PROJECT MANUAL

FIRE ALARM SYSTEM REPLACEMENT – SEWING PLANT

SCO # **xx-xxxx**

COLUMBUS CORRECTIONAL INSTITUTION

1255 PRISON CAMP RD
WHITEVILLE, NC 28425

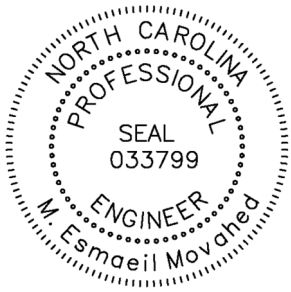
Prepared by:
NC Department of Adult Corrections
Central Engineering
JOS # XXXX

Date – 6/24/2024

DOCUMENT 00 0107 - SEALS PAGE

1.1 DESIGN PROFESSIONALS OF RECORD

A. Electrical Engineer:
   1. M. Esmaeil Movahed
   2. PE License # 033799.
   3. Responsible for Division 26 Section.



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FIRE ALARM SYSTEM REPLACEMENT-SEWING PLANT

COLUMBUS CORRECTIONAL INSTITUTION

JUNE 24, 2024

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SECTION 26 0519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Copper building wire rated 600 V or less.
2. Connectors, splices, and terminations rated 600 V and less.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: Indicate type, use, location, and termination locations.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Alpha Wire Company.
2. Okonite Company (The).
3. Southwire Company.

C. Standards:
1. Listed and labeled as defined in NFPA 70, by the NCBCC (North Carolina Building Code Council) accredited testing agency and marked for intended location and application.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 ASTM B496 for stranded conductors.

E. Conductor Insulation:
1. Type THHN and Type THWN-2: Comply with UL 83.
2. Type XHHW-2: Comply with UL 44.

2.2 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by the NCBCC (North Carolina Building Code Council) accredited testing agency and marked for intended location and application.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. 3M Electrical Products.
   2. AFC Cable Systems; Atkore International.
   3. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
   4. TE Connectivity Ltd.

C. Jacketed Cable Connectors: For steel jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
   1. Material: Copper.
   2. Type: standard barrels.
   3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; Class B stranded for No. 8 AWG and larger.

C. Use conductors not smaller than No. 12 AWG for power circuits. Maximum conductor size shall be 500 KCMIL.

D. Use minimum No. 10 AWG conductors for 20 ampere, 120-volt branch circuits longer than 50 feet. Refer to drawings for additional requirements.

E. Use No. 10 AWG conductors for 20 ampere, 277-volt branch circuits longer than 125 feet. Refer to drawings for additional requirements.

F. Use conductors not smaller than No. 14 AWG for control circuits. Use stranded conductors for control circuits.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. All wiring shall be Single conductor insulated wire in conduit. Install a code gauge green insulated grounding conductor in all raceways. Individual full neutral wire shall be provided for each circuit.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 26 0533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Completely and thoroughly swab raceway before installing wire.

D. Use manufacturer approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

E. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

F. Pull all conductors into raceway at same time.

G. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

H. Support cables according to Section 26 0529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

A. Clean conductor surfaces before installing lugs and connectors.

B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

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

D. Joints in solid conductors shall be made using Ideal "Wirenuts, 3M Company "Scotchlocks", or other approved insulated spring, with plastic cap, twist on connector.

E. Joints in stranded conductors shall be made using approved mechanical connectors and gum rubber or friction tape with an outer covering of two layers of plastic tape equal to Scotch "33+". Solderless mechanical connectors for splices and taps, provided with UL approved insulating covers, may be used in place of mechanical connectors and tape.

F. "Sta Kon" or other permanent type crimp connectors shall not be used for branch circuit connections.

G. Conductors, in all cases, shall be continuous from outlet to outlet and no splicing shall be made except within outlet or junction boxes, troughs and gutters.

H. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 26 0553 "Identification for Electrical Systems."

B. Color Coding:

C.	Phase	208Y/120V	277/480V
D.	A	Black	Brown
E.	B	Red	Orange
F.	C	Blue	Yellow
G.	Neutral	White	Natural Gray
H.	Ground	Green	Green

I. Identify each spare conductor at each end with identity number and location of other end of conductor and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 0544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

END OF SECTION 26 0519

SECTION 26 0529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Steel slotted support systems.
2. Conduit and cable support devices.
3. Support for conductors in vertical conduit.
4. Structural steel for fabricated supports and restraints.
5. Mounting, anchoring, and attachment components, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
6. Fabricated metal equipment support assemblies.

1.2 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, and coordinated with each other, using input from installers of the items involved.

B. Welding certificates.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by the NCBCC (North Carolina Building Code Council) accredited testing agency and marked for intended location and application.
1. Flame Rating: Class 1.
2. Self-extinguishing according to ASTM D635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Raceway and boxes shall be supported in a method and at a spacing as approved by the NFPA-70 NEC. Conduits installed on the interior of exterior building walls shall be spaced off the wall surface a minimum of 1/4 inch using “clamp-backs” or strut.

B. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. ABB, Electrification Business.
b. Allied Tube & Conduit; Atkore International.
c. B-line; Eaton, Electrical Sector.
2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
3. Material for Channel, Fittings, and Accessories: Paintable Galvanized steel.
4. Channel Width: Selected for applicable load criteria.
5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: NOT ALLOWED
2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      1) B-line; Eaton, Electrical Sector.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti, Inc.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.
6. Toggle Bolts: All Stainless-steel springhead type.
7. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 05 5000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
1. NECA 1.
2. NECA 101
3. NECA 105.

B. Comply with requirements "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
   1. Secure raceways and cables to these supports with two-bolt conduit clamps.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
   1. To Wood: Fasten with lag screws or through bolts.
   2. To New Concrete: Bolt to concrete inserts.
   3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
   4. To Existing Concrete: Expansion anchor fasteners.
   5. Powder Actuated Fasteners are not allowed.
   6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
   7. To Light Steel: Sheet metal screws.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

END OF SECTION 26 0529

PART 1 - SECTION 26 0533 – RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 2 - GENERAL

2.1 SUMMARY

A. Section Includes:
1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Surface raceways.
5. Boxes, enclosures, and cabinets.
6. Underground raceway installation
7. Handholes and boxes for exterior underground cabling.

2.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

2.3 INFORMATIONAL SUBMITTALS

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

PART 3 - PRODUCTS

3.1 METAL CONDUITS AND FITTINGS

A. Metal Conduit:
1. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by the NCBCC (North Carolina Building Code Council) accredited testing agency and marked for intended location and application.
2. GRC: Comply with ANSI C80.1 and UL 6.
3. IMC: Comply with ANSI C80.6 and UL 1242.
4. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
   a. Comply with NEMA RN 1.
   b. Coating Thickness: 0.040 inch, minimum.
5. EMT: Comply with ANSI C80.3 and UL 797.
6. FMC: Comply with UL 1; zinc-coated steel.
7. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings: Comply with NEMA FB 1 and UL 514B.
1. Listing and Labeling: Listed and labeled as defined in NFPA 70, the NCBCC (North Carolina Building Code Council) accredited testing agency and marked for intended location and application.
2. Fittings, General: Listed and labeled for type of conduit, location, and use.
3. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.

4. Fittings for EMT:
   a. Material: Steel.
   b. Type: compression.
5. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
6. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

3.2 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:

B. Listing and Labeling: Listed and labeled as defined in NFPA 70, the NCBCC (North Carolina Building Code Council) accredited testing agency and marked for intended location and application.
1. ENT: Comply with NEMA TC 13 and UL 1653.
2. RNC: Comply with NEMA TC 2 and UL 651 unless otherwise indicated.
3. LFNC: Comply with UL 1660.
4. HDPE : Smooth wall conduit, approved/listed for directional boring, approved/listed for electrical system installations, and minimum Schedule 80 meeting ASTM D2447/F2160/NEMA TC-7.

C. Nonmetallic Fittings:
1. Fittings, General: Listed and labeled for type of conduit, location, and use.
2. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
3. Fittings for LFNC: Comply with UL 514B.
4. Solvents and Adhesives: As recommended by conduit manufacturer.

3.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by the NCBCC (North Carolina Building Code Council) accredited testing agency and marked for intended location and application.

B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

3.4 BOXES, ENCLOSURES, AND CABINETS

A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

C. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

E. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

F. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

G. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

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

3.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:
1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, the NCBCC (North Carolina Building Code Council) accredited testing agency and marked for intended location and application. Retain one or more of three paragraphs below to select enclosure type(s) for areas not subject to traffic by vehicles. Indicate location of each type in "Raceway Application" Article. For enclosures with cover options, verify that selected cover is available with load rating specified in "Raceway Application" Article. If retaining more than one type of box and cover combination, indicate location of each type on Drawings.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Armorcast Products Company.
b. NewBasis.
c. Oldcastle Enclosure Solutions.
d. Oldcastle Precast, Inc.
e. Quazite; Hubbell Incorporated, Power Systems.
2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

6. Cover Legend: Molded lettering, "ELECTRIC" or “COMMUNICATION” as indicated on drawings.
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of cast iron.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Armorcast Products Company.
   b. NewBasis.
   c. Oldcastle Enclosure Solutions.
   d. Quazite; Hubbell Incorporated, Power Systems.
2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC" or “COMMUNICATION” as indicated on drawings.
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

PART 4 - EXECUTION

4.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: GRC.
3. Underground Conduit: RNC, Type EPC-40-PVC, concrete encased.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated.
1. Exposed, Not Subject to Physical Damage and above 8’-0” AFF: EMT.
2. Exposed and Subject to Severe Physical Damage or below 8’-0” AFF:
   a. GRC and two-hole straps fastened on both sides of the conduit with tamper resistant fasteners.
   b. Provide raceway boxes without knockouts. The use of knockout seals is acceptable as an alternative.
3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
5. Damp or Wet Locations: GRC.
6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface raceways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

4.2 INSTALLATION

A. Comply with requirements in Section 26 0529 "Hangers and Supports for Electrical Systems" for hangers and supports.

B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.

D. Do not fasten conduits onto the bottom side of a metal deck roof.

E. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

F. Comply with requirements in Section 26 0529 "Hangers and Supports for Electrical Systems" for hangers and supports.

G. Arrange stub-ups so curved portions of bends are not visible above finished slab.

H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

I. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.

J. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

K. Support conduit within 12 inches of enclosures to which attached.

L. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Arrange raceways to keep a minimum of 3 inches of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from ENT to GRC before rising above floor.

M. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

N. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

O. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

P. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

Q. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

R. Surface Raceways:
1. Install surface raceway with a minimum 2-inch radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

S. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces.

T. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Conduit extending from interior to exterior of building.
4. Conduit extending into pressurized duct and equipment.
5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
6. Where otherwise required by NFPA 70.

U. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
   d. Attics: 135 deg F temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per degree F of temperature change for PVC conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

V. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, use a maximum of 36 inches of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
   1. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

W. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

X. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between the box and cover plate or the supported equipment and box.

Y. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

Z. Locate boxes so that cover or plate will not span different building finishes.

AA. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

BB. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

CC. Set metal floor boxes level and flush with finished floor surface.

DD. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

4.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Directional Boring: Directional boring (DB) is a trenchless technology method to install high density polyethylene electrical (HDPE) conduit used for underground electrical distribution systems.

1. Provide smooth wall HDPE conduit, approved/listed for directional boring, approved/listed for electrical system installations, and minimum Schedule 80.
2. Provide a minimum size HDPE conduit of 4 inches. Install HDPE conduit with a minimum ground cover of 72 inches in pavement- or non-pavement-covered areas.
3. Pre-installed cable-in-conduit is not permitted. Install the conduit(s) immediately after the conduit hole is completed.
4. See drawings for details.

4.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.

D. Install handholes with bottom below frost line.

E. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

4.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

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

4.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies.

4.7 PROTECTION

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

END OF SECTION 26 0533

SECTION 26 0553 – ELECTRICAL IDENTIFICATION

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Nameplates and labels.

B. Wire and cable markers.

C. Conduit markers.

1.2 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code.

1.3 SUBMITTALS

A. Submit under provisions of Section 26 0100.

B. Product Data: Provide catalog data for nameplates, labels, and markers.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

1.4 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by third party agencies accredited by the NCBCC to label electrical and mechanical equipment, as suitable for purpose specified and shown, where such listing exists.

PART 2 – PRODUCTS

2.1 NAMEPLATES AND LABELS

A. Nameplates: Engraved three-layer laminated plastic, with white letters on a background colored as follows:

1.	Fire Alarm System:	Bright Red.
2.	Telephone/Data System:	Orange
3.	Sound System:	Dark Blue.
4.	Security	Dark Red (Burgundy)
5.	Emergency Systems	Green
6.	Data Systems	Brown
7.	Paging Systems	White (with black core)
8.	TV Systems	Purple
9.	208 Volt System:	Blue.
10.	480 Volt System:	Black.

B. Locations:

1. Each safety switch, panelboard, automatic transfer switch, transformer, switchboard, motor control center and other electrical equipment supplied for the project. Information

on the nameplate shall include; equipment controlled and/or served, phase and voltage appropriate NEC categorization load as indicated on the drawings.

C. Provide graphic sign that shows the location of all service points such as utility, generator, solar photovoltaic and battery bank on related electrical panel, disconnect switch or equipment.

D. Letter Size: Minimum of 1/2 inch.

E. Labels: Embossed adhesive tape, with 3/16-inch white letters on black background. Use only for identification of individual wall switches and receptacles.

F. Label Information: Equipment controlled and/or served, voltage, phase, etc.

G. Nameplates shall be securely attached to equipment with self-tapping stainless-steel screws; if the screw sharp end is protected; otherwise rivets shall be used.

2.2 WIRE MARKERS

A. Description: Cloth, tape, split sleeve, or tubing type wire markers.

B. Locations: Each conductor at panelboard gutters, pull boxes, outlet and junction boxes and each load connection.

C. Legend:
1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.

2.3 CONDUIT MARKERS

A. Location: Furnish markers for each conduit longer than 20 feet.

B. Color:

1.	Fire Alarm System:	Bright Red.
2.	Telephone/Data System:	Orange
3.	Sound System:	Dark Blue.
4.	Security	Dark Red (Burgundy)
5.	Emergency Systems	Green
6.	Data Systems	Brown
7.	Paging Systems	White
8.	TV Systems	Purple
9.	208 Volt System:	Blue.
10.	480 Volt System:	Black.

C. As an alternative to the above requirements, conduit in unfinished areas may be marked with spray paint.

2.4 UNDERGROUND WARNING TAPE

A. Description: 6-inch-wide, 4 mils thick, plastic tape, detectable type, bright colored with suitable warning legend, continuously printed, describing buried electrical lines.

PART 3 – EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive nameplates and labels.

3.2 APPLICATION

A. Install nameplates and labels parallel to equipment lines.

B. Secure nameplate to equipment front using rivets.

C. Paint colored band on each conduit longer than 20 feet, 20 feet on center.

D. All junction and pull boxes in conduit runs shall have their covers and exterior surfaces painted to match the colors in sections above.

E. All junction and pull boxes in conduit runs that serve Fire Alarm System Devices shall have their covers and exterior surfaces painted red.

E. Identify all underground conduits using underground warning tape. Install one tape per trench at 6 to 8 inches below finished grade.

F. All empty conduits, and conduits with conductors, for future use shall be identified for use and shall indicate on each end where they terminate. Identification shall be by tags with string or wire attached to the conduit or outlet.

END OF SECTION 26 0553

SECTION 28 4621.11 - ADDRESSABLE FIRE-ALARM SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. This section defines requirements for furnishing, installation, connection, and check-out of addressable fire alarm systems to be provided in the buildings specified on the drawings. They shall include all fire alarm devices shown on the drawings and specified herein, as well as methods necessary to interconnect the devices to obtain a completely operable system. Each building will a have new standalone fire alarm control unit that is either located near the Gard watch area or remote annunciates at the guard station; hence, it can be monitored 24/7.

1.2 ACTION SUBMITTAL

A. Product Data: For each type of product, including furnished options and accessories.
1. Include construction details, material descriptions, dimensions, profiles, and finishes.
2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Shop Drawings: For fire-alarm system.
1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output fire alarm functions matrix and fire alarm riser.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
12. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.
13. Drawings showing the location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the device.
14. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
15. Indicate audible appliances required to produce square wave signal per NFPA 72.

C. General Submittal Requirements:
   1. Shop Drawings shall be prepared by persons with the following qualifications:
      a. Trained and certified by manufacturer in fire-alarm system design.
      b. NICET-certified, fire-alarm technician; Level III minimum.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.
   1. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum five years documented experience, and with service facilities within 150 miles of Project.
   2. Installer: Company specializing in installing the products specified in this section with minimum five years documented experience. The technicians are required to be trained and individually certified by the manufacturer, for the FACP model/series being installed. This training and certification must have occurred within the most recent 24 months, except that a NICET Level III certification will extend this to 36 months. Copies of the Certifications must be part of the Shop Drawing submittal to the engineer.

B. Fire alarm system Manufactured by following shall be considered acceptable:
   1. Honeywell - Notifier or FCI
   2. Johnson Controls – Simplex Grinnell
   3. Siemens

C. Regulatory requirements
   1. Conform to requirements of the latest editions of the North Carolina State Building Code, NFPA 70, NFPA 72, NFPA 101, ANSI S34.1, UL listing for Fire Protection, UL864UUKLSmoke Control Listing, FM Approval-Factory Mutual Approval Guide, Owner and all applicable required government regulations.
   2. Furnish products listed and classified by third party agencies accredited by the NCBCC to label electrical and mechanical equipment as suitable for purpose specified and indicated, where such listing exists.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
   1. Copies of the following items include "Operation and Maintenance Data” shall deliver to Owner.
      a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
      b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
      c. Complete wiring diagrams showing connections between all devices and equipment include all device addresses and the Air-Sampling Ports
      d. Fire Alarm Riser diagram and Matrix
      e. Record copy of site-specific software.
      f. A signed statement of the Spare Parts and the Training that provided to the Owner.

g. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
   1) Equipment tested.
   2) Frequency of testing of installed components.
   3) Frequency of inspection of installed components.
   4) Requirements and recommendations related to results of maintenance.
   5) Manufacturer's user training manuals.
h. Manufacturer's required maintenance related to system warranty requirements.
i. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

B. Software and Firmware Operational Documentation:
   1. Software operating and upgrade manuals.
   2. Program Software Backup: On magnetic media or compact disk, complete with data files.
   3. Device address list.
   4. Printout of software application and graphic screens.

1.5 QUALITY ASSURANCE

A. All connections to the FACP and the system's programming shall be done only by the manufacturer, or by an authorized distributor that stocks a full compliant of spare parts for the system.

B. The installer may make program changes shall present for the 100% test during the Designer, the Owner and SCO inspection.

1.6 SPARE PARTS

A. The following spare parts shall be provided with the system. For multi-building projects, calculate quantities separately for each building that contains a dedicated fire alarm control panel. If FACP also serves auxiliary buildings (e.g., storage, boiler/chiller), calculate as if one building. Increase decimal quantities to the next higher whole number
   1. Fuses (If Used).....2 of each size in system
   2. Manual Fire Alarm Boxes.....2% of installed quantity
   3. Addressable Control Relays.....4% of installed quantity
   4. Indoor Horns/Speakers with Strobes Lights.....4% of installed quantity
   5. Indoor Strobe-only Notification Appliances.....4% of installed quantity
   6. Monitor Modules (Addressable Interface).....4% of installed quantity
   7. Isolation Modules / Isolation Bases.....4% of installed quantity
   8. Addressable, Electronic Heat Detectors.....4% of installed quantity
   9. Spot-Type Smoke Detectors / Sounder Bases.....6% of installed quantity
   10. No spares are required for projected beam, air sampling, or duct smoke detectors

1.7 WARRANTY

A. All equipment and associated wiring shall be free from inherent mechanical and electrical defects for manufacturer’s standard warranty period or a period of 12 months, whichever is greater, from the date of final acceptance.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Noncoded, NRTL, addressable system, with multiplexed signal transmission and horn/strobe evacuation.

B. All components provided shall be NCBCC approved third party listed for use with the selected system.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by the NCBCC (North Carolina Building Code Council) accredited testing agency and marked for intended location and application.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
1. Manual stations.
2. Heat detectors.
3. Smoke detectors.
4. Duct smoke detectors.

B. Fire-alarm signal shall initiate the following actions:
1. Continuously operate alarm notification appliances.
2. Identify alarm and specific initiating device at fire-alarm control unit connected network control panels.
3. Release fire and smoke doors held open by magnetic door holders.
4. Activate voice/alarm communication system.
5. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
6. Activate smoke-control system.
7. Close smoke dampers in air ducts of designated air-conditioning duct systems.
8. Record events in the system memory.
9. Record events by the system printer.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Loss of communication with any panel on the network.

D. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of communication with any addressable sensor, input module, relay, control module, printer interface, or Ethernet module.
4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal ac voltage at fire-alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.
10. Hose cabinet door open.

E. System Supervisory Signal Actions:

1. Initiate notification appliances.
2. Identify specific device initiating the event at fire-alarm control unit connected network control panels.
3. Record the event on system printer.
4. Transmit system status to building management system.

2.3 FIRE-ALARM CONTROL UNIT

A. General Requirements for Master Fire-Alarm Control Panel and Fire-Alarm Control Unit:
1. The system shall be the addressable type, with a 24vdc nominal operating voltage.
2. The system shall have multiple access levels, so owner's authorized personnel can disable individual alarm inputs or normal system responses (outputs) for alarms, without changing the system's executive programming or affecting operation of the rest of the system. The process on how to do this must be included in the training required to be given to the owner's designated personnel and shall also be part of the written documentation provided by the fire alarm equipment supplier.
3. Loss of Power: Alarm signals arriving at the main FACU shall not be lost following a power failure (or outage) until the alarm signal is processed and recorded.
4. The FACU must have an Alarm Silence Soft Key (Push Button) and be equipped with the Subsequent Alarm (alarm resound) feature. Any graphic displays located away from the alarm area must also include an audible signal with alarm resound feature.
5. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
    a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
    b. Include a real-time clock for time annotation of events on the event recorder and printer.
    c. Provide communication between the FACU and remote circuit interface panels, annunciators, and displays.
    d. The FACU shall be NCBCC approved third party listed for connection to a central station signaling system service.
    e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACU shall provide a minimum 500-event history log.
6. Addressable Initiation Device Circuits: The FACU shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
7. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACU shall be NCBCC approved third party listed for releasing service.
8. The FACU shall provide or be capable of expansion to 198 intelligent/addressable devices per Signaling Line Circuits (SLC) minimum, per system. The number of SLCs and Notification Appliance Circuits provided shall accommodate the number of devices as shown on the Drawings with minimum 20% spare capacity.
9. A supervised AHU bypass switch shall be provided in the FACU to accommodate testing and maintenance. The switch shall indicate a trouble condition when in the bypass position.
10. Programmable, supervised switches for fire safety function bypasses. i.e. NAC Bypass, HVAC Shutdown Defeat, Smoke Control Bypass, Door holder bypass, etc. Switch operation shall be password protected.

11. All existing fire alarm control units and new fire alarm control units will communicate with the new master fire alarm control unit located in Gate House building. See Drawing EF601 for more information.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
1. Annunciator and Display: Liquid-crystal type, three line(s) of 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

C. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
1. Pathway Class Designations: NFPA 72, Class A for Initiating Devices and Signaling-Line Circuits and Class B for Notification-Appliance circuits.
2. Pathway Survivability: Level 1.
3. Install no more than 100 addressable devices on each signaling-line circuit.
4. Serial Interfaces:
   a. One dedicated RS 485 port for future remote operation using point ID DACT.
   b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).

D. Notification-Appliance Circuit:
1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
2. Where notification appliances provide signals to sleeping areas, the alarm signal shall be a 520-Hz square wave with an intensity 15 dB above the average ambient sound level or 5 dB above the maximum sound level, or at least 75 dBA, whichever is greater, measured at the pillow.
3. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

E. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls shall be connected to fire-alarm system.

F. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

G. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also, print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

H. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 75% of the power-supply module rating.

I. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
Batteries: Shall be completely maintenance free, shall not require liquids, fluid level checks or refilling, and shall not be capable of producing spills and/or leaks. Batteries shall be sealed gel-cell type with expected life of 10 years. Battery voltage shall be as required by the FACP and related equipment. Battery shall have enough capacity to power the fire alarm system for not less than 24 hours plus 5 minutes of alarm upon a normal AC power failure. NAC circuits shall not exceed 75% of maximum current load allowed. Battery shall have label to read date of installation and date of manufacture.

J. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

K. Network Communication:
1. The network architecture shall be based on a Local Area Network (LAN), a firmware package that utilizes a peer-to-peer, inherently regenerative communication format and protocol. The network shall use a deterministic token-passing method. Collision detection and recovery type protocols are not acceptable substitutes due to life safety requirements. In addition, there shall be no master, polling computer, central file computer, display controller or other central element (weak link) in the network which, on failure, may cause complete loss of network communications or cause major degradation of network capability. There shall be no cascading of CPUs or master/slave relationships at the network level to facilitate network communications. Failure of any node shall not cause failure or communication degradation of any other node or change the network communication protocol among surviving nodes located within distance limitations. Each node/panel shall communicate on the network at a baud rate of not less than 312 KBPS (kilobits per second). A node may be an intelligent Fire Alarm Control Panel (FACU), Workstation, Embedded Gateway, Network Control Annunciator (NCA), BACnet Gateway, Modbus Gateway, or Network Web Server (NWS). The network shall be capable of expansion to at least 103 nodes.
2. Each network node address shall be capable of storing Event equations. The event equations shall be used to activate outputs on one network node from inputs on other network nodes.
3. The network shall be capable of communicating via wire or fiber optic medium. A wire network shall include a fail-safe means of isolating the nodes in the unlikely event of complete power loss to a node.
4. A mix (hybrid) fiber/wire network repeater shall be supported. Systems that have distance limitations and have no available means to regenerate signals are not suitable substitutes.
5. Fiber Optic Network Communication: The network shall support fiber optics as indicated on drawings.

2.4 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall

show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key operated switch.

2.5 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:
   1. Comply with UL 268; operating at 24-V dc, nominal.
   2. Detectors shall be two-wire type.
   3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
   4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
   5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
   6. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
   7. Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.

      a. Multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:
   1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
   2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
      a. Primary status.
      b. Device type.
      c. Present average value.
      d. Present sensitivity selected.
      e. Sensor range (normal, dirty, etc.).

C. Duct and Plenum Smoke Detectors: Photoelectric type suitable for air velocity present complying with UL 268A.
   1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
   2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
      a. Primary status.
      b. Device type.
      c. Present average value.
      d. Present sensitivity selected.
      e. Sensor range (normal, dirty, etc.).
   3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL, shall be NCBCC approved third party listed for use with the supplied detector for smoke detection in HVAC system ducts.
   4. Each sensor shall have multiple levels of detection sensitivity.

5. Sampling Tubes for duct detectors: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Provide a 12 inch by 12 inch (minimum depending on duct size and access required) hinged access panel for sampling tube inspection and cleaning. Indicate the airflow direction on the duct, adjacent to the detector using stencil or permanent decal.
7. Provide backbox and extension GIS pipe for spot type air plenum smoke detectors to readjust as suitable for free air sampling and current pathways.
8. Provide a Remote Alarm Indicator Light (RAIL) with an alarm LED and key type test switch. Locate as shown on plans or at an interior corridor location. RAIL's shall operate on 24 VDC nominal.

2.6 MULTICRITERIA DETECTORS

A. Mounting: Twist-lock base interchangeable with smoke-detector bases.

B. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

C. Automatically adjusts its sensitivity by means of drift compensation and smoothing algorithms. The detector shall send trouble alarm if it is incapable of compensating for existing conditions.

D. Test button tests all sensors in the detector.

E. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
   1. Primary status.
   2. Device type.
   3. Present sensitivity selected.
   4. Sensor range (normal, dirty, etc.).

F. Sensors: The detector shall be comprised of four sensing elements including a smoke sensor, a carbon monoxide sensor, an infrared sensor, and a heat sensor.
   1. Smoke sensor shall be photoelectric type as described in "System Smoke Detectors" Article.
   2. Carbon monoxide sensor shall be as described in "Carbon Monoxide Detectors" Article.
   3. Heat sensor shall be as described in "Heat Detectors" Article.
   4. Each sensor shall be separately listed according to requirements for its detector type.

2.7 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.
   1. Temperature sensors shall test for and communicate the sensitivity range of the device.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
   1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
   2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 195 deg F.
   1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
   2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.8 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
   1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol. Output sound level shall be 110 dB maximum.

C. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.
   1. Rated Light Output:
      a. 15/30/75/110 cd, selectable in the field.
   2. Mounting: Wall mounted unless otherwise indicated.
   3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
   4. Flashing shall be in a temporal pattern, synchronized with other units.
   5. Strobe Leads: Factory connected to screw terminals.
   6. Mounting Faceplate: Factory finished, red.
   7. The Fire Alarm Contractor shall verify all candela settings prior to conducting the voltage drop testing required later in this document. Contractor shall also verify the design candela settings are adequate for the space being covered. Care must be taken to assure the devices are mounted in the exact locations shown on the approved shop drawing documents. Notify the designer of any deficiencies.

D. Exit Marking Audible Notification Appliance:
   1. Exit marking audible notification appliances shall meet the audibility requirements in NFPA 72.
   2. Provide exit marking audible notification appliances at the entrance to all building exits.
   3. Provide exit marking audible notification appliances at the entrance to areas of refuge with audible signals distinct from those used for building exit marking.

2.9 FIREFIGHTERS' SMOKE-CONTROL SYSTEM

A. Initiate Smoke-Management Sequence of Operation:
   1. Comply with sequence of operation as described in drawings FA401, detail C3 "Sequence of Operations for HVAC DDC."
   2. Fire-alarm system shall provide all interfaces and control points required to properly activate smoke-management systems.

3. First fire-alarm system initiating device to go into alarm condition shall activate the smoke-control functions.
4. Subsequent devices going into alarm condition shall have no effect on the smoke-control mode.

B. Addressable Relay Modules:
1. Provide address-setting means on the module. Store an internal identifying code for control panel use to identify the module type.
2. Allow the control panel to switch the relay contacts on command.
3. Have a minimum of two normally open and two normally closed contacts available for field wiring.
4. Shall be NCBCC approved third party listed for controlling HVAC fan motor controllers.

2.10 MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
1. Electromagnets: Require no more than 3 W to develop 25-lbf holding force.
2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
3. Rating: 24-V ac or dc unless otherwise noted.

B. Material and Finish: Match door hardware.

2.11 GRAPHIC ANNUNCIATOR

A. Framed Graphic Plan: Framed floor plans, mounted at the FACP. Plans shall show all system devices with the unique device identification numbers indicated adjacent to each device. The identification numbers shall match those represented in the as-built drawings and those reported at the FACU.

2.12 ADDRESSABLE INTERFACE DEVICE

A. General:
1. Include address-setting means on the module.
2. Store an internal identifying code for control panel use to identify the module type.
3. Shall be NCBCC approved third party listed for controlling HVAC fan motor controllers.

B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.

C. Integral Relay: Capable of providing a direct signal.
1. Allow the control panel to switch the relay contacts on command.
2. Have a minimum of two normally open and two normally closed contacts available for field wiring.

D. Control Module:
1. Operate notification devices.

2.13 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632. Provide only digital communicator that are external to the fire alarm control unit (FACU). Do not incorporate the digital communicator in the FACU. The communicator transmitter shall be provided to accommodate future connection to Capitol Police.

B. Future Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:
   1. Verification that both telephone lines are available.
   2. Programming device.
   3. LED display.
   4. Manual test report function and manual transmission clear indication.
   5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:
   1. Address of the alarm-initiating device.
   2. Address of the supervisory signal.
   3. Address of the trouble-initiating device.
   4. Loss of ac supply.
   5. Loss of power.
   6. Low battery.
   7. Abnormal test signal.
   8. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.14 SYSTEM PRINTER

A. Printer shall be NCBCC approved third party listed and labeled as an integral part of fire-alarm system.

2.15 SURGE PROTECTION

The following protection against voltage transients and surges must be provided by the fire alarm equipment supplier, and installed by the electrical contractor:

A. On AC Input: A feed-through (not shunt-type) branch circuit transient suppressor such as Leviton 51020-WM-DIN, or Ditek DTK-120SRD 20 Amp or equivalent UL 1449 - Latest Edition Listed device.

B. On DC Circuits Extending Outside Building: At a point near entry to the building provide "pi"-type filter on each leg, consisting of a primary arrestor, series impedance, and a fast-acting secondary arrestor that clamps at 30v-40v. Some acceptable models: Simplex 2081-9027, Simplex 2081-9028, Transtector TSP8601, Ditek DTK 2MHLP24BWB series, Citel America

B280-24V, and Northern Technologies DLP-42. Submit data on others to the engineer for approval. UL 497B listing is normally a prerequisite for their consideration. Devices using only MOV active elements are not acceptable.

C. See additional information 'Transient Arrestor Installation Detail' on drawings.

2.16 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
   1. Factory fabricated and furnished by device manufacturer.
   2. Finish: Paint of color to match the protected device.
   3. Device guard shall be NRTL listed for use with device.

2.17 FIRE ALARM DOCUMENTS (FAD) STORAGE CABINET:

A. Description: The Fire Alarm Documents Cabinet (FAD) shall be provided, to comply with the NFPA 72 2013 requirements, and shall be maintained at the location of the fire alarm control unit. The Fire Alarm Documents cabinet shall be used as a storage box for both printed and digital documentation. This cabinet shall be constructed of durable 16 gauge steel with a solid piano hinge and key lock. The cabinet includes a 4GB USB memory flash drive interface. The Fire Document Box (FDB) interior is designed to contain critical manuals and documents. It is constructed with a durable steel retainer. The FDB has two key ring hooks to hold system keys, and a frame to insert Authorized personnel business cards. In the inner door, add the Legend Sheet to record property, system, service, code and AHJ certification information, as well as required documentation. Complete configuration data (site-specific programming) for the system shall be stored on USB memory flash drive and archived by the fire alarm system manufacturer or authorized distributor. A copy of this site-specific data base shall also be placed in the Documentation Cabinet.

B. Features:
   1. Installed with a 4 gigabyte digital flash drive interface with USB B connector.
   2. Overall Dimensions: 12" W x 13" H x 2¼" D.
   3. Offers two, key ring hooks to hold the system keys.
   4. Contains a frame plate to insert Authorized Personnel business cards.
   5. Constructed with 16 gauge steel box and cover for added security with a solid stainless steel hinge.
   6. Coated with a durable, baked-on finish (other colors available).
   7. Built with a stainless steel piano hinge with standard ¾"cat 30 key lock (other lock assemblies available).
   8. Includes a Legend Sheet to record passwords and system information.
   9. Imprinted with white indelible ink, 1" high lettering labeled, "FIRE ALARM DOCUMENTS."

2.18 FIRE-ALARM WIRE AND CABLE

A. AC power circuit shall be No. 12 AWG THHN/THWN solid copper color coded conductors.

B. Notification appliances circuits shall be installed using No. 14 AWG, stranded copper, type THHN/THWN conductors.

C. Air handler shutdown and door control shall be wired with No. 14 AWG, stranded copper, type THHN/THWN conductors.

D. Notification Alarm appliance (NAC) circuits shall be NFPA 72 Class B. The load connected to each circuit must not exceed 80% of rated module output and the coverage of each circuit shall not exceed 3 floors (to limit the effect of faults and to facilitate trouble shooting). The NAC voltage drop during alarm must not exceed 14% of the voltage measured across the batteries at that time. To achieve this, design must consider wire size, length of circuit, device load, inherent voltage loss within the FACU's power supply, etc. The contractor shall use power outage testing to verify that the NAC circuit was designed and installed properly. Notification appliance circuits shall be installed using minimum No. 14 AWG, stranded copper, type THHN/THWN conductors. Air handler shutdown and door control shall be wired with No. 14 AWG, stranded copper, type THHN/THWN conductors.

E. Addressable signaling line circuits (SLC) shall be NFPA Class A with no "T" taps. SLC's shall be wired per the manufacturer's published recommendations and requirements. Addressable loop (signaling line) circuits shall be wired with type FPL/FPLR/FPLP fire alarm cable, No. 18 AWG minimum, low capacitance, twisted unshielded copper conductors. Each must have a minimum of 20% spare addresses, for future use. Individual loops are permitted to cover more than 1 floor of a building, if shown on the drawings. Splices shall not be permitted other than at device terminal blocks or on terminal blocks in cabinets. "Wire nuts" and crimp splices will not be permitted. Shielded cable is permitted to be used if required by the manufacturer.

F. All junction boxes shall be painted red.

G. Color coding shall be as follows:
1. Alarm notification appliance circuits – Blue (+) / Black (-)
2. AHU Shutdown circuits – Yellow (+) / Brown (-)
3. Door Control Circuits – Orange
4. Addressable signaling circuits – Red (+) / Black (-) with red overall jacket.

For expansion or rework of new systems, the color-coding shall match the existing color codes.

H. Make addressable connections with supervised interface device to the following devices and systems. Install interface device less than 36 inch from device controlled.
1. Alarm-initiating connection to smoke-control system (smoke purge) at firefighters' smoke-control system panel.
2. Smoke dampers in air ducts of designated HVAC duct systems.
3. Magnetically held-open doors.
4. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
5. Supervisory connections at valve supervisory switches.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
   1. Devices placed in service before all other trades have completed cleanup shall be replaced.
   2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.
   3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.
   6. Do not locate addressable modules in unconditioned spaces.

B. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.

C. Manual Fire-Alarm Boxes:
   1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.
   2. Mount manual fire-alarm box on a background of a contrasting color.
   3. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.

D. Smoke- or Heat-Detector Spacing:
   1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
   2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
   3. Smooth ceiling spacing shall not exceed 30 feet.
   4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A in NFPA 72.
   5. HVAC: Locate detectors not closer than 36 inches from air-supply diffuser or return-air opening.
   6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.

E. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches long shall be supported at both ends.
   1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.

G. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector that is not readily visible from normal viewing position.

H. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

I. Visible Alarm-Indicating Devices: Install adjacent to each alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.

J. Device Location-Indicating Lights: Locate in public space near the device they monitor.

K. Install label on battery to read date of installation and date of manufacture.

3.3 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions. Connect hardware and devices to fire-alarm system.
   1. Verify that hardware and devices are NCBCC approved third party listed for use with installed fire-alarm system before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
   1. Alarm-initiating connection to smoke-control system (smoke management) at firefighters' smoke-control system panel.
   2. Smoke dampers in air ducts of designated HVAC duct systems.
   3. Magnetically held-open doors.
   4. Supervisory connections at valve supervisory switches.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals.

B. Install framed instructions in a location visible from fire-alarm control unit.

3.5 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.6 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction. The Engineer of Record is the AHJ for reviewing shop drawings and verifying testing requirements as per NFPA 72.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

D. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   1. Visual Inspection: Conduct visual inspection prior to testing.
      a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
      b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
   2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
   3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
   4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
   5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
   6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
   7. The person that programmed the system shall be present for the final inspection.
   8. Provide copies of battery and voltage drop calculations at the final inspection.

E. Pre-final inspection: The Contractor and Manufacturer’s authorized installer will conduct 100% full system test in the presence of the Owner and the Designer.

F. Final Inspection: The Fire Alarm Contractor’s technician that programmed the system, shall be present on the day of the AHJ and SCO inspection(s). The fire alarm system will be inspected, with portions of it functionally tested. Use synthetic smoke to simulate smoke for testing detectors, as well as functionally testing the system interface with building controls, fire extinguishing systems and any off premises supervising station. Operation of any smoke removal system will be checked as instructed by the AHJ. This statistical (sampling) inspection is intended to assure that the contractor has properly installed the system and performed the 100% operational test as required by NFPA 72. The electrical contractor shall provide two-way radios, ladders, keys for resetting and other equipment, and any other materials needed for testing the system, including a suitable smoke source. The contractor shall verify the voltage drop of each NAC circuit by testing and recording the voltage at the origin and at the EOL for each NAC circuit, under battery power only. Prior to conducting these tests, the contractor shall verify the candela settings of all strobes. Provide documentation of these tests at the SCO final inspection.

G. Fire-alarm system will be considered defective if it does not pass tests and inspections.

H. Prepare test and inspection reports.

I. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

J. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.7 DEMONSTRATION

A. The manufacturer's authorized representative must instruct the owner's designated employees in operation of the system, and in all required periodic maintenance. A minimum of 8 hours on-site time will be allocated for this purpose and, for those facilities operating on a 24-hour basis (prisons, hospitals, etc.) one additional hour of instruction will be individually provided for the 2nd and 3rd shift. The training shall be video recorded and digital copies shall be provided to the owner. Two copies of a written, bound summary will be provided, for future reference.

B. Some facilities maintain their own systems and require more in-depth training. Check to verify needs and requirements.

C. Scheduling of training must be arranged to meet the Owner’s schedule. Additional training shall be available at a cost to be mutually agreed upon by the Owner and the Contractor.

D. Training shall be in the Owner’s provided location.

E. The training may not be waived, deleted, or reduced in the number of hours required.

F. Training shall cover as minimum the following topics:
   1. Preventive maintenance service techniques and schedules, including historical data trending of alarm and trouble records.
   2. Overall system concepts, capabilities, and functions. Training shall be in depth, so that the owner shall be able to take any device out of service and return any device to service without need of Manufacturer’s approval or assistance.
   3. Explanation of all control functions, including training to program and operate the system software.
   4. Methods and means of troubleshooting and replacement of all field wiring devices.
   5. Methods and procedures for troubleshooting the main fire alarm control panel, including field peripheral devices as to programming, bussing systems, internal panel and unit wiring, circuitry and interconnections.
   6. Manuals, drawings, and technical documentation. Actual system software used for training shall be provided in digital form and shall be left with the Owner at the completion of training for the Owner’s use in the future.
   7. The training schedule shall be coordinated with the owner. A written competency test must be submitted to the engineer and to the owner as a sample prior to using the written competency test at the site. A written description of a hands-on test shall be provided to the engineer and owner for review prior to using the test at the site. As a minimum the following tests shall occur during certification of the owner’s employee.
      a. Three smoke heads shall be taken offline at the panel and removed physically.
      b. Three smoke heads shall be reinstalled and returned to service at the fire alarm panel.

c. The vendor shall provide three dirty smoke detector heads to be installed at various positions in the building. The owner shall print a sensitivity report and the employees shall find the “dirty” smoke detector heads by reviewing the sensitivity report.

d. A ground fault and an isolation problem shall be introduced by the vendor into the system. The employees shall then find the ground fault and the isolation problem.

e. An NFPA 72 “Record of Completion” form shall be provided, and the employees shall fill out the forms which shall be checked by the vendor for proper use of the form.

f. The vendors shall witness the owner’s “trained” employees, train other employees and correct any mistakes made during the training session.

END OF SECTION 28 4621.11