first terminal board.

2.3 MOUNTING ELEMENTS

- A. Backboards: 3/4-inch, interior-grade, fire-retardant-treated plywood.
- B. Distribution Racks: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
1. Module Dimension: Width compatible with EIA 310 standard 19-inch panel mounting.
 2. Finish: Baked-polyester powder coat.
- C. Power Strips: For mounting in the rack, with 15-A, 120-V ac, NEMA WD 6, Configuration 15-15R 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles, number as indicated, but in no case fewer than 6, and including the following:
1. LED indicator lights for power and protection status.
 2. LED indicator lights for reverse polarity and open outlet ground.
 3. Circuit breaker and thermal fusing. Unit continues to supply power if protection is lost.
 4. Cord connected with 15-foot line cord.
 5. Rocker-type on-off switch, illuminated when in on position.
 6. Peak Single-Impulse Surge Current Rating: 26 kA per phase.
 7. Protection modes shall be line-to-neutral, line-to-ground, and neutral-to-ground. UL 1449 clamping voltage for all 3 modes shall be not more than 330 V.
 8. One RJ11/12C telephone line protector, suitable for modem connection. Maximum clamping voltage 220 peak on pins No. 3 and No. 4.

- D. Wall-Mounting Rack: Aluminum, hinged wall bracket with provisions for power strip mounting.
- E. Floor-Mounting Rack: Steel, freestanding, modular, with vertical and horizontal cable management channels, top and bottom cable troughs, and grounding lug.
- F. Cabinets: Steel, freestanding, modular, with removable and lockable side panels, front and rear doors, ventilation openings in rear door and top panel, and the following components:
 - 1. Provisions for a roof-mounted ventilation fan.
 - 2. Key all locks alike.

2.4 UNSHIELDED TWISTED-PAIR CABLING

A. Cable Manufacturers:

- 1. Avaya Inc.
- 2. Belden Inc.; Electronics Division.
- 3. General Cable Technologies Corporation.
- 4. Helix/HiTemp Cables, Inc.
- 5. Nordex/CDT, a Subsidiary of Cable Design Technologies.
- 6. Superior Essex; Superior Telecommunications Inc.
- 7. West Penn Wire/CDT; a division of Cable Design Technologies.

B. Terminal and Connector Component and Distribution Rack Manufacturers:

- 1. AMP; a Tyco International Ltd. Company.
- 2. Amphenol Corporation.
- 3. Avaya Inc.
- 4. Cooper Wiring Devices; a division of Cooper Industries, Inc.
- 5. Hubbell Premise Wiring.
- 6. Leviton Voice & Data Division.
- 7. Lucent Technologies; Global Service Provider.
- 8. Nordex/CDT; a Subsidiary of Cable Design Technologies.
- 9. Thomas & Betts Corporation.

C. 100-Ohm UTP: Comply with UL 444.

D. Backbone Copper Cable:

- 1. No. 24 AWG, 25 pair.
- 2. Comply with ICEA S-80-576 and TIA/EIA-568-B.2, Category 6.
- 3. NFPA 70, type CMR complying with UL 1666.
- 4. Cable Jacket Color: Gray.

E. Horizontal Copper Cable:

- 1. No. 24 AWG, 100 ohm, four pair.
- 2. Comply with TIA/EIA-568-B.2, Category 6.
- 3. NFPA 70, types CMG and CMP.
- 4. Cable Jacket Color: Blue.

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- F. Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, using modules designed for punch-down caps or tools.
 - 1. IDC Terminal Block Modules: Integral with connector bodies, including plugs and jacks where indicated.
 - 2. IDC Connecting Hardware: Consistent throughout Project.
 - G. Cross-Connect Panel: Modular array of IDC terminal blocks arranged to terminate building cables and permit interconnection between cables.
 - 1. Number of Terminals per Field: One for each conductor in assigned cables plus 25 percent spare.
 - H. Patch Panel: Comply with TIA/EIA-568-B.2, meeting or exceeding cable performance. Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
 - 1. Number of Jacks per Field: One for each four-pair conductor group of indicated cables, plus spares and blank positions adequate to satisfy specified expansion criteria.
 - I. Jacks and Jack Assemblies: Modular, color-coded, RJ-45 receptacle units with integral IDC-type terminals. Use keyed jacks for data service.
 - J. Patch Cords: Factory-made, four-pair cables in 48-inch lengths; terminated with RJ-45 plug at each end. Use keyed plugs for data service.

2.5 FIBER-OPTIC CABLING

- A. Cable, Terminal, and Connector Product Manufacturers:
 - 1. Avaya Inc.
 - 2. Berk-Tek; an Alcatel Company.
 - 3. Chromatic Technologies; a Draka USA Company.
 - 4. General Cable Technologies Corporation.
 - 5. Mohawk/CDT; a division of Cable Design Technologies.
 - 6. Nordex/CDT; a Subsidiary of Cable Design Technologies.
 - 7. Optical Cable Corporation.
 - 8. Panduit Corp.
 - 9. Superior Essex; Superior Telecommunications Inc.
- B. Fiber-Optic Cable: 62.5/125-micrometer, multimode optical fiber.
- C. Backbone Fiber Cable: 24 fibers.
 - 1. Comply with TIA/EIA-492AAAA, tight buffer.
 - 2. NFPA 70, Type OFN complying with UL 1666.
 - 3. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.25 dB/km at 1300 nm.
 - 4. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
 - 5. Cable Jacket Color: Orange.

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- D. Horizontal Fiber Cable: Four fibers.
1. Comply with TIA/EIA-492AAAA, tight buffer.
 2. NFPA 70, Types OFN and OFNP.
 3. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.0 dB/km at 1300 nm.
 4. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
 5. Cable Jacket Color: Orange.
- E. Cross-Connect and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to satisfy specified expansion criteria.
- F. Patch Cords: Factory-made, dual fiber cables in 36-inch lengths.
- G. Cable Connecting Hardware:
1. Comply with TIA/EIA-568-B.3.
 2. Quick-connect, simplex- and duplex-Type SC couplers. Insertion loss not more than 0.7 dB.
 3. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.6 COAXIAL CABLE

- A. Manufacturers:
1. Alpha Wire Company.
 2. B & L Coaxial Connections Ltd..
 3. Belden Inc.; Electronics Division.
 4. Coleman Cable.
 5. CommScope Properties, LLC.
 6. Helix/HiTemp Cables, Inc.
 7. JSC Wire & Cable.
 8. West Penn Wire/CDT; a division of Cable Design Technologies.
- B. Cable Characteristics: Broadband type, recommended by cable manufacturer specifically for broadband data transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB maximum from 7 to 806 MHz, and shall be listed to comply with NFPA 70, Articles 810 and 820.
- C. RG-6/U: No. 16 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid. Jacketed with black PVC or PE. Suitable for indoor installations; NFPA 70, Type CATV or CM.
- D. Coaxial-Cable Connectors: Type BNC, 75 ohms. Of three-piece construction, consisting of a crimp-type center tip, sleeve, and main body.

2.7 MULTIUSER TELECOMMUNICATIONS OUTLET ASSEMBLY

A. Manufacturers:

1. ADC.
2. American Access Technologies, Inc.
3. Avaya Inc.
4. Molex Premise Networks; a division of Molex, Incorporated.
5. Nordex/CDT; a Subsidiary of Cable Design Technologies.
6. Ortronics, Inc.

B. Modular unit suitable for terminating single or multiple horizontal cables in one central location, providing an intermediary point between telecommunications closet and workstation.

1. NRTL listed as complying with UL 50 and UL 1863.
 - a. Unit shall be labeled to include maximum length of work-area cords.
 - b. When installed in plenums used for environmental air, NRTL listed as complying with UL 2043.
2. Number of Terminals per Field: One for each conductor in assigned cables.
3. Number of Connectors per Field:
 - a. One for each four-pair UTP cable indicated.
 - b. One for each four-pair conductor group of indicated cables, plus 25 percent spare positions.
4. Mounting: Recessed in ceiling, Wall, Desk/Furniture.

2.8 WORKSTATION OUTLETS

A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, modular, RJ-45. Comply with TIA/EIA-568-B.1.

B. Workstation Outlets: Dual jack-connector assemblies mounted in single or multigang faceplate.

1. Faceplate: High-impact plastic; color as selected by Architect.
2. Mounting: Flush, unless otherwise indicated.
3. Legend: Factory-labeled, top jack "Voice" and bottom jack "Data," by silk-screening or engraving.
4. Legend: Machine-printed, adhesive tape label identifying the circuit.

C. Flush dual fiber-optic connector assemblies mounted in 2-gang faceplate with flush dual RJ-45 jack assembly.

1. Faceplate: High-impact plastic; color as selected by Architect.
2. Mounting: Flush, unless otherwise indicated.
3. Legend: Factory-labeled, fiber-optic connectors "Data" and RJ-45 jacks "Voice," by engraving.

4. Legend: Machine-printed, adhesive tape label identifying the circuit.

2.9 BACKBOARDS

- A. A-C, void-free plywood, 84 inches high and 3/4-inch thick, fire rated.

2.10 GROUNDING AND BONDING

- A. Materials: Comply with NFPA 70, TIA/EIA-607, and UL 467.

2.11 IDENTIFICATION PRODUCTS

- A. Manufacturers:

1. Brady Worldwide, Inc.
2. HellermannTyton.
3. Kroy LLC.
4. Panduit Corp.

- B. Comply with TIA/EIA-606-A and with applicable requirements in Division 16 Section "Electrical Identification."

- C. Cable Labels: Self-adhesive vinyl or vinyl-cloth wraparound tape markers, machine printed with alphanumeric cable designations.

- D. Computer-based cable management system, with integrated database capabilities.

1. Document physical characteristics by recording the network, TIA/EIA details, and connections between equipment and cable.
2. Information shall be presented in database view, schematic plans, or technical drawings.
3. System shall interface with the following testing and recording devices:
 - a. Direct upload tests from circuit testing instrument into the PC.
 - b. Direct download circuit labeling into labeling printer.

2.12 SOURCE QUALITY CONTROL

- A. Coaxial Cable: Each cable spool sweep tested at the factory before shipping at frequencies from 5 MHz to 1 GHz. Sweep test shall test frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through specified frequency range and graphing the results.
- B. Fiber-Optic Cable: Each cable spool tested at factory before shipping at 850 and 1300 nm. Test and inspect equipment according to standard designation.

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- C. UTP Cable Verification of Performance: Test every cable package or reel at factory to verify that cable complies with TIA/EIA-568-B.2 requirements.

PART 3 - EXECUTION

3.1 INSTALLATION STANDARDS

- A. Comply with BICSI TCI, TIA/EIA-568-B.1, TIA/EIA-568-B.2, TIA/EIA-568-B.3, and TIA/EIA-569-A.

3.2 EXAMINATION

- A. Examine pathway elements intended for cables.
1. Verify proposed routes of pathways. Check raceways, cable trays, and other elements for compliance with space allocations, clearances, installation tolerances, hazards to cable installation, and other conditions affecting installation. Verify that cabling can be installed complying with EMI clearance requirements.
 2. Prepare wall penetrations and verify that penetrations of rated fire walls are made using products labeled for type of wall penetrated.
 3. Identify plan to support cables and raceways in suspended ceilings. Verify weight of individual types and sizes of cables. Verify that load capacity of cable support structures is adequate for each pathway.
 4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 APPLICATION OF MEDIA

- A. Backbone Cable for Data Service: Use fiber-optic cable for runs between equipment rooms and wiring closets and for runs between wiring closets.
- B. Backbone Cable for Voice Service: Use fiber-optic cable for runs between equipment rooms and wiring closets and for runs between wiring closets.
- C. Horizontal Cable for Data Service: Use UTP Category 6 cable for runs between wiring closets and workstation outlets.
- D. Horizontal Cable for Voice Service: Use UTP Category 6 cable for runs between wiring closets and workstation outlets.

3.4 INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Install cables in raceway and cable tray except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use UL-listed plenum cable in

environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces. Raceways and boxes are specified in Division 16 Section 16130.

C. Cable Installation:

1. Install exposed cables parallel and perpendicular to surfaces or exposed structural members and follow surface contours where possible.
2. Make splices, taps, and terminations only at indicated outlets, terminals, and cross-connect and patch panels.
3. Pulling Cable: Do not exceed manufacturer's written recommended pulling tensions. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
4. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
5. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Install UTP cables using techniques, practices, and methods that are consistent with Category 6 rating of components and that ensure Category 6 performance of completed and linked signal paths, end to end.
 - a. Do not untwist more than 1/2 inch of Categories 5e and 6 cables at connector terminations.
7. Outdoor Coaxial Cable:
 - a. Outdoor connections shall be installed in enclosures complying with NEMA 250, Type 4X. Connectors shall be corrosion resistant with properly designed O-rings to keep out moisture.
 - b. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches.

D. Wiring within Wiring Closets and Enclosures:

1. Install plywood backboards on walls of equipment rooms and wiring closets from floor to ceiling.
2. Mount patch panels, terminal strips, and other connecting hardware on backboards.
3. Group connecting hardware for cables into separate logical fields.
4. Train conductors to terminal points with no excess.
5. Use lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

E. Separation from EMI Sources: Comply with BICSI TDM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment. Comply with the following minimum separation distances from possible sources of EMI:

1. Separation between unshielded power lines or electrical equipment in proximity to open cables or cables in nonmetallic raceways is as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: 5 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: 12 inches.

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- c. Electrical Equipment Rating More Than 5 kVA: 24 inches.
 2. Separation between unshielded power lines or electrical equipment in proximity to cables in grounded metallic raceways is as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: 2-1/2 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: 6 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: 12 inches.
 3. Separation between power lines and electrical equipment located in grounded metallic conduits or enclosures in proximity to cables in grounded metallic raceways is as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: 3 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: 6 inches.
 4. Electrical Motors and Transformers, 5 kVA or HP and Larger: 48 inches.
 5. Fluorescent Fixtures: 5 inches.
- F. Conduit:
1. Comply with TIA/EIA-569-A for maximum length of conduit and bends between pull points, and for pull-box sizing.
 2. Use manufactured conduit sweeps and long-radius ells whenever possible.
 3. In telecommunications rooms, position conduit ends adjacent to a corner on backboard (in case of a single piece of plywood) or in the corner of room (where multiple sheets of plywood are installed around perimeter walls of room). Use cable trays to route cables if conduits cannot be located in these positions. Secure conduits to backboard when entering room from overhead. Extend conduits 1 to 3 inches in finished floor.
- G. Backboards: Install plywood with 84-inch dimension from floor up toward ceiling. Butt adjacent sheets tightly, and form smooth gap-free corners.

3.5 GROUNDING

- A. Comply with Division 16 Section "Grounding and Bonding" and with TIA/EIA 607.
- B. Grounding Points:
 1. Locate grounding terminals in each equipment room, wiring closet, rack, and cabinet.
 2. Telecommunications Grounding Busbars: Mount on wall of telecommunications entrance facility, equipment room, and closet, with standoff insulators.
- C. Bonding Conductors:
 1. Extend from telecommunications entrance facility to electrical entrance facility and connect to grounding electrode.
 2. Where a panelboard for telecommunications is located in same room or space as a grounding busbar, bond to equipment ground bus of electrical panelboard.

3. Extend from telecommunications entrance facility to grounding busbars.
4. Extend from grounding busbars to ground terminals in equipment racks and cabinets.
5. Extend from grounding busbars to building metal frame within room, or to metal frame external to room but readily accessible.

D. Special Requirements:

1. Bonding conductors shall be insulated copper, No. 6 AWG minimum.
2. Install only in nonmetallic conduit, unless specifically required for protection of conductor. Metallic conduit, if used, shall be RMC. For RMC that exceeds 36 inches in length, conductors shall be bonded at each end of conduit.
3. Bonding conductors shall be installed without splices unless approved by Architect because of special circumstances. Where splices are necessary, they shall be accessible and shall be located in telecommunications spaces. Splices shall be by irreversible compression connectors or by exothermic welding.

3.6 IDENTIFICATION

A. In addition to requirements in this Article, comply with TIA/EIA-606-A and with applicable requirements in Division 16 Section 16075.

1. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.

B. Using cable and asset management software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable, and label cable, jacks, connectors, and terminals to which it connects with same designation. Use logical and systematic designations for facility's architectural arrangement. At completion, cable and asset management software shall reflect as-built conditions.

C. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - a. All wiring conductors connected to terminal strips shall be individually numbered, and each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.
5. Within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

6. At Workstations: Label cables within outlet boxes.

- D. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- E. Cabling Administration Drawings: Show building floor plans with cable administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Perform the following field tests and inspections and prepare test reports:
- C. Category 5e UTP Cabling Tests:
 - 1. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in Annex I, complying with measurement accuracy specified in Annex H. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 3. Wire-map test that reports open circuits, short circuits, crossed pairs, reversed pairs, split pairs, and improper terminations.
 - 4. Channel and permanent link tests for cable length, insertion loss, near-end crosstalk loss, power sum near-end crosstalk loss, equal-level far-end crosstalk loss, power sum equal-level far-end crosstalk, return loss, propagation delay, and delay skew. Performance shall comply with minimum criteria in TIA/EIA-568-B.2.
- D. Category 6 UTP Cabling Tests:
 - 1. Tests shall include all tests of Category 5e, conducted from 1 to 250 MHz.
 - 2. Channel and permanent link tests shall be performed with a tester that complies with performance requirements in TIA/EIA-568-B.2, Level III. Include tests for longitudinal or transverse conversion loss.
 - 3. Performance shall comply with minimum criteria in TIA/EIA-568-B.2.
- E. Fiber-Optic Cable Tests:
 - 1. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

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2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 3. Link End-to-End Attenuation Tests:
 - a. Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
 - b. Attenuation test results for horizontal links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.
- F. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- G. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
- H. Retest and inspect cabling to determine compliance of replaced or additional work with specified requirements.
- 3.8 DEMONSTRATION
- A. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets.

END OF SECTION 16715

SECTION 16717 - COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Pathways.

B. Related Sections:

- 1. Division 16 Section "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
- 2. Division 16 Section "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

- A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- B. BICSI: Building Industry Consulting Service International.
- C. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel.
- D. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.
- E. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- F. EMI: Electromagnetic interference.
- G. IDC: Insulation displacement connector.
- H. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- I. LAN: Local area network.

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- J. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.
 - K. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
 - L. RCDD: Registered Communications Distribution Designer.
 - M. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom without ventilation openings.
 - N. Trough or Ventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom having openings for the passage of air.
 - O. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For coaxial cable, include the following installation data for each type used:
 - a. Nominal OD.
 - b. Minimum bending radius.
 - c. Maximum pulling tension.
- B. Shop Drawings:
 - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 - 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
 - 3. Cabling administration drawings and printouts.
 - 4. Wiring diagrams to show typical wiring schematics, including the following:
 - a. Cross-connects.
 - b. Patch panels.
 - c. Patch cords.
 - 5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
 - 6. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
- C. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

1.5 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.
- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-A.
- B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
 - 1. Support brackets with cable tie slots for fastening cable ties to brackets.
 - 2. Lacing bars, spools, J-hooks, and D-rings.
 - 3. Straps and other devices.
- C. Cable Trays:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. Cable Management Solutions, Inc.
 - b. Cablofil Inc.
 - c. Cooper B-Line, Inc.
 - d. Cope - Tyco/Allied Tube & Conduit.
 - e. GS Metals Corp.
 - 2. Cable Tray Materials: Metal, suitable for indoors, and protected against corrosion by electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inch (0.012 mm) thick.
 - a. Basket Cable Trays: 6 inches wide and 2 inches deep. Wire mesh spacing shall not exceed 2 by 4 inches.
 - b. Trough Cable Trays: .[Nominally 6 inches wide.
 - c. Ladder Cable Trays: Nominally 18 inches wide, and a rung spacing of 12 inches.
 - d. Channel Cable Trays: One-piece construction, nominally 4 inches wide. Slot spacing shall not exceed 4-1/2 inches o.c.
 - e. Solid-Bottom Cable Trays: One-piece construction, Nominally 12 inches wide. Provide without solid covers.

2.2 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements in Division 6 Section "Rough Carpentry" for plywood backing panels.

2.3 GROUNDING

- A. Comply with requirements in Division 16 Section "Grounding and Bonding" for grounding conductors and connectors.
- B. Comply with ANSI-J-STD-607-A.

2.4 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Division 16 Section "Electrical Identification."

2.5 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.
- B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 16 Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.
- C. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- D. Comply with requirements in Division 16 Section "Raceways and Boxes" for installation of conduits and wireways.
- E. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- F. Pathway Installation in Communications Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
 - 2. Install cable trays to route cables if conduits cannot be located in these positions.
 - 3. Secure conduits to backboard when entering room from overhead.
 - 4. Extend conduits 3 inches above finished floor.
 - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- G. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

2.6 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- C. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

END OF SECTION 16717