HARRIMAN

Hartt Transportation
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For Construction

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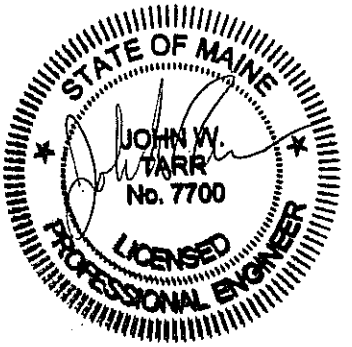
Electrical Engineer
H A R R I M A N



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HARTT TRANSPORTATION
MAINTENANCE GARAGE

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SECTION 260010 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Basic Electrical Requirements specifically applicable to all Division 26 Sections.

B. Intent is to provide and install complete electrical systems, as required to accommodate the new building.

C. Access Panels: Where required by NFPA 70 (N.E.C.)

D. All cable bundles shall be limited to a maximum of 12 Cables, individual bundles of cables shall be separated by at least two (2) inches in all directions.

E. Seismic Requirements

1.2 RELATED REQUIREMENTS

A. Including General and Supplementary Conditions per the General Contractor. Examine all contract documents for requirements affecting the work.

1.3 DEFINITIONS

A. As used in this section, "provide" shall mean, "furnish and install". "Furnish" shall mean "to purchase and deliver to the project site complete with every necessary appurtenance and support", and "Install" shall mean "to unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project".

1.4 REFERENCES

A. NEMA Standards.

B. NECA "Standard of Installation."

C. NFPA 70 (N.E.C.) latest edition.

D. NFPA 101 Life Safety Code.

E. U.L. Standards.

F. ANSI Standards.

G. Maine Uniform Building and Energy Codes (MUBEC) which include provisions of:
1. (IBC) International Building Code.
2. (IEBC) International Existing Building Code.
3. (IRC) International Residential Code.
4. (IECC) International Energy Conservation Code.
5. ASHRAE 62.1 Ventilation for Acceptable Indoor Air Quality.

6. ASHRAE 62.2 Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings.
7. ASHRAE 90.1 Energy Standard for Buildings except Low-Rise Residential Buildings.
8. ASTM E1465-06 Radon Standard for new residential construction - (Maine Model Standard).

1.5 SUBMITTALS

A. Submit Shop Drawings, Owner's Manuals, and Operating Instructions.

B. Include products specified in Division 26 individual sections.

C. Submit Shop Drawings and product data grouped by individual Sections to include complete submittals of related systems, products, and accessories. Label each with Section number and title. Partial Section submittals will not be reviewed.

D. Include access panels.

E. Include fire-stop seals and fillers.

1.6 RECORD DRAWINGS

A. Keep a marked set of Drawings at the site as a record set indicating all revisions in the work as the work progresses. At the completion of the work, mark the Drawings "As-Built Drawings" with the Contractor's name and date, and deliver to the Engineer.

1.7 PERFORMANCE REQUIREMENTS

A. Conform to requirements of the latest edition of ANSI/NFPA 70 National Electrical Code (N.E.C.).

B. Conform to requirements of all local, State and Federal laws and regulations, plus local electric utility company's rules, and the Fire Underwriters' requirements.

C. Furnish products listed and classified by Underwriters' Laboratories, Inc. (U.L.) as suitable for purpose specified and shown.

D. Secure and pay for all permits and certificates as required by local, State and Federal laws.

E. Request inspections from authority having jurisdiction.

F. Run separate circuits for lighting and receptacle outlets as indicated.
1. Circuits shall be balanced and loads and capacities shall be in accordance with requirements of local electric light company and National Board of Fire Underwriters.
2. Do not share neutral on branch circuits.

G. The entire electrical system shall be permanently and effectively grounded in accordance with Code requirements.

H. The Drawings indicate only diagrammatically the extent, layout and the general location and arrangement of equipment, conduit and wiring. Become familiar with all details of the work and verify all dimensions in the field so that the outlets and equipment will be properly located and

readily accessible.

1. Note that drawings do not show all junction boxes and fixture whips for lighting fixtures recessed in accessible ceilings. Although not specifically shown on the drawings, these fixtures shall be wired from junction boxes and 6'-0" unsupported whips. Provide number of junction boxes as required to allow for the 6'-0" whips. Wiring from fixture to fixture is not allowed. See Division 26 Section "Luminaires".
2. Lighting and Devices shown with same panel and circuit designation with no home run symbol may share same home runs to panelboards provided that the furthest device on the circuit does not exceed 2-1/2% voltage drop.
3. Where home run symbols are shown, use separate run to panelboard for each symbol, and do not share home run with other devices having same panel and circuit designation.

1.8 PROJECT/SITE CONDITIONS

A. Coordinate with all other trades to ensure proper access and space requirements.

B. Where project conditions occur necessitating departures from the drawings, submit for approval the details of and reasons for departures prior to implementing any change.

1.9 SEQUENCING AND SCHEDULING

A. Construct Work in sequence per General Contractor.

1.10 TEMPORARY LIGHT AND POWER

A. Provide Temporary Light and Power.

B. Temporary electrical work shall comply with OSHA and NEC requirements.

1.11 SEISMIC DESIGN

A. This project requires special provisions for the support and restraint of equipment components of the Life-safety system. The building has a Seismic Design Category = C. Components of this system shall continue to function after an earthquake. These provisions shall be incorporated in accordance with the following:
   1. The requirements of this Section are complementary and additional to requirements listed elsewhere for the fastening and support equipment and components.
   2. Life-safety systems shall be adequately supported and restrained to resist seismic forces in accordance with the 2000 International Building Code and associated supplements.
   3. Seismic Restraints for Equipment:
      a. Engage the services of a professional engineer (hereinafter known as the Engineering Specialist) with experience in the field of equipment support and seismic restraints. The Engineering Specialist shall select and coordinate the restraints and supports based on the final coordinated drawings showing exact locations of equipment and shall coordinate with the project Structural Engineer to ascertain that the connections to the structure will resist the horizontal forces to which they might be subjected. Submit details and calculations from the Engineering Specialist as required to demonstrate compliance. Equipment that shall be considered in the Engineering Specialist's seismic design shall include, but not be limited to all components of the Electrical Life-safety systems:
         1) Emergency Generator support
         2) Automatic transfer switches.

3) Feeder and branch circuits
4) Transformers and panelboards.
5) Lighting fixtures served from the life-safety automatic transfer switch (ATS-LS) and auditorium emergency lighting transfer switch (ELTS).
6) Fire Alarm Panels and distribution
7) Other components as may be require to assure proper operation of the building electrical life-safety systems.

4. Refer to Structural Drawings for exposure group and performance category.
5. Provide floor-mounted equipment with approved seismic control devices as required to prevent overturning or movement. Seismic devices shall be capable of keeping equipment captive under seismic loads.
6. Provide suspended equipment with approved seismic control devices as required to maintain the equipment in a captive attitude under seismic loads.]

PART 2 - PRODUCTS

2.1 ACCESS PANELS

A. Access panels required for items furnished under Division 26 shall be provided under this Division.

B. Standard panels: 12" x 16" except as indicated. Doors: flush type 14-gauge steel, hinged to 16-gauge frame. Latch: Flush face screw operated. All factory primed and painted to match in the field.
1. Same U.L. fire rating as wall, floor, or ceiling in which they are installed.
2. Equal To: Inryco/Milcor style "M" and Miami-Carey "HM".

2.2 VIBRATION ISOLATION MOUNT TYPES

A. Type DNP (Double Neoprene Pad)
1. Neoprene pad isolators shall be formed by two layers of 1/4" to 5/16" thick ribbed or waffled neoprene, separated by a stainless steel or aluminum plate. These layers shall be permanently adhered together. The pads shall be sized so that they will be loaded within the manufacturer's recommended range.
2. Type DNP isolators shall be formed from one of the following products or approved equal:
Type NR.....Amber/Booth
Type Korpad ..... Korfund Dynamics
Type WSW..... Mason Industries
Type NPS..... Kinetics Noise Control
Series Shear Flex .....Vibration Mountings & Control

B. Type HN (Hanger Neoprene)
1. Vibration isolation hangers shall consist of a neoprene-in-shear or glass fiber element contained in a steel housing. A neoprene neck bushing (or other element) shall be provided where the hanger rod passes through the hanger housing to prevent the rod from contacting the hanger housing. The diameter of the hole in the housing shall be sufficient to permit the hanger rod to swing through a 30° arc before contacting the hanger housing.

2. Type HN isolators shall be one of the following products or approved equal:
Type BRD-A .....Amber/Booth

Type H ..... Korfund Dynamics
Type HD ..... Mason Industries
Type RH or FH ..... Kinetics Noise Control
Type RHD or RFD.....Vibration Mountings & Control

PART 3 - EXECUTION

3.1 WORKMANSHIP AND INSTALLATION

A. Execute all work in a neat manner acceptable to the Local and State Electrical Inspector. Follow manufacturer's installation recommendations.

B. All electrical components and their attachments shall be properly supported and where required shall be designed for seismic forces.

C. Lighting fixtures shall be supported from structural steel. Provide unistrut channels or equal to span between top cord of joists. See Division 26 “Luminaires”.

D. Perform all electrical work by licensed electricians well skilled in the trade and supervised by a Master Electrician.

E. Replace or repair to new condition, defective equipment and equipment damaged during installation or testing.

F. Transformers: Transformers within the building construction shall be mounted on Type DNP isolators. If the transformers are suspended, use Type HN isolators selected to achieve not less than 0.1" static deflection.

G. Dimmers: Dimmer cabinets shall be mounted on Type DNP isolators.

H. Isolation Mounts: All mounts shall be aligned squarely above or below mounting points for the supported equipment.

I. Position isolated electrical equipment so that it is free standing and does not come in rigid contact with the building structure or other systems.

3.2 TESTING AND ADJUSTING

A. The entire installation shall be free from short circuits and improper grounds. Test in the presence of the Architects or their representatives.

B. Test feeders with the feeders disconnected from the branch circuit panels.

C. Test each individual branch circuit at the panel. In testing for insulation resistance to ground, the power equipment shall be connected for proper operation. In no case shall the insulation resistance be less than that required by the National Electrical Code and the manufacturer's recommendations. Correct failure in a manner satisfactory to the Architect and Engineers.

D. Completely test and adjust each system specified under Division 26 for proper operation.

3.3 SLEEVES, INSERTS AND OPENINGS

A. Sleeves:
   1. Furnish and install all sleeves required for the work.
   2. Sleeves through exterior building walls or through concrete construction shall be rigid galvanized steel.
   3. Sleeves shall be sized to provide a total of not less than 1/2-inch clearance around conduit.
   4. Sleeves for setting into walls shall be flush with finished construction. Sleeves for setting into floor shall be embedded in concrete slab and extend approximately 2 inches above finished floors.
   5. All sleeved openings within building shall be sealed airtight using fire barrier caulking with a UL classification for use as a fire penetration seal for walls and floors with up to a 3-hour fire rating expanded.
   6. Sleeves shall be provided in all locations where cables and conduits penetrate walls and floors.
   7. Selection of firestopping materials and installation shall be in accordance with architectural specifications to maintain rating of system.

END OF SECTION 260010

SECTION 260111 – CONDUIT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Metal Conduit.

B. Flexible Metal Conduit.

C. Liquidtight Flexible Metal Conduit.

D. Electrical Metallic Tubing (EMT).

E. Non-Metallic Conduit.

F. Flexible Nonmetallic Conduit.

G. Fittings and Conduit Bodies.

H. Innerduct - Non-Metallic Corrugated Flexible Raceway.

1.2 REFERENCES

A. NECA "Standard of Installation."

B. NEMA Standards.

C. NFPA 70 N.E.C. latest edition.

D. U.L. Standards.

1.3 DESIGN REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70 (N.E.C.)

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

C. Conduit Size: ANSI/NFPA 70 (N.E.C.) for conductors indicated. Increase size as required to include bonding conductors specified.

1.4 SUBMITTALS

A. Submit Shop Drawings, Owner's Manuals, and Operating.

B. Include only nonmetallic conduit (PVC) with associated fittings and describe intended use.

C. Include expansion fittings for all conduit types used on the project.

D. Include fire-stop seals and fillers.

1.5 PROJECT RECORD DOCUMENTS

A. Accurately record actual routing of all underground and other conduits 2” and larger.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site.

B. Accept conduit on site. Inspect for damage.

C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

D. Protect PVC conduit from sunlight.

1.7 PROJECT CONDITIONS

A. Verify that field measurements are as shown on Drawings.

B. Verify routing and termination locations of conduit prior to rough-in.

C. Conduit routing shown on Drawings in approximate locations unless dimensioned. Route as required to meet project conditions.

D. Where conduit routing is not shown, and destination only is indicated, determine exact routing and lengths required.

PART 2 - PRODUCTS

2.1 CONDUIT REQUIREMENTS

A. Except as otherwise specifically noted, all wiring throughout the building, including each of the systems specified, shall be enclosed in minimum size 3/4 inch conduit.

B. Underground Installations:
   1. More than Five Feet from Foundation Wall: Use rigid galvanized steel conduit, intermediate metal conduit, plastic coated steel conduit, thickwall nonmetallic conduit PVC-80, thinwall nonmetallic conduit PVC-40 encased in concrete where indicated.
   2. Within two feet of pole base: Use rigid galvanized steel conduit.
   3. Within five feet from foundation wall: Use rigid galvanized steel conduit, intermediate metal conduit, plastic coated steel conduit, thickwall nonmetallic conduit PVC-80, thinwall nonmetallic conduit PVC-40.
   4. In or Under Slab on Grade:
      a. Use rigid galvanized steel conduit, intermediate metal conduit, plastic coated steel conduit, thickwall nonmetallic conduit PVC-80 and thinwall nonmetallic conduit PVC-40.
      b. Rise through slab in rigid galvanized steel conduit.
      c. Conduit larger than 3/4" shall run below slab.
   5. Minimum Size: 3/4 inch.
   6. Under paved areas: rigid galvanized steel conduit or concrete encased PVC-40.
   7. Metallic conduits buried in soil: Coated with Bitumastic #50.

8. Primary electrical service conduits from riser pole to pad mounted transformer: PVC-40.
9. Communications (telephone, data, catv) service entrance conduits from riser pole to building: PVC-40

C. Outdoor Locations, Above Grade: Use rigid galvanized steel and aluminum conduit, intermediate metal conduit.

D. In Slab Above Grade:
1. Use rigid galvanized steel conduit, intermediate metal conduit, and electrical metallic tubing with water tight connectors.
2. Maximum Size Conduit in Slab: 3/4 inch.
3. Rise through slab in rigid galvanized steel conduit. In Garage area run ridged galvanized steel conduit up minimum 2'-6" above slab unless sealing fittings are provided.

E. Interior Wet and Damp Locations: Use rigid galvanized steel and aluminum conduit, intermediate metal conduit.

F. Dry Locations:
1. Concealed: Use rigid galvanized steel and aluminum conduit, intermediate metal conduit, electrical metallic tubing.
2. Concealed/ Accessible: Use rigid galvanized steel and aluminum conduit, intermediate metal conduit, electrical metallic tubing.
3. Exposed: Use rigid galvanized steel and aluminum conduit, intermediate metal conduit, electrical metallic tubing.
    a. Exposed conduit: Not allowed in finished areas except as specifically noted.
    b. Finished areas: Exposed raceways specified under Division 26 Section "Surface Raceways".

G. Panel Feeders: Use rigid galvanized steel, electrical metallic tubing, and PVC-40 in accordance with locations herein specified.

H. Couplings and connectors for electrical metallic tubing up to 2" shall be steel set screw or compression type. Set-screw connection shall be used for all tubing sizes with a minimum of four set-screws for coupling and two set-screws for connectors and fittings for sizes 1-1/4" and larger.

I. Couplings and connectors for rigid and intermediate metal conduit shall be threaded.

J. Termination for all conduit and tubing shall have insulated bushings or insulated throat connectors in accordance with code requirements.

K. Permanent Connection to Motors: Dry locations, use flexible metal conduit. Damp or wet locations, use flexible liquidtight Type UA conduit with approved liquidtight fittings. Maximum length two feet (2').

L. Inside Plant Innerduct: Premises Non-Metallic Corrugated Flexible Raceway designed for use within and without a conduit. Duct shall contain pre-installed pull string.
1. Carlon Plenum-Gard or equal for sizes 3/4" to 2"ID. Use where plenum cable is required and where indicated.
2. Carlon Riser-Gard or equal for sizes 3/4" to 2"ID. Use where riser cable is required and where indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. In general, all raceways shall be concealed above ceilings and within finished walls - securely supported in accordance with code requirements. Wiring in areas with no finished ceilings (exposed construction) shall be exposed overhead such that all raceways are parallel or perpendicular to joists, columns or beams and all drops to wall devices shall be concealed in walls.

B. Install exposed only where specifically indicated.

C. Aluminum conduits shall not be installed below grade or in poured concrete or masonry.

D. Install conduit in accordance with NECA "Standard of Installation."

E. Install nonmetallic conduit in accordance with manufacturer's instructions.

F. Arrange supports to prevent misalignment during wiring installation.

G. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

H. Group Related Conduits:
   1. Support using conduit rack of Power-Strut, or approved equal.
   2. Parallel runs shall be neatly clustered with all bends and offsets of uniform pattern
   3. Provide space on each for 25 percent additional conduit.

I. Substantially support with approved clips or hangers spaced not to exceed ten feet (10') on centers except 1/2" rigid conduit and 1/2" and 3/4" electrical metallic tubing shall have supports spaced not to exceed six feet (6').

J. Fasten conduit supports to building structure.
   1. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
   2. Do not attach conduit to ceiling support wires.
   3. Conduits larger than 2” shall be supported from top cord of joists.

K. Arrange conduit to maintain headroom and present neat appearance.

L. Route conduit parallel and perpendicular to walls.

M. Route conduit in and under slab from point-to-point.
   1. Install only where specifically indicated or required.
   2. Obtain approval from the Architect before installation.

N. Do not cross conduits in slab.

O. Maintain adequate clearance between conduit and piping.

P. Maintain 6 inch clearance between conduit and surfaces with temperatures exceeding 104ºF.

Q. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.

R. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.

S. Install no more than equivalent of three 90-degree bends between boxes. Use conduit bodies to make sharp changes in direction. Use factory elbows or hydraulic one-shot bender to fabricate bends in metal conduit 2 inches or larger in size.

T. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.

U. Provide suitable fittings to accommodate expansion and deflection where conduit crosses seismic, control and expansion joints.

V. Provide suitable labeled nylon pull string in each empty conduit.

W. Use suitable caps to protect installed conduit against entrance of dirt and moisture.

X. Use sleeves when passing through floors and walls.

Y. When serving roof top equipment, conduit shall enter within the weather-proof curbing. Maintain water tight roofing system.

Z. Ground and bond conduit under provisions of Division 26 Section “Grounding and Bonding.”

AA. Identify conduit under provisions of Division 26 Section “Electrical Identification.”

BB. All elbows in concealed nonmetallic conduit runs shall be rigid galvanized steel to eliminate "burn through" when pulling in conductors.

3.2 FIELD QUALITY CONTROL

A. No wire shall be installed until work which might cause damage to wires or conduits has been completed.

B. Conduits shall be thoroughly cleaned of water or other foreign matter before wire is installed.

3.3 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire-resistance rating of partitions and other elements, using approved seals, fillers and materials.

END OF SECTION 260111

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SECTION 260112 - SURFACE RACEWAYS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Wireways.

1.2 REFERENCES

A. NEMA Standards.

B. NFPA 70 N.E.C. latest edition.

C. U.L. Standards.

1.3 PERFORMANCE REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70. (N.E.C.).

B. Furnish products listed and classified by Underwriters' Laboratories, Inc. (U.L.) as suitable for purpose specified and shown.

C. Size per N.E.C. and manufacturer's recommendations.

1.4 SUBMITTALS

A. Submit Shop Drawings, Owner's Manuals, and Operating.

B. Include product data for wireways and accessories.

PART 2 - PRODUCTS

2.1 WIREWAYS

A. Acceptable Manufacturers:
   1. General Electric.
   2. Square D.
   3. Siemen.
   4. Or equal.

B. Description: U.L. approved narrow sheet metal enclosure, rectangular in cross section, hinged or removable cover for housing and protecting electric wires and cable and in which conductors are laid in place after the wireway has been installed as a complete system.

C. General purpose except as indicated. Raintight where installed outside or in damp locations, with knockouts only as required.

D. Size: As required by NEC Article 376 for the number and size wires indicated. Minimum 4 x 4 inches.

E. Cover: Hinged, Screws with built-in protection for conductors with full gasketing.

F. Fittings, Couplings, Elbows, Offsets, End Caps and Connectors: Furnish manufacturer's standard accessories for a complete installation. Fittings shall have removable front covers for installation of wires.

G. Code gauge, enameled steel with rust inhibiting primer coat. Gray enamel finish except as noted.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Exposed wiring shall not be installed in finished areas except as specifically indicated.

B. Install products in accordance with manufacturer's instructions.

C. Maintain grounding continuity between wireway components to provide a continuous grounding path. Ground and bond under provisions of Division 26 Section 260170 “Grounding and Bonding”.

D. Support wireways as approved with supports located at every splice and fitting and at intervals not to exceed five feet.

END OF SECTION 260112

SECTION 260123 - WIRE AND CABLE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Building wire and cable.

B. Underground feeder and branch circuit cable.

C. Service entrance cable

D. Metal clad cable.

E. Wiring connectors and connections.

1.2 REFERENCES

A. NEMA Standards.

B. NFPA 70 N.E.C. Latest Edition.

C. U.L. Standards.

1.3 DESIGN REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70. (N.E.C.)

B. Furnish products listed and classified by Underwriters' Laboratories, Inc. as suitable for purpose specified and shown.

C. Feeder sizes shown are based on aluminum. All other conductor sizes shown are based on copper.
   1. Equipment Manufacturer Requirements: Where equipment is provided whose manufacturer requires copper conductors at the terminations, or requires that only copper conductors be provided between components of equipment, provide copper conductors, or all necessary splices, splice boxes, and other work required to satisfy manufacturer's requirements.

D. Manufacturer's name, wire size and insulation type shall be clearly marked on the insulation or jacket.

1.4 SUBMITTALS

A. Submit Shop Drawings, Owner's Manuals, and Operating.

B. Include MC manufacturer’s specification sheets indicating construction, diameter, ampacity and bending radius.

C. Include aluminum wire; type, sizes, locations used.

1.5 PROJECT CONDITIONS

A. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet project conditions.

B. Where wire and cable routing is not shown, and destination or circuit number only is indicated, determine exact routing and lengths required.

1.6 COORDINATION

A. Locate such that outlets are readily accessible.

B. Determine required separation between cable and other work.

C. Determine cable routing to avoid interference with other work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. General Cable.

B. Triangle PWC, Inc.

C. Superior Essex Inc.

D. Southwire Company.

E. Allied Wire & Cable.

F. Cerro Wire.

G. AFC Cable Systems.

H. Encore Wire Corporation.

I. United Copper Industries.

J. Alcan Cable

K. The Okonite Co.

2.2 WIRE AND CABLE

A. Description: Single conductor insulated wire.

B. Conductors: Sizes #6 AWG and Smaller: Copper. Sizes #4 AWG and larger: Copper or aluminum unless the type of conductor material is specifically indicated, specified, or required by equipment manufacturer.

C. Aluminum Conductors: Aluminum alloy that is listed by Underwriters' Laboratories, Inc. Standard 486B, marked "AL9CU" for 90° C. rated circuits and shall be equal to Annealed

Stabiloy compact stranded (Aluminum Association 8000 series aluminum alloy) as manufactured by Alcan Cable - Atlanta, GA.

D. Insulation Voltage Rating: 600 volts.

E. Insulation: ANSI/NFPA 70 (N.E.C.), Type THHN/THWN, XHHW rated 90° C.

2.3 METAL CLAD CABLE

A. Description: ANSI/NFPA 70 (N.E.C.), Type MC with separate insulated ground.

B. Conductor: Copper, maximum # 10 AWG.

C. Insulation Voltage Rating: 600 volts.

D. Insulation Temperature Rating: 90º C.

E. Armor Material: Aluminum.

F. Armor Design: Interlocked Metal Armor

G. Jacket: None.

2.4 WIRING CONNECTORS

A. Use the Following Types As Herein Specified:
1. Split bolt connectors.
2. Solderless pressure connectors.
3. Spring wire connectors.
4. Compression connectors.
5. Insulation piercing connectors.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Verify that mechanical work likely to damage wire and cable has been completed.

3.2 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.3 WIRING METHODS

A. Concealed Dry Interior Locations: Use only wire Type THHN/THWN, XHHW insulation, in raceway or metal clad cable.

B. Exposed Dry Interior Locations:
1. Use exposed wiring only where specifically indicated.

2. Use only building wire Type THHN/THWN XHHW insulation, in raceway.

C. Wet or Damp Interior Locations: Use only building wire Type THWN, XHHW, XHHW-2 insulation, in raceway.

D. Exterior Locations: Use only building wire Type THWN, XHHW, XHHW-2 insulation, in raceway.

E. Underground Installations: Use only building wire Type XHHW or XHHW-2 insulation installed in raceway.

F. Panel and Transformer Feeders: Use only building wire Type XHHW and XHHW-2 insulation, in raceway.

G. Use other wiring methods only as specifically indicated on Drawings.

3.4 INSTALLATION

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

B. Except as otherwise specifically noted, all wiring throughout the building, including each of the systems specified, shall be enclosed in raceways.

C. In general, all wire in raceways and cable shall be concealed above ceilings and within finished walls, securely supported in accordance with code requirements. Wiring in areas with no finished ceilings (exposed construction) shall be raceways exposed overhead, but run along structures such that raceways have minimum visibility and such that all raceways are parallel or perpendicular to joists, columns or beams and concealed in walls.

D. Use solid conductor for feeders and branch circuits #10 AWG and smaller. At contractors option stranded conductors for #10 AWG and smaller shall be permitted as long as vinyl insulated support crimp-on fork terminals are use for all screw head terminations. Barrel lugs and screw activated compression clamps on back wired devices shall not require crimp-on terminals.

E. Use stranded conductor for feeders and branch circuits #8 AWG and larger.

F. Use stranded conductors for control circuits.

G. Minimum Size Conductors for Power and Lighting Circuits #12 AWG Except as Follows:
1. Minimum #10 AWG for 120 volt circuits more than 100 feet long.
2. Minimum #10 AWG for 277 volt circuits more than 230 feet long.
3. Sizes shall be not less than indicated.
4. Note: Wire sizes indicated on drawings and schedules are minimum requirements and shall be adjusted to meet the above criteria.

H. Use conductor not smaller than #16 AWG for control circuits with fusing sized accordingly.

I. Pull all conductors into raceway at same time.

J. Use suitable wire pulling lubricant for building wire #4 AWG and larger.

K. Support cables above accessible ceiling, using spring metal clips or approved cable ties to

support cables from structure. Do not support from ceiling suspension system. Do not rest cable on ceiling panels. Do not drape over ductwork or between bar joists. Wiring shall not be run diagonally and shall be cabled neatly.

L. Use approved cable fittings and connectors.

M. Neatly train and lace wiring inside boxes, equipment, and panelboards.

N. Clean conductor surfaces before installing lugs and connectors.

O. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

P. Use split bolt connectors, insulation piercing connectors or U.L. approved insulated connectors for copper conductor splices and taps, #6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.

Q. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, #8 AWG and smaller.

R. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

S. Wiring in sleeves passing through fire-rated barriers shall be sealed/filled with approved material to maintain the fire rating.

T. Terminations Involving Aluminum Conductors:

1. Make with solderless circumferential compression type, aluminum bodied connectors UL listed for AL/CU. Remove all surface oxides from aluminum conductors by wire brushing and immediately apply an oxide inhibiting joint compound and insert in connector. After joint is made, wipe away excess joint compound and insulate splice.
2. Terminate aluminum conductors to copper bus by utilizing a circumferential compression type, aluminum bodied terminal lug UL listed for AL/CU, and steel Belleville spring washers, flat washers, bolts, and nuts. Belleville spring washers shall be of cadmium-plated hardened steel. Take care to install the Belleville spring washers with the crown up toward the nut or bolt head, with the concave side of the Belleville bearing on a heavy-duty, wide series flat washer of larger diameter than the Belleville. Tighten nuts sufficiently to flatten Belleville and leave in that position. Lubricate all hardware with joint compound prior to making connection. Wire brush and apply joint compound to conductor prior to inserting in lug.
3. Terminate aluminum conductors to aluminum bus by utilizing all aluminum nuts, bolts, washers, and compression lugs. Wire brush and apply joint compound to conductor prior to inserting in lug. Lubricate all hardware with joint compound prior to making connection; if bus contact surface is unplated, scratch-brush and coat with joint compound (without grit).

3.5 INTERFACE WITH OTHER PRODUCTS

A. Identify wire and cable under provisions of Division 26 Section 260195 “Electrical Identification”.

B. Identify each conductor with its circuit number or other designation indicated on Drawings.

3.6 FIELD QUALITY CONTROL

A. Inspect wire and cable for physical damage and proper connection.

B. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.

C. Verify continuity of each branch circuit conductor.

D. Verify proper operation of each circuit.

3.7 TESTING

A. For conductors larger than #8AWG, perform Insulation-Resistance Test on each field-installed conductor with respect to ground and adjacent conductors.
   1. Applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable.
   2. Take readings after 1 minute and until the reading is constant for 15 seconds.
   3. Minimum insulation-resistance values shall not be less than 25 Megohms for 300 volt rated cable and 100 Megohms for 600 volt rated cable.

END OF SECTION 260123

SECTION 260130 - BOXES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Wall and Ceiling Outlet Boxes.

B. Pull and Junction Boxes.

C. Hinged Cover Cabinet Enclosures.

D. Floor Boxes.

1.2 REFERENCES

A. NEMA Standards.

B. NFPA 70 N.E.C. Latest Edition.

C. U.L. Standards.

1.3 SUBMITTALS

A. Submit Shop Drawings, Owner's Manuals, and Operating.

B. Include product data for nonmetallic boxes, boxes larger than 12x12x6 inches and boxes with hinged covers.

C. Include product data for Flush Floor Device Boxes.

1.4 PROJECT RECORD DOCUMENTS

A. Accurately record actual locations and mounting heights of outlets if not as shown on Drawings, plus pull and junction boxes larger than 12x12x6 inches and boxes used for panel feeders.

1.5 PERFORMANCE REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70. (N.E.C.)

B. Furnish products listed and classified by Underwriters' Laboratories, Inc. as suitable for purpose specified and shown.

C. Size per N.E.C. Art. 314.

D. Covers for flush floor devices and poke-through fittings shall meet UL scrub water standards for installation in carpet and tile floors.

1.6 PROJECT CONDITIONS

A. Verify field measurements are as shown on Drawings.

B. Verify locations of boxes and outlets in areas prior to rough-in.

C. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Install at location required for box to serve intended purpose.

D. Generally pull boxes are not shown on Drawings. Provide as required.

1.7 COORDINATION

A. Locate such that outlets are readily accessible and do not interfere with other work.

B. Provide for access panels where required.

PART 2 - PRODUCTS

2.1 OUTLET BOXES

A. Sheet Metal Outlet Boxes: Standard type galvanized steel, minimum four inch square or octagon by 2-1/8 inch deep.
   1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2 inch male fixture studs where required.
   2. Concrete Ceiling Boxes: Concrete type, three and four inch deep or depth as to coordinate with concrete slab.
   3. Single Wall Type: Minimum size, four inch square by 1-1/2 inch deep, except as noted. Provide dry wall plaster rings raised as required to insure flush finish mounting.
   4. Ganged Wall Type: Minimum depth 3 inches except as noted, ganged as required under common plate to contain device shown. On 277 volt circuits ganged boxes for switches shall contain only one circuit or provide box with permanent barriers per N.E.C. Art 404-8.

B. Nonmetallic Outlet Boxes: Carlon or equal, impact resistant rigid PVC.
   1. Minimum 3 inch deep.
   2. Single or multigang.
   3. For use only where nonmetallic cable is specified.

C. Cast Boxes: Type FD deep, aluminum or, cast feralloy.
   1. Provide number of threaded hubs as required.
   2. Use in all exterior, damp or exposed in mechanical space.
   3. Provide gasketed cover and accessories by box manufacturer for complete weatherproofing.

2.2 PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: Standard type galvanized steel, minimum four inch square or octagon by 2-1/8 inch deep.
   1. Sizes up to 12x12x6 inch: Provide screw-type or hinged covers.
   2. Sizes greater than 12x12x6 inch: Provide hinged covers.

B. Exterior Surface-Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface-mounted junction box.
   1. Material: Galvanized cast iron.

2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

C. In-Ground Cast Metal Box: NEMA 250, Type 6, inside flanged, recessed cover box for flush mounting.
1. Material: Galvanized cast iron.
2. Cover: Nonskid cover with neoprene gasket and stainless steel cover screws.
3. Cover Legend: ELECTRIC.

D. Fiberglass Handholes: Die-molded fiberglass handholes.
1. Cable Entrance: Pre-cut 6 x 6 inch cable entrance at center bottom of each side.
2. Cover: Fiberglass weatherproof cover with nonskid finish.

2.3 CABINET ENCLOSURES

A. Covers: Continuous hinge, held closed by flush latch operable by screwdriver.

B. Boxes: Galvanized steel minimum 12"x12"x6" deep or as noted. Provide 3/4 inch (19 mm) thick plywood backboard painted matte white, for mounting terminal blocks.

C. Power Terminals: Unit construction type, closed-back type, with tubular pressure screw connectors, rated 600 volts.

D. Signal and Control Terminals: Modular construction type, channel mounted; tubular pressure screw connectors, rated 300 volts.

2.4 FLUSH FLOOR REACH-IN DEVICE BOXES

A. Walker (Wiremold) RFP series four-compartment combination reach-in type fully recessed and concealed floor box. Box shall be capable of providing service fittings for one duplex receptacle or one duplex voice/data outlet for each of four compartments (two data and two power), plus Flip-up lid. Include all components as required to provide the devices indicated. Provide blank plates where devices are not used to assure separation between line and low voltage. Minimum components shall include:
1. RFB4-CI-1: Concrete-tight cat iron floor box, nominal 14 1/2"W x 11 7/8"W x 3 7/16"D with one 1" and one 1 1/4" feed thru per compartment. 2" pre-pour adjustability.
2. Floor Port Activation Cover: TopGuard protection from water, dirt and debris. Hidged doors with seals, flanged Activation Kit with Die-Cast aluminum trim ring and access hatch.
3. Box Accessories: Mounting plate for specific activity inserts and feed through wire management.
4. Floor box Mudcap.
5. UL listed for use on tile or carpet.
6. For on grade applications and in the gymnasium.
7. Equal by Hubbell.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.

1. Except where specifically noted, boxes on finished surfaces shall be flush mounted with finished cover plate.
2. Consult Architect prior to installing in finished areas.

B. Install electrical boxes to maintain headroom and to present neat mechanical appearance.

C. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

D. In Non-accessible Ceiling Areas: Install outlet and junction boxes no more than 12 inches from ceiling access panels or from removable recessed luminaires such that they are accessible.

E. In accessible Ceiling Areas: Install outlet and junction boxes such that they are accessible from ceiling access panels or from removable recessed luminaires.

F. Install boxes to preserve fire-resistance rating of partitions and other elements.

G. Align Wall Boxes for Switches, Receptacles, Telephone, and Similar Devices with Each Other as Follows:
1. Horizontally for outlets with same mounting height.
2. Vertically for outlets shown in similar locations with different mounting heights.

H. Do not install flush mounted boxes back-to-back in walls; provide minimum 6 inch separation. Provide minimum 24 inches separation in acoustic and fire rated walls.

I. Accurately position flush mounted wall boxes to allow for surface finish thickness.
1. Box shall be flush with finished surface.
2. Use wall box support brackets that span two studs.
3. Single stud support will be allowed only if used with Caddy H series E-Z Mount Brackets or equal product to support side opposite the stud.

J. Install flush mounting box without damaging wall insulation and vapor barrier or reducing its effectiveness.

K. Use adjustable steel channel fasteners for hung ceiling outlet box.

L. Do not fasten boxes to ceiling support wires.

M. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches of box.

N. Use gang box where more than one device is mounted together. Do not use sectional box.

O. Use 4" square box with plaster ring for single device outlets.

P. Use cast outlet box in exterior locations exposed to the weather and wet locations.

Q. Use cast floor boxes for installations in slab on grade; formed steel boxes are acceptable for other installations.

R. Set floor boxes level.

S. Large Pull Boxes: Boxes larger than 100 cubic inches in volume or 12 inches in any dimension.

1. Interior Dry Locations: Use hinged covers.
2. Other Locations: Use surface-mounted cast metal box.

3.2 INTERFACE WITH OTHER PRODUCTS

A. Coordinate masonry cutting to achieve neat opening.

B. Coordinate mounting heights and locations of outlets mounted above counters, benches and backsplashes.

C. Position outlet boxes to locate luminaires as shown on reflected ceiling plan.

3.3 ADJUSTING

A. Adjust floor box flush with finish flooring material.

END OF SECTION 260130

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SECTION 260141 - WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Wall Switches.

B. Wall Dimmers.

C. Receptacles.

D. Device Plates.

E. Lighting Occupancy Sensors.

F. Relays and Contactors.

1.2 REFERENCES

A. NEMA Standards.

B. NFPA 70 N.E.C. Latest Edition.

C. U.L. Standards.

1.3 SUBMITTALS

A. Submit Shop Drawings, Owner's Manuals, and Operating.

B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

C. Include documentation showing compliance with UL, Fed. Spec. and NEMA references.

1.4 PERFORMANCE REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters' Laboratories, Inc. as suitable for purpose specified and shown.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
   1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
   2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
   3. Leviton Mfg. Company Inc. (Leviton).

4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
1. Cooper; BR20

B. Device Body:
1. Devices shall be Ivory.

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, feed -through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped. Will not energize if line and load wiring are reversed.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
1. Cooper; GF20.
2. Hubbell; GFR5352
3. Pass & Seymour; 2095

2.4 WALL SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:
1. Cooper; CSB Seires.
2. Approved Equal.

C. Device Body: Toggle handle type, color: Ivory.

D. Pilot Light: Neon type #1720-120v red. Separate gang position combined under same plate as switch or separately mounted.

2.5 LIGHTING OCCUPANCY SENSORS

A. Manufacturers:
1. Cooper Controls.
2. Approved equal.

B. Complete with Faceplates, Color: White except as noted.

C. Occupancy Sensor - Room Ceilings - OAC-DT-2000-R dual technology ceiling mounted sensor with auxiliary isolated relay and photocell.
1. 24 VDC/VAC and halfwave rectified AC
2. Ultrasonic frequency of 40kHz
3. Time delays: automatic and fixed (5, 15 or 30 minutes), walk-through, test-mode. Set units for 30 minute delay to OFF.
4. Sensitivity adjustment: SmartSet (automatic) or reduced sensitivity (for PIR sensitivity); ultrasonic sensitivity is variable with trimpot
5. Built-in light level sensor works from 0 to 300 footcandles.

6. Low voltage, momentary switch input for manual operation
7. Auxiliary isolated relay with N/O and N/C outputs; rated for 1 Amp @ 30 VDC/VAC for use by the Building Automation System.
8. Multi-level, 360° Fresnel lens for superior occupancy detection
9. Control unit (power pack): up to 4 sensors or 3 sensors and 1 Add-A-Relay. Include the Add-A-Relay for use by the Building Automation System.
10. Typical PIR Coverage: 2000 sq.ft.
11. UL and CUL listed; Five year warranty
12. Provide control units (power packs) CU300A, mounting brackets and other hardware as required for a complete working system to cover the areas indicated.

D. Occupancy Sensor - Corridor - OAC-U-2000-R dual technology ceiling mounted sensor with auxiliary isolated relay and photocell.
1. 24 VDC/VAC and halfwave rectified AC
2. Ultrasonic frequency of 40kHz
3. Time delays: automatic and fixed (5, 15 or 30 minutes), walk-through, test-mode. Set units for 30 minute delay to OFF.
4. Sensitivity adjustment: SmartSet (automatic) or reduced sensitivity (for PIR sensitivity); ultrasonic sensitivity is variable with trimpot
5. Built-in light level sensor works from 0 to 300 footcandles.
6. Low voltage, momentary switch input for manual operation
7. Auxiliary isolated relay with N/O and N/C outputs; rated for 1 Amp @ 30 VDC/VAC for use by the Building Automation System.
8. Multi-level, 360° Fresnel lens for superior occupancy detection
9. Control unit (power pack): up to 4 sensors or 3 sensors and 1 Add-A-Relay. Include the Add-A-Relay for use by the Building Automation System.
10. Typical PIR Coverage: 2000 sq.ft.
11. UL and CUL listed; Five year warranty
12. Provide control units (power packs) CU300A, mounting brackets and other hardware as required for a complete working system to cover the areas indicated.

2.6 WALL DIMMERS

A. Manufacturers:
1. Cooper Controls
2. Approved equal

B. Plastic with linear slide and ON/OFF button.

C. 1200VA, 120/277 Volt AC 60Hz, Single-Pole & 3-Way.

2.7 WALL PLATES

A. Decorative Cover Plate: Ivory smooth face nylon.

B. Rain-Tight While-in-use Cover Plates: NEMA 3R Clear cover extra deep, Leviton 5966-DCL Series.

C. Utility Area Cover Plates for Surface Mounting: Cadmium plated steel with rounded edges.

2.8 RELAYS/ CONTACTORS, AND TIME CLOCK CONTROLS

A. Similar to the following with characteristics as indicated or equal:

B. Control Relays: Allen-Bradley Bulletin "700" Series.
1. 120 volt coil as required.
2. Number of poles as indicated or required. Minimum number of poles: two.
3. Minimum continuous ampere rating: 5 amps.
4. Enclosure: NEMA-1, except as noted.
5. Electrically held, except as noted.
6. 600 volt rated.
7. For non-lighting low voltage control applications.

C. Motor Load Relays/ Contactors: Allen-Bradley Bulletin "500" Series.
1. 120 volt coil as required.
2. Number of poles as indicated or required. Minimum number of poles: three.
3. Horsepower rated for connected motor, except minimum NEMA size 0.
4. 600 volt rated.
5. Enclosure: NEMA-1, except as noted.
6. Electrically held, except as noted.

PART 3 - EXECUTION

3.1 INSTALLATION

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

B. Install devices and plates vertical and plumb. Boxes shall be flush with finished surface.

C. Provide matching blank face plate for all unused wall boxes.

D. Install switches with Off position down.
1. Locate close to door frame on latch side of door, or beyond swing of door where appropriate.
2. Where door frames have side lights, switch shall be either located below side light where a 3'-0" mounting height is possible, or beyond the side light. Coordinate with door frame schedule.
3. Switches indicated in the same area at the same mounting heights shall be ganged together under a common plate.

E. Install wall dimmers to achieve full rating specified. Do not break off cooling fins. Mount in separate gangs as required.

F. Do not share neutral conductor on load side of dimmers.

G. Install receptacles with grounding pole on top.

END OF SECTION 260141

SECTION 260149 – LIGHTING CONTROL SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pre-wired, microprocessor controlled relay panels with standard relays controlled via a complete list of communication based accessories including but not limited to, all wiring, digital switches, digital photocells, Digital Time Clock (DTC) and interface cards, and other contact closure or analog based devices and programming for a complete system.

B. Low Voltage panels, complete with relay modules, cards, interiors

C. Low Voltage switches and faceplates.

D. Dataline Communications Network.

E. All programming, testing, training and performance of all operations of the intelligent system as indicated on the drawings and as herein specified.

1.2 PERFORMANCE REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by a nationally recognized testing laboratory such as Underwriters' Laboratories, Inc. or ETL as suitable for purpose specified and shown.

C. Include all necessary software, programming and the selection of the proper type and quantities of the system components to assure a complete, operational, and Code Compliant System.

D. Provide the Owner with all required components, interfaces, passwords and training to allow them full access to the programming features. See Part 3 of this Section for training and field services.

E. The drawings do not show all details of the System. It shall be the responsibility of the authorized supplier/installer to provide a fully operational system.

F. Special programming requirement:
   1. Any OFF command from the central system and or by a remote “out of sight” local switch shall cause a flicker event with 5 minutes delay before commanding the lighting to OFF. If an ON command is initialed during the delay, then lighting shall remain ON for two hours before initiating another OFF command.

G. Programming and control shall be from the Control Keeper TouchScreen network lighting control panel.

1.3 PROJECT CONDITIONS

A. Low Voltage wire and cable routing is not shown on the Drawings. Route wire and cable and determine exact lengths as required to meet project conditions.

1.4 QUALIFICATIONS

A. Manufacturer:
   1. Company specializing in manufacturing the products specified in this Section with minimum five years documented experience.
   2. Company maintaining engineering and service departments capable of rendering advice regarding installation, programming and final adjustment of the system.

B. Manufacturer and/or Supplier/Installer (Vendor):
   1. Company authorized by the manufacturer with minimum five years experience.
   2. Company offering Start-up, training, Documentation, Programming, and extended service contracts for continuing factory authorized service after the initial warranty period.

1.5 SUBMITTALS

A. Submit Shop Drawings, Owner's Manuals, and Operating.

B. Product Data: Submit manufacturer's data on lighting control system and all components.

C. Shop Drawings: Submit dimension Drawings of all lighting control system components and accessories.

D. Typical Wiring Diagrams: Submit typical wiring diagrams for all components including, but not limited to, relay panels, relays, dimmer modules, low voltage switches, Boosters, Photocells, Day Lighting Sensors.

E. See Part 3, DOCUMENTATION for additional requirements.

1.6 SYSTEM DESCRIPTION

A. The lighting control system shall be a networked system that communicates via RS485. The system shall be able to communicate with fully digital centralized relay panels, digital switches, photocells, various interfaces and shall include all operational software.

B. System software shall provide real time status of each relay, each zone and each group.

C. Lighting control system shall be able to be monitored by and take commands from a remote PC. At any time, should the remote PC go off-line all system programming uploaded to the lighting control system shall continue to operate as intended.

D. All devices shall be pre-addressed at the factory.

E. All programs, schedules, time of day, etc, shall be held in non-volatile memory for a minimum of 10 years at power failure. At restoration of power, lighting control system shall implement programs required by current time and date. Time of day shall be battery backed for at least 10 years.

F. System shall be capable of warning of an impending “OFF” sweep by flashing lights Off/On once or twice (programmable) by relay or by zone prior to the lights being turned off. The warning interval times between the flash and the final lights off signal shall be definable for each

zone. Occupant shall be able to override any scheduled Off sweep using local wall switches within the occupied space. Occupant override time shall be locally and remotely programmable and not exceed 2-hours.

G. The system shall be capable of implementing On commands, Off commands for any relay, group or zone by means of digital wall switches, photocell, web based software or other devices connected to programmable inputs in a lighting control panel.

H. The lighting control system shall provide the ability to control each relay and each relay group per this specifications requirement. All programming and scheduling shall be able to be done locally at the master LCP and remotely via dial up modem and via the Internet. Remote connection to the lighting control system shall provide real time control and real time feedback.

I. System shall consist of centralized a relay panel, digital switches, photocells and various digital interfaces. Verify exact components specified. Centralized relay panel and digital switches shall communicate as one network via RS485.

J. Control wiring shall be in accordance with the NEC requirements for Class 2 remote control systems, Article 725 and manufacturer specification.

K. Lighting control panels (LCPs) shall be UL 916 listed.

L. Lighting control system shall be digital and consist of a master LCP with up to 48 individual relays, slave LCPs with up to 48 individual relays in each panel, digital switches and digital interface cards. All system components shall connect in a "daisy chain" style configuration and be controlled via category 5 patch cable with RJ45 connectors, providing real-time two-way communication with each system component.

M. Relay panels shall be pre-wired, pre-assembled, and preprogrammed.

N. Standard relays shall have contacts rated for 120/277V minimum 20A.

O. Relay panel electronics shall provide current visual status and control of each relay or zone. All system control electronics shall store programming in a non-volatile memory and provide 10 year battery back up for time of day.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

A. Cooper Controls Green Gate

2.2 RELAY PANELS SHALL CONSIST OF THE FOLLOWING:

A. Relay Panels:
   1. NEMA 1 rated enclosure with hinged door.
   2. 16 AWG steel barrier shall separate the high voltage and low voltage compartments of the panel and separate 120v and 277v.
   3. LCP input power shall be capable of accepting 120v or 277v without rewiring
   4. Control electronics in the low voltage section shall be capable of driving 2 to 48 relays, control any individual or group or relays, provide individual relay overrides, provide a

master override for each panel, store all programming in non-volatile memory, after power is restored return system to current state, provide programmable blink warn timers for each relay and every zone, and be able to control Normally Open (NO) or Normally Closed (NC) relays.

5. All system components shall connect and be controlled via a single Category 5, 4 twisted pair cable, providing real time two-way communication with each system component.

B. Standard Output Relays:
   1. Normally open.
   2. Relays shall be individually replaceable. Relay terminal blocks shall be capable of accepting two (2) #10AWG wires on both the line and the load side.
   3. Rated at 20 Amp, 277VAC Ballast, Tungsten, HID, 1 HP at 120 Vac, 2 HP at 240 Vac.
   4. Relays to be rated for 250,000 operations minimum at 20a lighting load, use Zero Cross circuitry and be Normally Closed (NCZC). All incandescent circuits shall be energized by use of a Normally Closed SoftStartT (NCSS) relay rated at 100,000 operations at full 20a load.

C. Low Voltage Switches:
   1. Cooper Controls Green Gate GDS series.
   2. Any switch button function shall be able to be changed locally (at the DTC or at the PC) or remotely, via modem, Ethernet or Internet.
   3. Switches shall be available in 1 through 6-button version with engraveable buttons, LED locator.
   4. Switches shall be capable of handling electrostatic discharges of at least 30,000 volts (1cmspark) without any interruption or failure in operation.

D. Switches/Plates:
   1. Provide wall pate.

E. DTC - Digital Electronic Time Clock:
   1. A Digital Time Clock (DTC) shall control and program the entire lighting control system and supply all time functions and accept interface inputs.
   2. DTC shall be capable of up to 32 schedules. Each schedule shall consist of one set of On and Off times per day for each day of the week and for each of two holiday lists. The schedules shall apply to any individual relay or group of relays.
   3. The DTC shall be capable of controlling up to 127 digital addresses on a single bus and capable of interfacing digitally with other individual busses using manufacturer supplied interface cards.
   4. The DTC shall accept control locally using built in button prompts or from a computer or modem via an on-board RS 232 port. All commands shall be in plain English. Help pages shall display on the DTC screen.
   5. The DTC shall be run from non-volatile memory so that all system programming and real time clock functions are maintained for a minimum of 10 years with loss of power.
   6. System shall come with a Pre-Installed modem that allows for remote programming from any location using a PC. Modem shall include all necessary software for local or remote control.
   7. DTC shall provide system wide timed overrides. Any relay, group or zoned that is overridden On, before or after hours, shall automatically be swept Off by the DTC a maximum of 2 hours later.

F. Photocells:
   1. Photocells used for exterior lights shall provide multiple trip points from 1 roof mounted unit. All trip points shall be able to be changed remotely via Internet or dial up modem.
   2. Photocell, exterior (PCO), shall provide readout on the DTC screen in number values analogous to foot-candles. Each photocell shall provide a minimum of 14 trigger points. Each trigger can be programmed to control any relay or zone. Each trigger shall be set through DTC, locally or remotely.

G. Provide the following Interfaces:
   1. A dry contact input interface card that provides 14 programmable dry contact closure inputs. Use shielded cable to connect input devices to interface card.
   2. Interface card providing digital communication from one system bus to another system bus, allowing up to 12,000 devices to communicate.
   3. An exterior (PCO) and interior (PCI) photocell that provides readout on the DTC screen in number values analogous to foot-candles. Each photocell shall provide a minimum of 14 trigger points. Each trigger can be programmed to control any relay or zone. Each trigger shall be set through programming only.
   4. A voice prompted telephone override interface module. Interface module shall accept up to 3 phone lines and allow up to 3 simultaneous phone calls. Voice prompted menu and up to 999 unique pass codes shall be standard with each interface module.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mount relay control cabinet adjacent to respective lighting panelboard. Cabinet shall be surface mounted. Wiring between relay control cabinet and panelboards shall be per local codes and acceptable industry standards. Neatly lace and rack wiring in cabinets. During construction process, protect all interior components of each relay panel and each digital switch from water, dust and debris.

B. Switches: Provide outlet boxes, single or multi-gang, as required for the low voltage digital switches. Mount switches as indicated. Provide faceplates and the required low voltage cable, Category 5, 4 twisted pair, with pre-assemble RJ45 connectors and snagless boots (commonly referred to as a Cat 5 patch cable) between all switches and panels. Field-test all Cat 5 patch cable with a recognized cable tester. All low voltage wire shall be run in EMT or ENT or as specifically indicated on the drawings.

C. Provide a crimping kit with sufficient approved EZ Brand RJ 45 connectors to populate the whole system. Include a manual that shows all the pitfalls of crimping RJ 45s and instructions on how to properly terminate the connectors.

D. Wiring:
   1. Do not mix low voltage and high voltage conductors in the same conduit.
   2. Ensure low voltage conduits or control wires do not run parallel to current carrying conduits.
   3. Place manufacturer supplied "terminators" at each end of the system bus per manufacturer instructions.
   4. Neatly lace and rack wiring in cabinets.
   5. Plug in Category 5, 4-twisted pair cable that has been field tested with a recognized cable

tester, at the indicated RJ45 connector provided with each lighting control device, per manufacturer instructions.

6. Use Category 5, 4 twisted pair cable for all system low voltage connections. Additional conductors may be required to compensate for voltage drop with specific system designs. Contact manufacturer or consult manual for further information.
7. Use shielded cable for dry contact inputs to lighting control system.
8. Do not exceed 4,000 ft-wire length for the system bus.
9. All items on the bus shall be connected in sequence (daisy chained).
10. All wiring shall be per manufacturer's instructions.

3.2 SEQUENCE OF OPERATION

A. Each load is switched On/Off via associated Low Voltage Switch.

B. Each load is switched On/Off via scheduled event.
   1. Coordinate scheduled events with Owner, adjust as necessary.

3.3 INSTALLATION AND SET-UP

A. Verify that conduit for line voltage wires enters panel in line voltage areas and conduit for low-voltage control wires enters panel on low-voltage areas. Refer to manufacturer's plans and approved shop drawings for location of line and low-voltage areas. It is the responsibility of the contractor to verify with lighting control manufacturer all catalog information and specific product acceptability.

B. For approved line voltage type micro relay panel switches connected to matrixed inputs of the micro relay panel, furnish #18 AWG solid conductors. For all other digital switches provide wiring required by system manufacturer.

C. Contractor shall test all low voltage cable for integrity and proper operation prior to turn over. Verify with system manufacturer all wiring and testing requirements.

D. Panels shall be located so that they are readily accessible and not exposed to physical damage.

E. Panel locations shall be furnished with sufficient working space around panels to comply with the National Electric Electrical Code.

F. Panels shall be securely fastened to the mounting surface by at least 4 points.

G. Unused openings in the cabinet shall be effectively closed.

H. Cabinets shall be grounded as specified in the National Electrical Code.

I. Lugs shall be suitable and listed for installation with the conductor being connected.

J. Conductor lengths shall be maintained to a minimum within the wiring gutter space. Conductors shall be long enough to reach the terminal location in a manner that avoids strain on the connecting lugs.

K. Maintain the required bending radius of conductors inside cabinets.

L. Clean cabinets of foreign material such as cement, plaster and paint.

M. Distribute and arrange conductors neatly in the wiring gutters.

N. Follow the manufacturer's torque values to tighten lugs.

O. Before energizing the panelboard, the following steps shall be taken:
   1. Retighten connections to the manufacturer's torque specifications. Verify that required connections have been furnished.
   2. Remove shipping blocks from component devices and the panel interior.
   3. Remove debris from panelboard interior.
   4. Follow manufacturers' instructions for installation and all low voltage wiring.

P. Service and Operation Manuals:
   1. Submit operation and service manuals. Complete manuals shall be bound in flexible binders and data shall be typewritten.
   2. Manuals shall include instructions necessary for proper operation and servicing of system and shall include complete wiring circuit diagrams of system, wiring destination schedules for circuits and replacement part numbers. Manuals shall include as-built cable Project site plot plans and floor plans indicating cables, both underground and in each building with conduit, and as-built coding used on cables. Programming forms of systems shall be submitted with complete information.

3.4 DOCUMENTATION

A. Each relay/dimmer module shall have an identification label indicating the originating branch circuit number and panelboard name along with the relay number. Each line side branch circuit conductor shall have an identification tag indicating the branch circuit number.

B. Provide a point-to-point wiring diagram for the entire lighting control system. Diagram shall indicate exact mounting location of each system device. This accurate "as built" shall indicate the loads controlled by each relay/dimmer module and the identification number for that module, placement of switches and location of photocell. Placed copy of drawing inside the door of each LCP.

3.5 SUPPORT SERVICES

A. Start Up: Contact Manufacturer at least 7 days before turnover of project. Contractor shall be available at the time of dial in to perform any corrections required by Manufacturer.

B. Telephone factory support shall be available at no additional cost both during and after the warranty period. Factory shall pre-program the lighting control system per plans and approved submittal, to the extent data is available. The specified manufacturer, at no added cost, shall provide additional remote programming via modem as required for as long as a phone line is available for the life of the system. Manufacturer shall provide remote dial up software at no added cost.

C. Manufacturer's Field Services.
   1. Provide the services of a factory authorized technical representative of the manufacturer of the equipment to supervise the installation and final connections, plus adjusting, programming and all testing of the system required to assure a complete and fully

operative system and to instruct designated personnel in the operation, adjustment, testing and maintenance of the system.

2. Inspect final connections to units prior to energizing system.
3. Perform field inspection and testing.

D. Provide initial programming as required to activate local switches. Adjust scheduling as directed by Owner.

3.6 ON SITE TRAINING

A. Provide a factory technician for on-site training of the owners' representatives and maintenance personnel.

B. Before Substantial Completion, arrange and provide Owner with instruction period designated to Owner personnel. Set-up, commissioning of the lighting control system, and Owner instruction includes:

1. Demonstrate entire system operation and communication to each device.
2. Demonstrate operation of individual relays, switches and occupancy sensors.
3. Confirmation of system Programming, photocell settings, override settings, etc.

C. Provide training to cover installation, maintenance, troubleshooting, programming, and repair and operation of the lighting control system.

END OF SECTION 260149

SECTION 260170 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Grounding electrodes and conductors.

B. Equipment grounding conductors.

C. Bonding.

1.2 REFERENCES

A. NEMA Standards.

B. NFPA 70 (N.E.C.) Latest Edition.

1.3 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: Conform to requirements of ANSI/NFPA 70. (N.E.C.), except that the Minimum System Resistance shall be 5 ohms.

1.4 SUBMITTALS

A. Submit Shop Drawings, Owner's Manuals, and Operating.

B. Product Data: Provide data for grounding electrodes and connections.

C. Test Reports: Indicate overall resistance to ground and resistance of each electrode.

1.5 GROUNDING ELECTRODE SYSTEM

A. All connections shall be made by Exothermic weld. Connections to thin water pipe shall be made by accessible clamp.

B. Minimum 4/0 copper home run from service entrance rated main circuit breaker to concrete-encased electrode in building footings.

C. Ground Ring at Transformer Pad.
   1. 4/O Bare copper direct buried 3'-0" continuous around pad at 4'-0" beyond pad.
   2. Ground rod at each corner and one in pad hand hole.
   3. Extend ring with #4/0 to building main switchboard. Do not connect ring to ground rod in pad hand hole.

D. Metal structure of the building.

E. Concrete-encased electrode in building footings.

F. Rod electrode.

1.6 PROJECT RECORD DOCUMENTS

A. Accurately record actual locations of grounding electrodes.

PART 2 - PRODUCTS

2.1 ROD ELECTRODE

A. Manufacturers:
   1. Erico, Eritech copper bonded ground rod.
   2. Approved Equal.

B. Material: Copper-clad carbon steel.

C. Diameter: 3/4 inch.

D. Length: Sectional 10 feet.

2.2 MECHANICAL CONNECTORS

A. Manufacturers:
   1. Thomas & Betts/Blackburn, Model J2D.
   2. Approved equal.

B. Material: Bronze.

2.3 EXOTHERMIC CONNECTIONS

A. Manufacturers:
   1. Erico, Cadweld.
   2. Continental Industries, thermOweld.
   3. Burndy, BURNDYWeld.
   4. Approved equal.

2.4 WIRE

A. Material: Copper.

B. Foundation Electrodes: #4/0 AWG.

C. Grounding Electrode Conductor: Size to meet NFPA 70 requirements, but not smaller than indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.2 INSTALLATION

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

B. Install rod electrodes at locations indicated and as required. Install additional rod electrodes as required to achieve specified resistance to ground.

C. Install ground wire from water entrance to main entrance switchboard. Provide additional ground wire from main service to building structural steel and 20 feet of 1/2" minimum re-bar or 4/0 copper conductor in concrete footing, as required by NEC. Enclose wire in PVC-40 where exposed.

D. Equipment Grounding Conductor: Provide separate, 600 volt insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

E. Provide and install bonding conductor to each item of electrical equipment.

F. Bonding conductors shall be continuous where possible. Where splices are required, provide T & B, or approved equal, compression connectors of approved pattern. Insulate connectors to equivalent thickness of conductors.

G. Provide grounding system for neutrals of dry type transformer secondaries as indicated and required.

END OF SECTION 260170

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SECTION 260180 - EQUIPMENT WIRING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electrical connections to equipment specified under other Sections including but not limited to: exhaust fans, air handling units, air-conditioning units, circulators, heating system pumps, burner, etc.

B. All line voltage wiring including final branch circuit connections to disconnects, motor controllers, Variable Frequency Drives (VFD), Isolation transformers, and motors. See Equipment Schedules on Drawings for wiring and plans for equipment locations.

C. Fused and non-fused disconnect switches for the equipment, except disconnect switches specifically provided with the equipment.

D. Except as specifically noted, motors, variable frequency drives (VFD), isolation transformers for VFD, magnetic or manual starters and thermal overload protection will be furnished with the equipment for installation under Division 26 Section 260180.
   1. Single pole switches, switch and pilots, and light/fan switches shall be provided and installed under Division 26 Section 260180. Coordinate with equipment schedules on H&V Drawings.

1.2 REFERENCES

A. NEMA Standards.

B. NFPA 70 (N.E.C.) Latest Edition.

C. U.L. Standards.

D. ANSI Standards.

1.3 PERFORMANCE REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70. (N.E.C.)

B. Furnish products listed and classified by Underwriters' Laboratories, Inc. (U.L.) as suitable for purpose specified and shown.

C. Drawings do not show all required disconnect servicing switches. Furnish and locate as required by N.E.C.

D. Size fuses and thermal elements per N.E.C. and manufacturer's recommendations.

E. Connect motors for correct voltage, phase and rotation.

1.4 SUBMITTALS

A. Submit Shop Drawings, Owner's Manuals, and Operating.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Eaton/Cutler-Hammer.

B. I-T-E Siemens.

C. General Electric.

D. Square D.

2.2 DISCONNECT SWITCHES

A. Enclosed, heavy-duty type, except as noted with visible blades, Horsepower rated 600-volt and 250-volt ratings as required by the particular circuit.

B. NEMA-1 enclosure, for dry locations; NEMA-3R raintight for exterior locations; NEMA-4X in wash bay.

C. Fuses and ampere rating and number of poles as indicated on Drawings, or as required by the specific equipment.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 PREPARATION

A. Review equipment submittals prior to installation and electrical rough-in. Verify location, size, and type of connections. Coordinate details of equipment connections with supplier and installer.

3.3 INSTALLATION

A. Use wire and cable with insulation suitable for temperatures encountered in heat-producing equipment, but in no case less than the wire specified under Division 26 Section 260123 “Wire and Cable.”

B. Conduit Connections to Equipment: Dry locations, use flexible conduit. Damp or wet locations, use flexible liquidtight Type UA conduit with approved liquidtight fittings. Maximum length two feet (2').

C. Install pre-finished cord set where connection with attachment plug is indicated or specified, or use attachment plug with suitable strain-relief clamps.

D. Provide suitable strain-relief clamps for cord connections to outlet boxes and equipment connection boxes.

E. Semiportable Machines: Use heavy-duty oil-resistant type SO cord with stranded copper conductors No. 12 AWG, minimum size and number of wires as required to include each phase conductor, white neutral conductor, and green grounding conductor. Furnish and install Kellems Series H cord grips and spring hangers for each cord connected machine with overhead supply.

F. Moving (traversing) equipment: Use Daniel Woodhead Company POW-R-TAG Festoon power cord carrying system or equal. Complete including end clamps, carriers, wire rope, hardware and heavy-duty oil-resistant type SO cord with stranded copper conductors. Conductor sizes as required to coordinate with circuit breaker ampacity serving the conductor.

G. Make wiring connections in wiring compartment of prewired equipment in accordance with manufacturer's instructions.

H. Install disconnect switches, controllers, control stations, temperature switches as indicated or required.

I. Overhead Doors: Mount door control panels. Coordinate with overhead door manufacturer for proper wiring diagrams and final connection requirements.

END OF SECTION 260180

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SECTION 260195 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Nameplates and Tape Labels.

B. Wire and Cable Markers.

C. Conductor Color Coding.

1.2 REFERENCES

A. NFPA 70 (N.E.C.) Latest Edition.

1.3 REQUIREMENTS

A. Label all panelboards plus circuits on all spaces of switchboards and distribution panels, all safety switches, controls, relays, junction boxes, pull boxes, pilot lights, special switches and outlets. Label on panelboards shall include name and circuit number of source.

B. Nameplates shall identify function of device, space controlled, voltage conditions, fuse size, panel serving switch, as indicated or required without abbreviations. Details shall be as approved.

C. Conform to requirements of ANSI/NFPA 70. (N.E.C.) Art. 200 for grounded neutral conductor, Art. 210 for branch circuits and art. 250 for grounding (bonding) conductor.

1.4 SUBMITTALS

A. Submit Shop Drawings, Owner's Manuals, and Operating.

B. Only include if details of nameplates, wiring markers and conductor color code are not as specified below.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Nameplates: Engraved three-layer laminated plastic, white letters on a black background.

B. Tape Labels: Embossed adhesive tape, with 3/16 inch white letters on black background.

C. Junction Box Labels: Hand lettered with indelible black marker. Indicate voltage and circuit.

D. Wire and Cable Markers: Cloth markers, split sleeve or tubing type.

E. Fire Alarm Junction Boxes: Paint red.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install nameplates and tape labels parallel to equipment lines.

B. Secure nameplates to equipment fronts using screws, or rivets, or adhesive. Secure nameplate to inside face of recessed panelboard doors in finished locations. Secure nameplate to outside face of surface panelboards in unfinished locations.

C. Use embossed tape only for identification of control device stations.

3.2 WIRE IDENTIFICATION

A. Conductors throughout the building shall be color coded to identify voltage and phases.
   1. All metallic bonding conductors - Green.
   2. Insulated Isolated Grounding Conductor: Green with yellow stripe.
   3. Phase Conductors of 120/208 Volt System: Black, red, blue. Neutral: white.
   4. Phase Conductors of 277/480 Volt System: Brown, orange and yellow. Neutral: Gray.

B. All circuit conductors of the same color shall be connected to the same ungrounded feeder conductor throughout the installation.

C. Where conductors are not available in the colors indicated, due to size, prewired cable, or other reason: Install identifying adhesive bands 3/4" wide of colors indicated above around each conductor within six inches (6") and twelve inches (12") of each end and at a maximum of five foot (5') intervals along wireways, at back of panelboards, and wherever conductors are accessible.

D. Power and lighting circuits in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection: Provide wire markers on each conductor and Identify with branch circuit or feeder number.

E. System control wires at control panel and load connection:
   1. Provide wire markers on each conductor and identify with number as indicated on manufacturer's schematic and interconnection diagrams.
   2. Fire Alarm System: Follow local Fire Department color code and labeling standards.

END OF SECTION 260195

SECTION 260420 - SERVICE ENTRANCE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Arrangement with Power Company for permanent electric service.

B. Arrange with Power Company to provide for metering.

C. Underground duct banks, conduits and secondary wires from Pad Mounted Transformer to service entrance equipment.

D. Primary service duct banks, conduits and secondary lugs.

E. Arrange for the installation of concrete pad for Power Company furnished pad mounted transformer.

1.2 SYSTEM DESCRIPTION

A. System Voltage: 277/480 volts, three phase, four wire, 60 Hertz.

B. Service Entrance: As indicated on Drawings.

C. Primary System Voltage: 12470 volts.

1.3 REFERENCES

A. NEMA Standards.

B. NFPA 70 (N.E.C.) latest edition.

C. U.L. Standards.

D. ANSI Standards.

1.4 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70. (N.E.C.) and ANSI C2 National Electrical Safety Code.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. (U.L.) as suitable for purpose specified and shown.

C. Power Company:
Central Maine Power Company
Contact: Gary Saucier
Telephone: (207)753-3144

D. Install in accordance with Power Company's rules and regulations.

1.5 SUBMITTALS

A. Submit Shop Drawings, Owner's Manuals, and Operating.

B. Include meter socket.

PART 2 - PRODUCTS

2.1 METERING EQUIPMENT

A. Intent is that the metering CT/PT will be installed by the Power Co. and located within the Pad Mounted Transformer.

2.2 SECONDARY CONDUCTORS

A. Specified Under Division 26 Section 260123 “Wire and Cable.”

B. Underground: Type XHHW insulation, type USE cross-linked polyethylene, designed for direct burial but installed in raceway.

2.3 PRIMARY CONDUCTORS

A. Provided by the Power Company.

2.4 CONDUITS AND DUCT BANKS

A. Specified Under Division 26 Section 260111 “Conduit.”

B. Rigid galvanized steel conduits on poles, rise up as directed. Use long sweep bends.

C. Duct Banks: Minimum three inch concrete cover all sides. Form sides for smooth finish to minimize frost action.

D. Trenching, Backfill, Earthwork by general contractor.

E. Separators: High impact polystyrene, spaced not to exceed 5'-0". Stagger the joints of the conduits by rows and layers.

F. See Drawings for details.

2.5 OTHER MATERIALS

A. Concrete Pad for Transformer: Conform to Power Company requirements and details.

B. Transformer secondary lugs and spades to accept service conductors. Verify size and coordinate with Power Co.

C. Bonding and Grounding: Ground rods at pad, at metering, and at riser conduit at utility pole, and as required by Power Company.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Make arrangements with Power Company to obtain permanent electric service to the Project.

B. Underground Secondary: Install service entrance conduits from Power Company's pad-mounted transformer to building service entrance equipment.

C. Concrete Pad for Transformer: Coordinate specific details and location with Power Company and obtain approvals prior to installation of pad.

3.2 PAD-MOUNTED TRANSFORMER GROUNDING

A. Grounding: NFPA 70 and ANSI C2, and Power Company requirements, except that grounds and grounding systems shall have a resistance to solid earth ground not exceeding 5 ohms. Provide multiple ground rods as required.

3.3 INSTALLATION UNDERGROUND WORK

A. Earthwork: By General Contractor.

END OF SECTION 260420

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SECTION 260461 – DRY TYPE TRANSFORMERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Dry type two winding transformers.

1.2 REFERENCES

A. NEMA Standards.

B. NFPA 70 (N.E.C.) Latest Edition.

C. U.L. Standards.

D. ANSI Standards.

1.3 PERFORMANCE REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70. (N.E.C.)

B. Furnish products listed and classified by Underwriters' Laboratories, Inc. (U.L.) as suitable for purpose specified and shown.

C. Natural-draft, air cooled dry type transformers. Use of cooling fans not acceptable.

D. Size per Drawings.

1.4 SUBMITTALS

A. Submit Shop Drawings, Owner's Manuals, and Operating.

B. Include outline and support point dimensions of enclosures and accessories, unit weight, voltage, KVA, and impedance ratings and characteristics, loss data, efficiency at 25, 50, 75 and 100 percent rated load, sound level, tap configurations, insulation system type, and rated temperature rise.

C. Include details of support platforms on all transformers not floor mounted.

D. Include certification of tests.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Cutler-Hammer.

B. General Electric.

C. Square D (Schneider Electric).

D. Hevi-Duty.

E. ITE-Siemens

F. Hammond Power Systems

2.2 DRY TYPE TWO WINDING TRANSFORMERS

A. Dry Type Transformers: ANSI/NEMA ST 20; factory-assembled, natural-draft, air cooled dry type transformers; ratings as shown on the Drawings. Transformers for three-phase circuits shall be energy efficient TP-1 three-phase type rated for 480 volt delta primary and 120/208 volt, three-phase, four-wire wye secondary, except as noted.

B. Insulation System and Average Winding Temperature Rise As Follows: [note coordinate avail with k rated]

Insulation Class	Temperature Rise (degree C)
220EC (total insulation system)	150

C. Case temperature shall not exceed 30ºC rise above ambient at its warmest point.

D. Winding Taps: Two 2-1/2% above and below rated voltage on primary winding.

E. Sound Levels: NEMA TR-27. Maximum sound levels as follows:

KVA	Sound Rating Level
1-9	40 db
10-50	45 db
51-150	50 db
151-300	55 db
301-500	60 db
501-700	62 db

F. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

G. Mounting: Suitable for wall and platform mounting for ratings 45 KVA and below and platform mounting for transformers rated 46 KVA and above. Provide mounting supports and platforms as required.

H. Coil Conductors: Continuous windings with terminations brazed or welded.

I. Enclosure: NEMA Type 1 Air-cooled with steel enclosures ventilated as required and provided with suitable terminal compartments and terminals designed to receive both copper and aluminum conductors.

J. Isolate core and coil from enclosure using vibration absorbing mounts to minimize noise transmission.

K. Impedance range: Levels as follows:

KVA	Impedance (%)
15	4.0 - 5.2
30	3.0 - 5.9
45	3.0 - 3.2
75	3.0 - 4.2
112.5	3.5 - 5.4
150	4.5 – 5.0
225	6.25 – 6.5
300	3.1 – 4.1

L. Nameplate: Include transformer connection data, rated KVA and voltage, insulation class, temperature rise, and overload capacity based on rated allowable temperature rise.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set transformer plumb and level. Ventilated transformers located against walls shall be located sufficient distance from wall for proper ventilation. Coordinate with manufacturer's recommendations and Code requirements.

B. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.

C. Use flexible conduit, 2 ft minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure. See manufacturer's drawings for allowable locations.

D. Platforms shall be suspended from angles between top chord of beams. Install hangers prior to concrete pour.

E. Secondary neutral of transformer shall be grounded to building steel and to grounding conductor from source and as required by NEC. Neutral conductor shall terminate on isolated neutral bus and grounding conductor shall terminate on ground bus in panel served.

F. Install cable lugs to transformer studs so that lug protrusion is facing away from front cover to maximize the distance from the lug to the cover.

G. Provide seismic restraints. See Division 26 Section 260010.

3.2 FIELD QUALITY CONTROL

A. Check for damage and tight connections prior to energizing transformer.

B. Measure primary and secondary voltages and make appropriate tap adjustments.

3.3 TESTS

A. Test in accordance with current NEMA and ANSI Standards.

B. Field Verify Minimum Megger Readings of 1000 Megohms as Follows:
   1. Primary to ground.
   2. Secondary to ground.

END OF SECTION 260461

SECTION 260470 – PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Panelboards.

B. Individually mounted circuit breakers.

1.2 REFERENCES

A. NEMA Standards.

B. NFPA 70 N.E.C. Latest Edition.

C. U.L. Standards.

1.3 PERFORMANCE REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70 (N.E.C.).

B. Furnish products listed and classified by Underwriters Laboratories, Inc. (U.L.) as suitable for purpose specified and shown.

C. NFPA 70E Requirements from manufacturer
1. Include Short Circuit and Coordination study. Coordinate pad mounted transformers with the utility.
2. Based on the available short circuit and the fault clearing time, the distribution system components, shall limit the incident energy such that the PPE Hazard/Risk Category is 1.
3. Revise and make recommendations to size of distribution system equipment to meet this criteria.
4. Provide Hazard Warning Label on equipment.
5. See also Article “SUBMITTALS”

1.4 SUBMITTALS

A. Submit Shop Drawings, Owner's Manuals, and Operating.

B. Include outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement, catalog, specification and sizes, panel dimensions, and gutter space.

C. Include coordination study with recommended breaker settings and fault current and arc flash hazard analysis showing compliance for the AIC requirements listed herein.

D. Include calculations and details of selected components to confirm compliance with the NFPA 70E criteria. Provide completed labels with following details.
1. Include Completed Hazard Warning Labels To Read As Follows:
! Warning; Arc Flash and Shock Hazard.
Appropriate PPE Required.

Failure To Comply Can Result In Death or Injury.
Refer to NFPA 70E.
Flash Hazard Boundary: ____inch;
Flash Hazard at 18 in. : ____Cal/cm^2
Category ___; PPE Description _____.
Clove Class: ____.
Voltage: Shock Hazard when cover is removed.
Limited Approach: ____inch.
Restricted Approach: ____inch.
Prohibited Approach: ____inch.

2. Located on each panel per NEC Art. 110.16

1.5 SPARE PARTS

A. Keys: Furnish to Owner 1 key for each panel. All panels shall be keyed alike. Minimum 5 keys.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURES - PANELBOARDS

A. Eaton/Cutler-Hammer.

B. I-T-E Siemens.

C. General Electric.

D. Square D (Schneider Electric).

2.2 DISTRIBUTION PANELBOARDS RATED OVER 400AMPERE

A. Panelboards:
1. Circuit breaker type with mains and circuits as indicated on the Drawings and designed for three phase, four wire, solid neutral, 60 cycle service rated for 277/480 volt as scheduled.

B. Enclosure: NEMA Type 1 except as noted. Code gauge galvanized steel boxes and enameled steel fronts, sized for 6" minimum side, top and bottom gutters, or greater as required by NEC.

C. Bus: Copper or aluminum ratings as scheduled on Drawings. Lugs designed for use for both copper and aluminum conductors.

D. Neutral Bar: Full size insulated from the cabinet and provided with lugs as required to receive the conductors indicated and specified.

E. Bonding strap securely attached to the cabinet with lugs as required to receive the bonding conductors indicated and specified.

F. Molded Case Circuit Breakers:
1. Unless indicated otherwise on the drawing schedules, breakers shall be fully rated for a minimum interrupting rating of 42,000 AIC at 480 volts and coordinated with branch breakers.

2. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.

2.3 PANELBOARDS RATED 400AMPERE AND LESS

A. Circuit breaker type with mains and circuits as indicated on the Drawings and all designed for three phase, four wire, solid neutral, 60 cycle service rated for 120/208 volt and 277/480 volt service as scheduled.

B. Enclosure: NEMA Type 1 except as noted. Code gauge galvanized steel boxes and enameled steel fronts, sized for 6" minimum side, top and bottom gutters, or greater as required by NEC. Flush or surface mounting as indicated by the panel schedule, concealed hinge and flush lock all keyed alike.

C. Bus: Copper ratings as scheduled on Drawings. Provide subfeed and feed-through lugs as required. Lugs designed for use for both copper and aluminum conductors. Subfeed shall signify that lugs are tapped ahead of buses and feed-through shall signify that lugs are tapped on load side of the main and buses.

D. Neutral Bar: Copper, full size insulated from the cabinet and provided with lugs for each branch circuit space in the panel.

E. Bonding strap securely attached to the cabinet with lugs as required to receive the bonding conductors indicated and specified.

F. Minimum Integrated Short Circuit Rating:
1. 10,000 amperes rms symmetrical at 240 volt for 120/208V panels served by a dry type transformer rated 75 KVA or less.
2. 22,000 amperes rms symmetrical at 240 volt for 120/208V panels served by a dry type transformer rated greater than 75 KVA.
3. 10,000 amperes rms symmetrical for 480 volt panelboards if down steam of a current limiting breaker.
4. All 480 volt panelboards with feeders less than 100 feet shall have Minimum Short Circuit Rating of 42,000 amperes rms symmetrical. 480 volt Branch panelboards with feeders greater then 100 feet shall have Minimum Short Circuit Rating of 18,000 amperes rms symmetrical.

G. Molded Case Circuit Breakers: Toggle type thermal-magnetic, quick-make, quick-break, with silver-plated contacts, bolt-in type, and with common trip for multiple circuits. Breakers shall have a nominal thickness of 1" per pole. Provide circuit breakers UL listed as Type SWD for switching lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where indicated.

H. Bedroom Circuit Breakers: UL listed as Arc-Fault Circuit Interrupter.

2.4 INDIVIDUALLY MOUNTED CIRCUIT BREAKERS

A. Circuit Breakers as Main: As specified above for Main Panelboard: U.L. labeled for use as service entrance equipment.

B. Molded Case Circuit Breakers: As specified above for Panelboards.

C. Enclosure: NEMA Type 1 general purpose except as noted.

D. Flush or surface mounted as indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards plumb and properly secured. Recessed panels shall be flush with wall finishes.

B. Height: Per N.E.C or as specifically indicated.

C. Provide filler plates for unused spaces in panelboards.

D. Provide typed directory completely filled-in indicating outlets, fixtures, devices, and locations served by the circuit. Revise directory to reflect circuiting changes required to balance phase loads.

E. Stub 4 empty one inch conduits to accessible location above, ceiling and below floor, from each recessed panelboard that has accessible ceilings above and/or below the panel.

F. Provide completed Hazard Warning Labels mounted on each panel.

G. Properly support backboards, and panels. Provide blocking as required.

H. Properly support backboards, and panels. At non structural walls, provide separate support system for panelboards and equipment. Use UNISTRUT P5000 channels or equal. Length and spacing to form rigid separate wall.

3.2 FIELD QUALITY CONTROL

A. Measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 20 percent, rearrange circuits in the panelboard to balance the phase loads within 20 percent. Take care to maintain proper phasing for multi-wire branch circuits.

B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

3.3 WARNING

3.4 PANELBOARD SCHEDULE

A. See Drawings.

END OF SECTION 260470

SECTION 260510 – LUMINAIRES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Interior and exterior luminaires and accessories.

B. Exterior luminaires, poles and accessories.

C. Ballasts.

D. Additional wiring methods for luminaires.

E. Work associated with lighting incentives including but not limited to all forms, worksheets, coordination with Efficiency Maine, submission of invoice or proof of payment submission to Efficiency Maine, coordination with Efficiency Maine for meeting to verify compliance with technical requirements. Efficiency Maine guidelines shall be followed.

F. Pre-approval of incentives by Efficiency Maine is required prior to the purchase and installation of energy efficient equipment.

1.2 REFERENCES

A. NEMA Standards.

B. NFPA 70 N.E.C. Latest Edition.

C. U.L. Standards.

D. ANSI/NFPA 101 - Life Safety Code.

1.3 PERFORMANCE REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70 (N.E.C.).

B. Furnish products listed and classified by Underwriters' Laboratories, Inc. (U.L.) as suitable for purpose specified and shown.

C. Luminaire and pole sized for minimum 100 m.p.h. steady wind with 1.3 gust factor.

1.4 SUBMITTALS

A. Submit Shop Drawings, Owner's Manuals, and Operating.

B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.

C. Product Data: Provide dimensions, ratings, performance data and total input watts.

D. Provide documentation

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site. Inspect for damage.

B. Protect from moisture, corrosion and entrance of debris by storing above grade. Provide appropriate covering.

1.6 PROJECT CONDITIONS

A. Wiring to fixtures as shown on Drawings is diagrammatic only and is intended to show circuit and switching arrangements. Fixtures shall not be used as raceways except as specifically allowed by N.E.C. Art 410.

B. Where panel designation and circuit numbers are shown with no homerun symbol, wiring to same circuits may share same homerun to panel.

PART 2 - PRODUCTS

2.1 LUMINAIRES

A. Furnish products as specified on Drawings.

B. All fixtures shall be approved by Underwriters' Laboratories, Inc., and bear Underwriters' labels.

C. Poles: Provide poles with each site/roadway luminaire. Height, round, square, aluminum or enamel steel as indicated on the schedule. Color to match luminaire. Handhole capable of accepting a duplex receptacle.

2.2 LED Dimming Driver:

1. Fully electronic designed to operate properly on the LED sources indicated. Coordinate with LED manufacturer for compatibility.
2. Drivers shall have a Class A sound rating.
3. Dimming shall be controlled by a Class 1 or Class 2 low-voltage 0-10V circuit.
4. Driver shall operate LEDs at a frequency of 60 Hz.
5. Drivers shall operate from 50/60 Hz input source of 120V or 277V with sustained variations of +/- 10% (voltage and frequency) with no damage to the drive..
6. Driver shall have a Power Factor greater than 90% and the input current shall have Total Harmonic Distortion (THD) of less than 20%.
7. Driver shall tolerate sustained open circuit and short circuit output conditions without damage and without need for external fuses or trip devices.
8. Driver shall have a minimum operating temperature of -40C (-40F).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fixtures: Complete with wiring, drivers, stems, hangers, fittings, end plates, pendant feeds,

aircraft cable, etc.

B. Install in accordance with manufacturer's instructions.

C. Suspended Luminaires.
   1. Pendants:
      a. 1/2" rigid conduit stems, painted to match fixture, with swivel mounts.
      b. Where indicated provide aircraft cable suspension. Feed end shall have canopy with feed grommet and white coiled cord wrapped around cable. Stretch coil making 1" gaps.
      c. Provide pendant length required to suspend luminaire at indicated height. Cut or lengthened to give mounting heights as indicated and required.
      d. Where fixtures are specifically indicated to be chain mounted, provide wire hook chain set & jack chains cut to length as required to suspend luminaire at indicated height. Use MC cable supported by cable ties from fixture to junction box mounted in structure above each fixture.
      e. Except as specifically noted, fixtures shall be supported from structural steel. Provide unistrut channels or equal to span between top cord of joists. Supports shall be suitable for fixture weight and seismic forces.
      f. Pendant suspension details shall be submitted for approval prior to installation.

D. Provide 12 gauge safety hanger wire supports for all fixtures recessed in ceiling grids of suspended acoustical ceilings. Hangers shall be independent of ceiling framing suspension system and shall extend from fixture housing to structure above. Lighting fixtures weighing less than 56 pounds shall have two hangers, at diagonal corners of fixture (2 locations). Lighting fixtures weighing more than 56 pounds shall have four hangers, one at each corner of fixture (4 locations). Wires shall have no tension (slack) to prevent ceiling distortion. In addition, attach to ceiling framing “T”s as required by code.

E. Fixtures with one (1) piece 8' channel shall be supported within two feet (2') of each end and fixtures with 4' channel shall be supported within one foot (1') of each end. Fixtures indicated in continuous rows shall have ends bolted together and shall be provided with 4' long lens constructed so the joint between two (2) sections of an 8' fixture appear the same as two (2) 4' fixtures butted together.

F. Fixtures in sloping ceilings shall have angle face plate for proper orientation of fixture.

G. Locate recessed ceiling luminaires as indicated on reflected ceiling plan. Fixtures shall have frame and trim details to match the ceiling suspension system furnished. Coordinate details with Acoustical Treatment Section and installation with the Ceiling Installer to assure fixtures are centered on tiles or on joints as required.

H. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Install spacers where required to allow proper installation of rabbeted (Tegular) ceiling tiles. Secure to prevent movement.

I. Install clips to secure recessed luminaires in place. Install recessed luminaires to permit removal from below.

J. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.

K. Install wall mounted luminaires at height as indicated.

L. Install accessories furnished with each luminaire.

M. Additional Wiring Methods For Luminaires:
1. Refer to Division 26 Section 260010 - Basic Electrical Requirements: Performance Requirements.
2. Refer to Division 26 Section 260123 - Wire and Cable: Wiring Methods.
3. Recessed and surface incandescent fixtures: Wiring rated minimum 300E F in metallic conduit where required for Underwriters' approval.
4. Fluorescent Fixtures: Wiring within housings and between fixtures and junction boxes above ceilings shall be Type THHN insulated conductors rated for use at temperatures not lower than 90ºC.
5. Wiring From Recessed Fixtures To Junction Boxes: As described in Division 26 Section 260010 “Basic Electrical Requirements”: Performance Requirements.
6. Wiring to Exterior Pole Mounted Luminaires and Bollards: Per Division 26 Section 260111 “Conduit”: Conduit Requirements for underground installations and Section 260123 “Wire and Cable”: Wiring Methods for underground installations and as shown on the Drawings.

N. Bond products and metal accessories to branch circuit equipment grounding conductor.

O. Install poles plumb. Provide shims or double nuts to adjust plumb. Grout around each base for neat smooth tight finish.

3.2 INTERFACE WITH OTHER PRODUCTS

A. Locate fixtures to avoid interference with mechanical and structural features.

B. In finished spaces, consult the Architect prior to making adjustment to fixture locations.

3.3 FIELD QUALITY CONTROL

A. All fixtures and equipment shall be in first-class condition at time of delivery of building to Owners with all scratches, mars, etc., refinished to factory standards.

B. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.4 ADJUSTING/CLEANING/RELAMPING

A. Aim and adjust luminaires after dark as directed.

B. Clean electrical parts to remove conductive and deleterious materials.

C. Remove dirt and debris from enclosure.

D. Clean photometric control surfaces using procedures as recommended by manufacturer.

E. Clean finishes and touch up damage.

3.5 SCHEDULE

A. Shown on Drawings.

END OF SECTION 260510

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SECTION 260535 – EMERGENCY LIGHTING EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Emergency lighting battery units.

B. Exit signs.

1.2 REFERENCES

A. NEMA Standards.

B. NFPA 70 (N.E.C.) Latest Edition.

C. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures.

D. U.L. Standards.

E. ANSI Standards.

1.3 DESIGN REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.(N.E.C.)

B. Conform to local and NFPA 101 for installation requirements.

C. Furnish products listed and classified by Underwriters Laboratories, Inc. (U.L.) as suitable for purpose specified and shown.

D. All components of the same manufacturer.

1.4 SUBMITTALS

A. Submit Shop Drawings, Owner's Manuals, and Operating.

B. Include all components, electrical characteristics, recommended maintenance procedures and intervals.

C. Submit manufacturer's instructions.

1.5 WARRANTY

A. Fully guaranteed for a minimum of three (3) years. Except as noted, batteries shall be warranted for an additional seven (7) years minimum, on a prorated basis with a life expectancy of ten (10) years.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Sure-Lites.

B. Or Approved Equal.

2.2 EMERGENCY LIGHTING BATTERY UNITS

A. As Scheduled on Drawings

2.3 EXIT SIGNS

A. Universal LED type Self powered, complete with ceiling, side wall brackets and arrows and faces as indicated. Brown out, low voltage disconnect, test switch, power indicator.

B. Polycarbonate construction white Face and Red letters.

C. Red LED's Smooth look and no visible LED dots. Less than 3Watts input power.

D. Nickel Cadmium Battery with 15 year pro rated warranty.

E. Sure-Lite LPX Series.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units plumb and level.

B. Aim directional lamp heads to maximize light in egress paths and as directed.

C. D.C. Wiring: No.10 AWG. minimum, or as noted, in rigid conduit or electrical metallic tubing or concealed MC cable.
   1. Except as noted, use home run from each device to associated battery unit.
   2. Devices may share same home run to battery unit provided that each home run meets the following criteria or wire sizes are increased to assure maximum of 2-1/2% voltage drop.

Total Watts	Total Conductor Distance
70	25 ft.
50	35 ft.
36	45 ft.
19	95 ft.

D. AC Wiring to Exit Lights: In separate conduit, or MC cable with ground.

E. Exit Sign Mounting: Generally mount directly above and centered over the doorway opening, on the wall where possible, or mounted from the ceiling when wall mounting is not possible. The intent is to locate signs to allow for maximum visibility. Consult Architect before installation, if in question.

END OF SECTION 260535

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SECTION 260721- FIRE ALARM SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Complete Addressable Fire Alarm System including but not limited to:
   1. Equipment, materials, labor, installation, connection, programming, testing, training and performance of all operations of the intelligent reporting fire alarm system as indicated on the drawings and as herein specified.
   2. Alarm initiating devices, alarm notification appliances, fire alarm control panel (FACP), auxiliary control devices, annunciators, and wiring.
   3. Electronic digital communicator to report Fire alarm events to the owner's central receiving station for fire department notification.

1.2 REFERENCES

A. NFPA 70 (N.E.C.) latest edition.

B. U.L. Standards.

C. FM Factory Mutual

D. NFPA 72 National Fire Alarm Code.

E. ADA - Americans with Disabilities Act.

F. NFPA 101 - Life Safety Code.

G. Local and State Codes.

H. International Electrotechnical Commission (IEC)

I. Fire Department - Rules & Regulations for the Installation of Fire Alarm Systems.

1.3 PERFORMANCE REQUIREMENTS

A. All components shall be of the same manufacturer, FM approved and listed by Underwriters' Laboratories, Inc., and so labeled.

B. Conform to requirements of NFPA 70. (N.E.C.), specifically Art 760.

C. Conform to requirements of the National Fire Protection Association, Standards NFPA 72 NFPA 101 and also all applicable Federal, State and local codes.

D. Conform to all requirements of the Authority Having Jurisdiction (AHJ).

E. Furnish products listed and classified by Underwriters' Laboratories, Inc. (U.L.) as suitable for purpose specified and shown. The fire alarm control panel, network interface and all transponders shall meet the modular labeling requirements of U.L. Each subassembly, including

all printed circuits, shall include U.L. modular labels.

F. Include all necessary software, programming and the selection of the proper type and quantities of the system components to assure a complete, operational, and Code Compliant System.

G. Where the effect of more than one strobe is visible in one location (including reflected light), then configure the system to synchronize the strobes.

H. System shall be field programmable.
   1. Provide the Owner with all required components, interfaces and passwords to allow them full access to the programming features. Provide minimum onsite training on programming features as specified herein under PART 3 "TRAINING".
   2. Provide all hardware, software, programming tools, and documentation necessary to allow modifying the fire alarm network on site. Modifications include addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices and zones.
   3. The system structure and software shall place no limit on the type and extent of ON-SITE software modifications. Software modification shall not require power shut down of system and shall not cause loss of system fire protection while making modifications.

I. The drawings do not show all components, devices and details of the Fire Alarm System. It shall be the responsibility of the authorized supplier/installer to provide full documentation and to provide a fully operational code compliant system.

J. Coordinate with and obtain approval from the local Fire Chief (AHJ), prior to the Shop Drawing submittal.

1.4 SYSTEM DESCRIPTION

A. Fire Alarm System: Addressable automatic and manual initiating with audio visual, Intelligent reporting, microprocessor controlled fire detection/alarm system with network communications capabilities.

B. An active/interactive type system where each addressable device is repetitively scanned, causing a signal to be transmitted to the local fire alarm control panel node indicating that the FACP and its associated initiating devices and notification appliance circuit wiring is functional. Loss of this signal at the local FACP shall result in a trouble indication on both the FACP display and at the network display.

C. System Performance and Supervision (Based on 2007 NFPA 72):
   1. Alarm, trouble and supervisory signals from all intelligent reporting devices: Encoded on NFPA style 6 (Class A) signaling line circuits (SLC).
   2. Initiating device circuits (IDC): Wired class A NFPA Style D as part of an addressable device connected by the SCL circuit (end of line returns to the panel using a separate path).
   3. Notification appliance circuits (NAC): Wired class A NFPA Style Z.
   4. Digital electronic signals: Employ check digits or multiple polling.
   5. Occurrence of single ground or open condition in initiating or signaling circuit places circuit in TROUBLE mode.
   6. Occurrence of single ground or open condition in the initiating circuit does not disable any device on that circuit.

7. Occurrence of single ground or open condition on alarm initiating or signaling circuits does not disable that circuit from transmitting in ALARM.
8. Component or power supply failure places system in TROUBLE mode.
9. Alarm signals arriving at the main FACP shall not be lost following a primary power failure until the alarm signal is processed and recorded.
10. Batteries: Under or over battery voltage, shorted or disconnected battery supply places system in TROUBLE mode.
11. FACP devices are to consist of low current, solid-state integrated circuits, and shall be powered locally from a primary power and standby power source.
12. Power for initiating devices and notification appliances shall be from the main fire alarm control panel, the FACP to which they are connected or to a Remote Booster Power Supply (FCPS).
13. Notification appliance circuits shall have 25% spare capacity.

D. Alarm Sequence of Operation: Actuation of manual fire alarm station, automatic initiating device and sprinkler flow switches causes system to enter ALARM, which includes the following operations:
1. Indicate location of alarm zone on fire alarm control panels for all events.
2. Indicate on LCD display.
3. Activate programmed audio visual devices.
4. Energize the digital electronic communicator to send a message to the owner's central receiving station.
5. Activate all programmed events.
6. Sound and display throughout the building the fire alarm (horn/light) signaling devices as required to evacuate all areas of the building.
7. See Special Programmable Features for additional requirements.

E. Alarm Silence: Configure the system such that the alarm horns/speakers may be silenced, after three (3) minutes, at the associated locked FACP control cabinet and at the locked remote annunciators. Alarm strobes shall remain flashing until system is reset. A subsequent zone alarm shall reactivate the signals.

F. Alarm Reset: RESET function resets alarm system to NORMAL condition (out of ALARM) if alarm initiating circuits have cleared.

G. Trouble Sequence of Operation: System trouble, including grounding or open circuit of supervised circuits, or power or system failure causes system to enter TROUBLE mode, including the following operations:
1. Visual and audible trouble alarm by zone at associated control panel.
2. Visual and audible trouble alarm at annunciator panels.
3. Manual ACKNOWLEDGE function (trouble silence switch) at control panel and at the locked remote annunciators, silences audible trouble alarm; visual alarm is displayed until initiating trouble is cleared.

H. The activation of any system smoke detector shall initiate an Alarm Verification operation whereby the panel resets the activated detector and waits for a second activation. If, after reset, a second alarm is reported from the same or any other smoke detector within one (1) minute the system shall process the alarm. If no second alarm occurs within one minute the system shall resume normal operations. The Alarm Verification shall operate only for smoke detectors. Other activated initiating devices shall be processed immediately.

I. Zoning: Programmable set up and program as direct by Owner and Local Fire Department.

1.5 QUALIFICATIONS

A. Fire alarm equipment Manufacturer: Edwards Systems Technology, Inc. (EST).

B. Supplier (Vendor): R.B.Allen (Tim Biron).
1. Company authorized by the manufacturer and specializing in fire alarm systems with minimum five years experience.
2. Company shall employ NICET (minimum Level II fire alarm technology) technicians.
3. Provide the services of a factory trained and certified representative or technician, experienced in the installation and operation of the type of system provided.
4. The technician shall supervise installation, software documentation, adjustment, preliminary testing, final testing and certification of the system. The technician shall provide the required instruction to the owner's personnel in the system operation and maintenance.
5. The equipment supplier shall be authorized and trained by the manufacturer to calculate, design, install, test, and maintain the system.
6. Company offering service contracts for continuing factory authorized service after the initial warranty period.

1.6 SUBMITTALS

A. Submit Shop Drawings, Owner's Manuals, and Operating.

B. Include floor plan layout and system riser showing all components, devices, wiring, ID addresses and connections:
1. Electronically mark-up showing all wiring between devices, number of conductors, and labeling system.
2. Shop drawings will not be reviewed by the Architect without these drawings.

C. Graphic map plan and drawing shall be submitted to the Owner for review with the Fire Department for approval before installation.

D. Include proposed wiring color code and verification that it meets Bowdoin College standards.

E. Coordinate with the Owner for Fire Department review.

F. Include narrative description of system functions and sequence of operation.

G. Include connection diagrams and catalog cuts of all components, including all equipment, devices, annunciator layout, control panel modules, and internal terminal configurations.

H. Include documentation showing proof of U.L. listing for all system components.

I. Include a fire alarm system function matrix as referenced by NFPA 72. Matrix shall illustrate alarm input/out events in association with initiation devices. Matrix summary shall include system supervisory and trouble output functions.

J. Include Power calculations and Battery capacity calculations. Provide the following supporting information:

1. Total panel supervisory current.
2. Total horn/strobe signal current.
3. Total auxiliary power.
4. Total smoke detector supervisory and alarm power.
5. Total battery amp-hour calculations.
6. Total power on each Remote Booster Power Supply (FCPS).
7. Voltage drop on each notification appliance circuit (NAC voltage drop at each appliance).
8. Power supply rating justification showing power requirements for each of the system power supplies. Power supplies shall be sized to furnish the total connected load in a worst-case condition plus 25% spare capacity.
9. NAC circuit design shall incorporate a 25% spare capacity for future expansion.
10. Battery size shall be a minimum of 125% of the calculated requirement.

K. Include all cable types.

L. Submit manufacturer's instructions.

M. Software and Firmware Operational Documentation:
1. Software operating and upgrade manuals.
2. Program Software Backup: On portable media (jump drive/compact disk), complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

N. Product Data: For each type of product:
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Complete manufacturer’s catalog data including supervisory power usage, alarm power usage, physical dimensions, and finish and mounting requirements.

O. See additional requirement specified in PART 1 under “PERFORMANCE REQUIREMENTS”

1.7 PROJECT RECORD DOCUMENTS

A. Accurately record actual locations and mounting heights of outlets if not as shown on Drawings, plus pull and junction boxes larger than 12x12x6 inches.

B. Accurately record actual routing of conduits larger than 1 inch and main wiring trunks.

1.8 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data.

B. Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

C. Include operating instructions, and maintenance and repair procedures.

D. Include manufacturer's representative's letter stating that system has been tested and is operational. Use NFPA 72 FIRE ALARM SYSTEM CERTIFICATION and DESCRIPTION form.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. EST: Addressable system. Model numbers used except as noted.

2.2 FIRE ALARM CONTROL PANELS AND COMMAND CENTER

A. Fire alarm control panel shall be EST Model iO500. Provide all necessary modules for a complete operational system. Panel shall include a microprocessor based central processing unit (CPU). The FACP shall communicate with and control the following types of equipment used to make up the system: intelligent detectors, addressable modules, control circuits, notification appliance circuits, transponders, local and remote operator terminals, printers, annunciators, and other system controlled devices.

B. FACP shall perform the following functions:
1. Supervise and monitor all intelligent/addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.
2. Supervise all signaling and notification circuits throughout the facility.
3. Detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed.
4. Visually and audibly annunciate any trouble, supervisory and alarm conditions on operator’s terminal, panel display, and annunciators.

C. Capacity and General Operation:

The control panel shall be a multi-processor-based system designed specifically for fire and releasing system applications. The control panel shall be listed and approved for the application standard(s) as listed under the General section.

The control panel shall include all required hardware, software and system programming to provide a complete and operational system. The control panel shall assure that life safety takes precedence among all panel activities.

The control panel shall include the following capacities:

Support up to 500 analog/addressable points per panel.
Support up to 5 fully supervised network remote annunciators.
Support a DACT (dialer) for off premise notification
Support up to 576 chronological events in history.

The control panel shall include the following features:
- Provide auto programming and electronic addressing and mapping of analog/addressable devices.
- Provide an operator interface display that shall include functions required for annunciation, command and control system functions.
- Provide a discreet system control switch provided for reset, alarm silence, local silence,

drill switch, up/down switches, status switch, program switch, two programmable switches.

- Provide system reports that provide sensitivity and history details.
- Provide an authorized operator with the ability to operate or modify system functions like system time, date, passwords; and auto program, enable mapping, restart the system and clear control panel event history file.
- Provide an authorized operator to perform test functions within the installed system.

Supervision of system components, wiring, initiating devices and software shall be provided by the control panel. Failure or fault of system component or wiring shall be indicated by type and location on the LCD display. Software and processor operation shall be independently monitored for failure.

D. Annunciation:

The system shall be designed and equipped to receive, monitor, and annunciate signals from devices and circuits installed throughout the building. Manufacturer's standard control switches shall be acceptable if they provide the required operation, including performance, supervision and position indication. If the manufacturers' standard switches do not comply with these requirements, fabrication of custom manual controls acceptable to the owner is required.

Receipt of alarm, trouble, and supervisory signals shall activate integral audible devices at the control panel(s) and at each remote annunciation device.

The networked annunciator(s) shall be an EST IO500 series.

D. REPORTS:

The system shall provide the operator with system reports that give detailed chronological description of the last 576 system events. The system shall provide a report that gives a listing of the sensitivity and environmental compensation usage of all of the detectors on the system, or specified analog/addressable circuit.

The system report shall also include facility name, compiled date, compiler revision, project revision and report date. The system shall output these reports via the main LCD, and reports shall be capable of being printed on the system printer.

E. DIGITAL ELECTRONIC COMMUNICATOR:

Provide digital electronic communicator.

2.3 SYSTEM COMPONENTS - CONVENTIONAL

A. Horn/Strobes: Combination Audible/Visible signals.

1. Electronic sounders shall operate on 24 VDC nominal.
2. Electronic sounders shall be field programmable without the use of special tools, at a sound level of at least 90 dBA measured at 10 feet from the device.
3. Ability to silence the horn while leaving the visible signal active.
4. Capable of meeting the candela requirements of ADA.
5. Polarized to allow electrical supervision.
6. Candela ratings: Selectable 15, 30, 75, 110, with visual indicator.
7. Set strobe candela initially as shown on drawings and as recommended by the authorized technician.
8. Where drawings show 15/75, then use a fixed 15/75 or set selection at 75.

9. Where more than one strobe is visible in one location, synchronization shall be required.
10. Red face plate with white letters.
11. Flush mounted except in existing masonry walls. Where surface mounted, provide red matching back box.

B. Strobe lights shall meet the requirements of the ADA, UL Standard 1971 and shall meet the following criteria:
1. The maximum pulse duration shall be 2/10 of one second.
2. Strobe intensity shall meet the requirements of UL 1971.
3. The flash rate shall meet the requirements of UL 1971.
4. Where more than one strobe is visible in one location, synchronization shall be required.
5. Candela ratings: Selectable 15, 30, 75, 110, with visual indicator.
6. Set strobe candela initially as shown on drawings and as recommended by the authorized technician.
7. Where drawings show 15/75, then use a fixed 15/75 or set selection at 75.
8. Red face plate with white letters.

C. Beacon (Visual Signals):Tomar Electronics, Inc.
1. Model #495S-1280.
2. DC strobe with ½" male thread mount.
3. 12-80 VDC operation.
4. Red Lens.
5. NEMA 4X.
6. UL standard #583.
7. RFI filter.

2.4 SYSTEM COMPONENTS - INTELLIGENT

A. Addressable Devices - General:
1. Each analog addressable smoke detector's sensitivity shall be capable of being programmed individually as: most sensitive, more sensitive, normal, less sensitive or least sensitive.
2. An alternate alarm sensitivity level shall be provided for each detector, which can be set to any of the five (5) sensitivity settings manually or automatically using a time of day event.
3. The detector's sensing element reference point shall automatically adjust, compensating for background environmental conditions such as dust, temperature, and pressure. Periodically, the sensing element real-time analog value shall be compared against its reference value. The detector shall provide a maintenance alert signal that 80% to 99% compensation has been used. The detector shall provide a dirty fault signal that 100% compensation has been used.
4. The system shall allow for changing of detector types for service replacement purposes without the need to reprogram the system. The replacement detector type shall automatically continue to operate with the same programmed sensitivity levels and functions as the detector it replaced. System shall display an off-normal condition until the proper detector type has been installed or change in the application program profile has been made.

B. Addressable Pull Box (Manual Station):
1. Analog/addressable double action, single stage fire alarm stations at the locations shown on the drawings. The fire alarm station shall be of polycarbonate construction and incorporate an internal toggle switch. A locked test feature shall be provided. The station shall be finished in red with silver "PULL IN CASE OF FIRE" lettering. The manual

station shall be suitable for mounting on North American 2 ½ (64mm) deep 1-gang boxes and 1 ½ (38mm) deep 4 square boxes with 1-gang covers.

C. Intelligent Photoelectric Smoke Detector with CO sensor: The system shall have the ability to set the sensitivity and alarm verification of each of the individual detectors on the circuit. It shall be possible to automatically change the sensitivity of individual analog/addressable detectors for the day and night periods. Each smoke detector shall be capable of transmitting alarm signals as well as normal, trouble and need cleaning information. It shall be possible to program control panel activity to each level. Each smoke detector may be individually programmed to operate at any one of five (5) sensitivity settings. Each detector microprocessor shall contain an environmental compensation algorithm that identifies and sets ambient environmental thresholds approximately six times an hour. The microprocessor shall monitor the environmental compensation value and alert the system operator when the detector approaches 80% and 100% of the allowable environmental compensation value. Field replaceable carbon monoxide sensor/daughterboard. With audible (sounder) base for all bedroom sensors/detectors.

2.5 SYSTEM INITIATION & CONTROL MODULES - INTELLIGENT

A. Intelligent Modules - General:

It shall be possible to address each intelligent module without the use of DIP or rotary switches. Devices using DIP switches for addressing shall not be acceptable. The personality of multifunction modules shall be programmable at site to suit conditions and may be changed at any time using a personality code downloaded from the Analog Loop Controller. Modules requiring EPROM, PROM, ROM changes or DIP switch and/or jumper changes shall not be acceptable. The modules shall have a minimum of 2 diagnostic LEDs mounted behind a finished cover plate. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status. The module shall be capable of storing up to 24 diagnostic codes which can be retrieved for troubleshooting assistance. Input and output circuit wiring shall be supervised for open and ground faults. The module shall be suitable for operation in the following environment:

- Temperature: 32^{o}F to 120^{o}F (0^{o}C to 49^{o}C)
- Humidity: 0-93% RH, non-condensing

B. Addressable Dry Contact Input Module:

1.

The Single Input Module shall provide one (1) supervised Class B input circuit capable of a minimum of 4 personalities, each with a distinct operation. The module shall be suitable for mounting on North American 2 ½" (64mm) deep 1-gang boxes and 1 ½" (38mm) deep 4" square boxes with 1-gang covers. The single input module shall support the following circuit types:

- Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.)
- Normally-Open Alarm Delayed Latching (Waterflow Switches)
- Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.)
- Normally-Open Active Latching (Supervisory, Tamper Switches)

2. The Dual Input Module shall provide two (2) supervised Class B input circuits each capable of a minimum of 4 personalities, each with a distinct operation. The module shall be suitable for mounting on North American 2 ½" (64mm) deep 1-gang boxes and 1 ½" (38mm) deep 4" square boxes with 1-gang covers. The dual input module shall support the following circuit types:

- Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.)

- Normally-Open Alarm Delayed Latching (Waterflow Switches)
- Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.)
- Normally-Open Active Latching (Supervisory, Tamper Switches.

C. Addressable Control Relay Module:

1. The Control Relay Module shall provide one form "C" dry relay contact rated at 2 amps @ 24 Vdc to control external appliances or equipment shutdown. The control relay shall be rated for pilot duty and releasing systems. The position of the relay contact shall be confirmed by the system firmware. The control relay module shall be suitable for mounting on North American 2 ½" (64mm) deep 1-gang boxes and 1 ½" (38mm) deep 4" square boxes with 1-gang covers.

D. Signal Module:

1. The Single Input (Single Riser Select) Signal Module shall provide one (1) supervised Class B output circuit capable of a minimum of 2 personalities, each with a distinct operation. When selected as a telephone power selector, the module shall be capable of generating its own "ring tone". The module shall be suitable for mounting on North American 2 ½" (64mm) deep 2-gang boxes and 1 ½" (38mm) deep 4" square boxes with 2-gang covers, or European 100mm square boxes. The single input signal module shall support the following operations:
   - Audible/Visible Signal Power Selector (Polarized 24 Vdc @ 2A, 25Vrms @50w or 70 Vrms @ 35 Watts of Audio)
2. The Dual Input (Dual Riser Select) Signal Module shall provide a means to selectively connect one of two (2) signaling circuit power risers to one (1) supervised output circuit. The module shall be suitable for mounting on North American 2 ½" (64mm) deep 2-gang boxes and 1 ½" (38mm) deep 4" square boxes with 2-gang covers, or European 100mm square boxes. The dual input signal module shall support the following operation: Audible/Visible Signal Power Selector (Polarized 24 Vdc @ 2A, 25 Vrms @ 50w or 70 Vrms @ 35w of Audio).

E. Serially Connected Annunciator Requirements:

1. The annunciator shall communicate to the fire alarm control node or INA via an EIA-485 (multi-drop) two wire communications loop. The FACP node shall support two 6,000 ft. EIA-485 wire runs. Up to 32 annunciators, each configured up to 64 points, may be connected to connections, for a system capacity of 2,048 points of annunciation.
2. An EIA-485 repeater shall be available to extend the EIA-485 wire distance in 3,000 ft. increments. An optional (UL 864 listed) version shall allow the EIA-485 circuit to be transmitted over Fiber optics.
3. Annunciator switches may be programmed for system control such as global acknowledge, global signal silence, global system reset, and on/off control of any control point in the system.
4. An optional module shall be available utilizing annunciator points to drive EIA-485 driven relays. This shall extend the system point capacity by 2,048 remote contacts.

F. LCD Alphanumeric Display Annunciator (within FACP panel):

1. The alphanumeric display annunciator shall be a supervised, back-lit LCD display containing a minimum of 640 characters for alarm annunciation in clear English text.
2. The LCD annunciator shall display all alarm and trouble conditions from either the network node or complete network, via the INA.
3. Up to 32 LCD annunciators may be connected to a specific (terminal node) EIA-485

interface. LCD annunciators shall not reduce the annunciation capacity of the system. Each LCD shall include vital system wide functions such as system acknowledge, silence and reset.

4. Annunciator control switches for system acknowledge, signal silence, drill and reset shall be key enabled. Provide 2 keys for Owner and 2 keys for the Fire Department.

G. Graphic Map: At FACP, provide a graphic map of the building foot print (1/8"=1”-0” scale) with alpha numeric engraved labels indicating locations for all devices. Graphic map shall have all devices located for all levels and areas. The alpha-numeric display and the graphic map shall be both coordinated to show initiation location by zone, area, floor, room name and number (number shall be the room numbers assigned by the Owner and not the room numbers shown on the contract drawings), device description and device number. The “area” shall be as directed by the local fire department. The graphic map shall be framed and permanently secured to wall. Exact location and layout as approved by shop drawing submittal and the fire department. The graphic map shall meet fire department standards. The graphic map shall have the building foot print “in phase” with the viewer and shall indicate in RED to the viewer “YOU ARE HERE”. Graphic map panel detail plan and drawing shall be submitted to the Fire Department for approval before installation.

2.6 BATTERIES

A. Sealed lead calcium type capable of operation of the system under supervisory conditions for a minimum of 60 hours after power failure and capable of operating the alarm devices for 15 minutes during the 60 hour period. If batteries do not fit in control panels, then remotely mount in battery cabinet in nearest storage/mech room.

2.7 AUXILIARY DEVICES

A. Provide and install interface relays with number of poles as required (in no event less than three poles). Relays shall be Allen-Bradley, or approved equal, Bulletin 700, Type "BR" series, 120 volt coil in NEMA I enclosures. Paint enclosure red and mark "Fire Alarm Relay."

2.8 REMOTE BOOSTER POWER SUPPLIES

A. Remote Booster Power Supplies: The power supply is a device designed for use as either a remote 24 volt power supply or used to power Notification Appliances.

1. Up to 10 amps of regulated 24 volt power. It shall include an integral charger designed to charge 7.0 amp hour batteries.
2. Provide with batteries to support 60 hour standby.
3. The Power Supply shall have two input triggers. The input trigger shall be a Notification Appliance Circuit from the fire alarm control panel or Addressable Control Module. Four outputs (two Style Y or Z and two style Y) shall be available for connection to the Notification devices.
4. The FCPS shall include a surface mount back box.
5. The Power Supply shall include the ability to delay the AC fail delay per NFPA requirements.
6. The Power Supply shall include power limited circuitry, per 1995 UL standards.
7. Provide quantity as required to serve devices shown on plans. Locate in mechanical, electrical or storage rooms. Extend circuit from standby panelboard 120V, 20A, spare breaker. Intent is to distribute the loads to limit wire runs and voltage drop.

2.9 FIRE ALARM WIRE AND CABLE

A. Fire Alarm Power Branch Circuits: Specified in Section 260123 - "Wire and Cable."
   1. Fire Alarm Control Panel: Provide 120 volt 20 amp dedicated circuit from standby electrical panel.
   2. Remote power supplies and other devices requiring line voltage are not shown on the plans. Provide 120 volt 20 amp dedicated circuits from nearest emergency electrical panel.

B. Alarm System Wiring Within Building: Minimum size #16 AWG for initiating circuits and #14 AWG for alarm signal circuits, all copper-THWN, except as noted. Non power-limited wiring (NPLFA) and exposed wiring shall be in rigid conduit or electrical metallic tubing or flexible metal conduit in accordance with Specifications for locations used, see Section 260123 – "Wire and Cable". In lieu of raceways, concealed power limited wiring (PLFA) in dry locations above ceilings, in attic space, in stud walls, except as noted, may be Type MC-FPLP cables approved for use in an air plenum for fire alarm systems.
   1. Cables shall be properly supported, and labeled.
   2. Cables shall be separated from any conductors of power or class 1 circuits and shall not enter in same conduits or J-boxes.
   3. Installation shall meet requirements of NEC Article 760 "Fire Alarm Systems."

C. SLC Multiplex Communication Loop: Twisted shielded pair sized per manufacturer and installed in conduit or as an approved type MC-FPLP cable.

D. Telephone Circuits: Twisted shielded pair sized per manufacturer and installed in conduit or as an approved type MC-FPLP cable.

E. All wiring shall be per manufacturers recommendations for load and length required.

F. Type MC-FPLP:
   1. Armor: Galvanized Interlocking Steel (red or red striped).
   2. Conductors: Solid Copper.
   3. Conductor Insulation: TFN 18 & 16 AWG and/or THHN 14 & 12 AWG
   4. Assembly: Polyester Assembly Tape; Twisted Shielded: Laminated Aluminum/Mylar® Shield with Tinned Copper drain wire
   5. Maximum FPLP: 105°C (dry)
   6. Maximum 300V (FPLP)
   7. Manufacturer: AFC Cable Systems or equal.

2.10 ENCLOSURES

A. Control panels shall be housed in UL listed cabinets suitable for surface or semi-flush mounting. Cabinets shall be corrosion protected, given a rust-resistant prime coat, and the manufacturer's standard finish. Mount flush in finished areas.

2.11 FIREMAN'S KEY BOXES

A. Fireman's Key Boxes: Provided by the General Contractor.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, and shelf life if applicable.

B. Store materials inside, under cover, above ground, and kept dry and protected from physical damage until ready for use. Remove from site and discard wet or damaged materials.

3.2 PROJECT CONDITIONS

A. Installed products or materials shall be free from any damage including, but not limited to, physical abuse, dirt and debris, moisture, and mold damage.

B. Environmental Limitations: Do not deliver or install products or materials until spaces are enclosed and weather tight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

3.3 INSTALLATION

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

B. Wiring shall be concealed in walls and above ceilings. Wiring in exposed construction shall be enclosed in conduit and run along structural members and painted to match.

C. Minimum size conduit: 3/4 inch. Refer to above paragraph: FIRE ALARM WIRE AND CABLE.

D. Install manual station with operating handle 48 inches above floor. Install audible and visual signal devices 80 inches above floor, or 6” below ceiling whichever is lower, except as noted.

E. Smoke detectors shall not be installed prior to system programming and testing period. If construction is on going during this period, then protect the smoke detectors from contamination and physical damage.

F. Make conduit and wiring connections to door release devices, sprinkler flow switches, sprinkler valve tamper switches.

G. Automatic Detector Installation: Per NFPA 72.

H. Provide nameplates identifying all equipment, junction boxes and controls. Paint all junction boxes red.

I. Wiring Color Code: See Division 26 Section 260195 "Electrical Identification."

J. All devices and panels shall be flush mounted in finished areas and may be surface mounted in unfinished areas such as storage rooms. Where devices are surface mounted, the back box shall be a cast red box designed to mate with the device for a smooth appearance.

K. Remote fire alarm voice evacuation microphone stations shall be located at the auditorium and

the gymnasium, and as listed herein, coordinate exact locations with the fire department.

L. Wire installation shall be inspected by the fire department. Coordinate with Owner for inspections from the fire department.

M. Factory Trained, licensed authorized technical representative of the manufacturer of the equipment shall adjust taps after installation to meet requirements.

3.4 SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for 2 years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

C. Provide 30 days' notice to Owner to allow scheduling and access to system.

3.5 MANUFACTURER'S FIELD SERVICES

A. Provide the services of a Factory Trained, licensed authorized technical representative of the manufacturer of the equipment to supervise the installation and final connections, plus adjusting, programming and all testing of the system required to assure a complete and fully operative facility in accordance with the specifications; and to instruct designated personnel in the operation, adjustment, testing and maintenance of the system. Provide letter certifying results of test.

B. Include testing at substantial completion, at 6 months after occupancy and again two weeks prior to end of first year warranty. (Total of 3 complete documented tests). Invite the Owner, Architect and Local Fire Department to witness each test.

C. Include testing of the fire alarm system Horn/Strobe audio/visual devices to assure that the signals are operating according to the guidelines set by the NFPA 72 and the Americans with Disabilities Act (ADA).
   1. The limitations are as follows: NFPA – "Audible signals intended for operation in the public mode should have a sound level of not less than 75 dBA at 10 feet or more than 130 dBA at the minimum hearing distance from the audible appliance." ADA – "Audible emergency alarms shall produce a sound that exceeds the prevailing equivalent sound level in the room or space by at least 15 dBA or exceeds any maximum sound level with a duration of 60 seconds by 5 dBA, whichever is louder. Sound levels for alarm signals shall not exceed 120 dBA."
   2. Test the audio/visual units and make adjustments where required, including setting volume of horns and replacing strobes with proper intensity level. If horns are not adjustable then replace for proper dB level. Submit findings in writing, with areas marked that do not meet criteria after adjustments have been made.

3.6 SYSTEM FIELD TEST

A. Test in accordance with NFPA 72 and local fire department requirements. See PART 1 of this specification, article "SUBMITTALS" for additional requirements.

B. Test shall include but not be limited to:
   1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
   2. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.
   3. Verify activation of all flow switches.
   4. Open initiating device circuits and verify that the trouble signal actuates.
   5. Open signaling line circuits and verify that the trouble signal actuates.
   6. Open and short notification appliance circuits and verify that trouble signal actuates.
   7. Open and short (wire only) network communications and verify that trouble signals are received at network annunciators or reporting terminals.
   8. Ground initiating device circuits and verify response of trouble signals.
   9. Ground signaling line circuits and verify response of trouble signals.
   10. Ground notification appliance circuits and verify response of trouble signals.
   11. Check alert tone and prerecorded voice message to all alarm notification devices.
   12. Check installation, supervision, and operation of all intelligent smoke detectors using walk test.
   13. Each of the alarm conditions that the system is required to detect shall be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control panel points.
   14. When the Vendor determines that the system must be equipped with optional features to satisfy this specification, the manufacturer's manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

C. Arrange with the Owner for final system test and approval by the Local Fire Department (Authority Having Jurisdiction).

3.7 FINAL INSPECTION

A. A factory trained representative shall demonstrate that the system functions as specified.

B. Demonstrate in the presence of the Owner, Local Fire Chief, and the contractor. Invite the Architect's representative.

3.8 INSTRUCTIONS

A. In addition to the site training on programming features previously specified, provide minimum of two four hour periods to instruct the owner in the proper operation and maintenance requirements of the system. Provide one four hour period at substantial completion (after all testing and the system is fully operational and accepted by the fire department) and the other four hour period six months after substantial completion. Video tape both training sessions for owner's record.

B. Provide a typewritten, bound, laminated "Sequence of Operation" to the Owner.

3.9 TRAINING

A. Provide minimum of 8 hours on site training on programming features.

END OF SECTION 260721

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SECTION 270010 - VOICE/DATA SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This Section includes the following:
   1. Voice/Data Connectivity: Cable and terminations between Patch Panels and Station Outlets.
   2. Voice/Data cabling system terminated in labeled rack mounted modular patch panels, terminated per ANSI/TIA/EIA assignments as directed by owner with Category 6A cable tested to Cat 6A specifications.
   3. Voice, data outlets and faceplates.
   4. Termination patch panels, in two-post rack.
   5. Complete installed and tested data cabling system.
   6. J-Hooks to manage cabling.

1.2 SECTION DOES NOT INCLUDE

A. Wiring pathways; Coordinate with Section 260010 Basic Electrical Requirements.

1.3 RELATED REQUIREMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section. Examine all contract documents for requirements affecting the work.

1.4 REFERENCES

A. In addition to appropriate standards identified in other sections of this specification, the installation of voice/data systems shall conform to the following:
   1. NFPA 70 (NEC) latest edition.
   2. ANSI/TIA/EIA Standards (telecommunications industry association standards - all applicable with addenda) latest edition. When items or systems have been specified and standards have not yet been adopted by ANSI/TIA/EIA, the latest proposed standard at the time of installation shall be used.
      a. ANSI/TIA/EIA-568B.1 - Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements
      b. ANSI/TIA/EIA-568B.2 - Commercial Building Telecommunications Cabling Standard - Part 2: Balance Twisted-Pair Cabling Components
      c. ANSI/TIA/EIA-568B.2-1 - Commercial Building Telecommunications Cabling Standard - Part 2: Balance Twisted-Pair Cabling Components Addendum 1 - Transmission Performance Specifications for 4-pair 100 Ohm Category 6 Cabling.
      d. ANSI/TIA/EIA-569A - Commercial Building Standard for Telecommunication Pathways and Spaces
      e. ANSI/TIA/EIA-606 - Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
      f. ANSI/TIA/EIA-607 - Commercial Building Grounding and Bonding Requirements for Telecommunications

1.5 QUALITY ASSURANCE

A. Owner's IT Representative
   1. Coordinate installation with owner's technology department.

B. Product and System Certification:
   1. The voice/data communications systems shall be furnished, installed and tested as a category 6A system.
   2. All individual components furnished shall be designed, manufactured, tested and certified to meet the standards for the system category for which they were furnished.
   3. The installed system(s) shall be installed, tested and carry a Asystem certification and warrantee that it meets the standards for the system category specified.

C. Qualifications:
   1. Company specializing in the installation of voice/data and fiber optic system connectivity with a minimum of five years experience.
   2. Company shall possess licenses/permits required to perform voice/data installations in the project jurisdiction.
   3. The company shall be registered with BICSI and have at least one RCDD on staff. In lieu of an on-staff RCDD the contractor may sub-contract the services of an RCDD to provide contractor design and construction oversight and to supervise all testing. Provide a minimum of 40 hours of RCDD field time during construction plus time to document field notes. A minimum of five site visits shall be made during construction. In addition, provide on-site services of an RCDD to supervise all testing and certification.
   4. The contractor shall have previous experience in installing systems of the category specified.
      Provide qualified technicians with extensive backgrounds in data/communications and fiber optic installation, termination and testing. Personnel shall be trained and certified in the design and installation of the cabling system provided by the system manufacturer. Personnel certifications shall be current and updated by attending a manufacturer's re-certification class at least every two years.
   5. Company shall offer service contracts for continuing service after the initial warranty period.

1.6 SUBMITTALS

A. Include racks, wire management, devices, wire and cable, performance characteristics, details for labeling and color coding.

B. Include cable attenuation and NEXT specifications.

C. Test results: Provide in labeled three ring binder showing test results of all station runs. Each test shall be labeled with station ID. Include data on testing equipment, including manufacturer, model number, date last tested.

1.7 PROJECT RECORD DOCUMENTS

A. Accurately record actual locations and mounting heights of outlets if not as shown on Drawings, plus cable routing.

1.8 PRODUCT HANDLING

A. Delivery and Storage: Job materials shall be kept dry and protected at all times. Protect against exposure to wet weather and contact with damp or wet surfaces.

1.9 PROJECT CONDITIONS

A. Wire and cable routing is not shown on Drawings. Route wire and cable as required to meet project conditions.

B. Determine exact routing, number of conductors and lengths required.

1.10 COORDINATION

A. Locate such that outlets are readily accessible.

B. Determine required separation between cable and other work.

C. Determine cable routing to avoid interference with other work.

D. Verify exact device type and configuration plus color coding prior to shop drawing submittals.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide products for a category 6A voice/data communications system.

B. Products shall be individually tested and shall be certified to meet, by the manufacturer, the individual component test standards for the category system in which they will be applied.

C. The completed communication system(s) shall be tested from patch panel to each station drop. Test results shall be verified and certified by the system components manufacturer to provide the category performance specified. The components manufacturer shall provide a minimum 15 year systems performance warranty.

D. Product catalog numbers indicated are based on a Siemons/Comm Scope solution unless otherwise indicated. Numbers are latest available. Update model numbers as required to assure conformance to latest approved category 6 standards. The following manufacturers with warrantied solutions will be considered for approval.
   1. Manufacturer:
      a. Siemons
      b. Hubbell
      c. Superior Modular Products
      d. Panduit.
      e. Krone
      f. NORDX
      g. Approved equal.

2.2 COMMUNICATION DISTRIBUTION RACKS

A. Racks shall be 7 foot high by 19 inch wide racks, black, provided with both vertical and horizontal cable management and equipped as shown and/or specified. Vertical cable management shall be provided although not specifically detailed on drawings. Vertical cable organizers shall be provided on each end of the rack assembly and one between each rack 19 inch section.

B. Equipment racks sections - 7' H x 19" W, 45 rack units, black Hubbell HPW84RR19.

C. Grounding Strap: 16 position grounding strap rack.

D. Vertical cable organizers: 4 ½" wide, vertical "Z" channel, black, Hubbell VS74

E. Horizontal cable organizers - 7 split "D"-Rings, 6 pass through holes, hinged cover duct, Hubbell HC219CC3N

2.3 CAT 6 COPPER SYSTEM 48-PORT PATCH PANELS:

A. Rack mounted 48-port Hubbell Nextspeed cat 6 patch panel, two rack units high (2UPPP) with clear plastic label holders, #P6E48U.

B. Provide quantity of patch panels to receive all cables plus 25%.

2.4 COPPER TERMINATIONS

A. Terminal Blocks:
   1. Acceptable Manufacturers:
      a. AT&T, Model #110 Series.
      b. Leviton.
   2. Wiring Block: Fire-retardant molded plastic, 100 pair block with horizontal index strips to secure 25 cable pairs each.
      a. Self-supporting with legs to provide space behind the block for cables terminated on the wiring block and space on the sides for vertical jump through.
      b. Index Strips: Designed to accept 22 through 26 gauge conductors and marked with five tip colors.
   3. Connecting Block: 4-pair insulation displacement 1-piece fire-retardant plastic double ended unit.
      a. Termination End: Solder-plated quick clips that cut through the insulation when pushed onto the wiring block.
      b. Cross Connect End: Designed to accept 22 through 26 gauge wires without removing the insulation.
      c. Front color coded per owner requirements.
      d. Quantity as required to cover all index strips specified.
   4. As a minimum, provide number of blocks to receive all outlets shown plus 50%.

2.5 COMMUNICATION OUTLETS

A. Based on Hubbell solutions or approved equal.
   1. White, modular type, front loading. Provided with outlet configurations indicated.
   2. All unused openings shall be provided with blanks.
   3. Single gang plate frames: IMF1W (Total 6 unit modules)
   4. Double gang IMF2W (Total 6 unit modules per gang)

5. Equal to Hubbell “Xcelerator” with front loading keystone modules to receive devices indicated.

B. Wall phone face plates shall be stainless steel single outlet designed to accept wall-mounted phone.

C. Jacks shall be identified as voice or data.

2.6 WIRE AND CABLE

A. Acceptable Manufacturers: Cable manufacturers certified as Hubbell Cable Partners including:
1. Comm Scope, General Cable, Mohawk/CDT, Superior Essex, Berk-Tek, Approved equal.

B. Inside Plant Voice/Data Cat 6 Copper Cable:
1. 100 Ohm balanced, 4 pair, 24 gauge, UTP.
2. UL MPR/CMR, Non-Plenum, Riser-Rated.
3. Flame retardant PVC jacket.
4. Jacket color: Ivory for Voice and Blue for Data.

2.7 BACKBOARDS

A. Material: APA Plywood Grade AC.

B. Size: 3/4 inch thick, 4 x 8 feet for main backboard, minimum 4x4 feet for satellite backboards or as shown on Drawings.

C. Paint all sides two coats Dark Gray.

D. Provide copper ground wire terminated on copper ground bus - see specifications.

2.8 WIRING PATHWAYS & SUPPORTS

A. Caddy Cablecat Clips or equal (J-hooks)
1. Assembly clip spacing shall not exceed four (4) feet (Random 3’ to 4’). Spacing shall allow no more than 12 inch cable sag at mid span.
2. Cable Attachment: Secure all cables to assemblies/clips with velcro ties.
3. Accessories and Fittings: Manufacturer's standard clamps, hangers, brackets.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work.

B. Verify that field measurements are as shown on Drawings.

C. Verify that building is watertight before start of installation. Do not install cable until building is water- tight.

3.2 INSTALLATION

A. Coordinate pathways with Division 26.

B. Support all cables above ceiling from on J-hooks tied loosely with Velcro straps, Maintain separation between voice and data cables and limit cable in bundles to 12 cables maximum.

C. Install and terminate connectivity in accordance with manufacturer's guidelines for the equipment specified.

D. Label each station outlet and port on patch panel with Rack number, room number and station number. Verify labeling with Owner.

E. Color coding of individual wires for data shall match Owner's standard color code system. Contractor to confirm with Owner.

3.3 TESTING

A. Testing of all newly installed cable channels shall be performed prior to system cut over.

B. General Copper Testing:
1. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA/EIA-568.
2. All pairs of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed.
3. All twisted-pair copper cable links shall be tested for continuity, pair reversals, shorts, opens and performance as indicated.
4. Continuity - Each pair of each installed cable shall be tested using a test unit that shows opens, shorts, polarity and pair-reversals, crossed pairs and split pairs. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance

C. Cat6 Copper Testing:
1. All category 6A field testing shall be performed with an approved digital level 3 balanced twisted-pair field test device.
2. All installed category 6A channels shall perform equal to or better than the minimum requirements listed in ANSI/TIA/EIA-568B.2-1.
3. All Category 6A balanced twisted-pair cables shall be 100 percent tested according to ANSI/TIA/EIA-568-B.1. Test parameters include wire map, length, NEXT loss (pair-to-pair), and NEXT loss (power sum, ELFEXT loss (pair to pair), ELFEXT loss (power sum), return loss, insertion loss, propagation delay, and delay skew.
4. Each installed cable link shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to outlet. The cable length shall conform to the maximum distances set forth in the ANSI/TIA/EIA-568-B Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number.
5. Test equipment criteria
    a. All balanced twisted-pair field testers shall be factory calibrated each calendar year by the field test equipment manufacturer as stipulated by the manuals provided with the field test unit. The calibration certificate shall be provided for review prior to the start of testing.

b. Autotest settings provided in the field tester for testing the installed cabling shall be set to the default parameters.
c. Test settings selected form options provided in the field testers shall be compatible with the installed cable under test.

D. Replace and retest all cable that does not meet the minimum requirements.

3.4 ADMINISTRATION AND DOCUMENTATION

A. Labeling:
1. Horizontal cables shall be labeled at each end. The cable or its label shall be marked with its identifier.
2. A unique identifier shall be marked on each faceplate to identify it as connecting hardware.
3. Each port in the faceplate shall be labeled with its identifier
4. A unique identifier shall be marked on each piece of connecting hardware to identify it as connecting hardware.
5. Each port on the connecting hardware shall be labeled with its identifier.

B. Drawings: As-built drawings shall be supplied by the Contractor showing the locations of and identifiers for all cable routing and terminations.

C. Records:
1. All records shall be created by the installation Contractor and turned over at the completion of work.
2. The format shall be computer based and both soft copies and hard copies shall be part of the As-built package. The minimum requirements include:
a. Cable records must contain the identifier, cable tray, termination positions at both ends, splice information as well as any damaged pairs/conductors.
b. Connecting hardware and connection hardware position records must contain the identifier, type damaged position numbers, and references to the cable identifier attached to it.
c. Test documentation on all cable types shall be included as part of the As-built package.

D. Reports: All reports shall be generated from the computer based program to create the records above. These reports should include but not be limited to the following:
1. Cable reports.
2. Cross-connect reports.
3. Connecting hardware reports.

3.5 SYSTEM WARRANTY

A. A minimum 15 year warranty for the category 6A structured cabling system shall be provided for the end-to-end channel model installation which shall cover applications, assurance, cable, connecting hardware and the labor cost for the repair or replacement thereof.

B. Additional Features of the Warranty Shall Include:
1. Margin over category 6 channel specifications on all parameters across the entire frequency range of 1-250 Mhz as noted below: Manufacturer shall publish and submit their values in the following form:

Parameter	Guaranteed Margin 1-250 Mhz (dB)
Insertion loss	dB
NEXT loss	dB
PS NEXT loss	dB
ACR	dB
PS ACR	dB
ELFEXT	dB
PS ELFEXT	dB
Return loss	dB
Propagation Delay	ns
Delay Skew	ns

2. Performance claims based on worst case testing and channel configurations.
3. Applications shall not exceed bit error rates specified by IEEE, ATM Forum, ANSI and ISO standards for all current and future applications operating on compliant LAN equipment that has been designed for use with a compatible category or class of balanced twisted-pair cabling.

END OF SECTION 270010

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