

SECTION 26 00 10 – BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Summary of Electrical Work: The electrical work includes, but is not limited to, the following:
 - 1. Underground secondary electric service and distribution.
 - 2. Grounding System.
 - 3. Roughing in and branch circuit wiring.
 - 4. Interior and Emergency Lighting System.
 - 5. Fire Alarm System.
 - 6. Telecommunications Wiring System.
 - 7. Coordination with mechanical subcontractor including supervision of HVAC temperature control system wiring work.
 - 8. Other work as required to provide a complete and operating system.
- B. Site Inspection: Visit the site, before submitting bid, to become familiar with the procedural manner, materials, labor, quantities, and expenses involved in completing the work. No allowances for extra work will be granted to accomplish these ends if the need for which could have been foreseen or anticipated by such a visit.
- C. Allowances
 - 1. Cash Allowance: \$5,000.
 - 2. Allowance includes payment to Central Maine Power for installation of distribution conductors, service connections, and equipment to the building.
- D. Related Sections:
 - 1. Drawings, Division 00, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUBMITTALS

- A. Submit under procedures given in Section 01 33 00.
- B. Submit shop drawings and product data grouped in sets to include complete submittals of related systems, products, and accessories in a single submittal. Clearly mark each submittal with appropriate specification section and paragraph reference.
- C. Mark dimensions and values in units to match those specified.
- D. Electrical submittals shall be reviewed by, and carry the approval stamp of, the electrical subcontractor and be initialed and dated by the reviewer.
- E. Submit certificate of final inspection and approval from authority having jurisdiction, and record electrical drawings.
- F. Upon request, provide samples for inspection. Samples will be returned after inspection is completed.
- G. Manual: Upon completion of this portion of the Work, and as a condition of its acceptance, deliver to the Engineer for the Owner two copies of a manual describing the system:
 - 1. Provide manuals in durable plastic ring binders, nominal 8½ x 11" size.

2. Identification on, or readable through, the front cover stating general nature of the manual.
3. A copy of all reviewed submittals and shop drawings.
4. Complete instructions regarding operation and maintenance of all equipment involved.
5. Complete name and address of nearest vendor of replaceable parts.
6. Copy of all guarantees and warranties issued.
7. Where contents of manuals include manufacturer's catalog pages, clearly indicate the precise items included in this installation.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Electrical: Conform to ANSI/NFPA 70, National Electrical Code.
2. Utility: Conform to the standards of:
 - a. Central Maine Power Co. (CMP)
3. Obtain permits and request inspections from local building inspector.

B. Electrical materials, devices, and equipment shall be new. Where standards have been established by the following, they shall conform to those standards as to quality, fabrication, application, and installation and be not less than further required under this specification.

1. Underwriters Laboratories, Inc. (UL).
2. National Electrical Manufacturers Association (NEMA).
3. American National Standards Association (ANSI).
4. National Fire Protection Association (NFPA).
5. Occupational Safety and Health Administration (OSHA).
6. National Electrical Contractors Association (NECA).
7. Fairpoint.
8. Central Maine Power Co. (CMP).
9. Standards of local Building Codes, Electrical, and Fire Departments, City of Portland.

1.4 WORK SEQUENCE & COORDINATION

- A. Install work under this section so as to conform to the progress of the work of other sections. Complete the electrical work as soon as conditions of the building will permit.
- B. Coordinate in advance with other trades the shape, size and position of all necessary openings, sleeves, supports and related and coordinate electrical installation with mechanical equipment, piping and ductwork to avoid conflicts and to provide electric service and wiring as required for a complete and operating system.
- C. Refer to Division 23 for electrical work required for mechanical. Prior to roughing in, verify that the electrical characteristics of the mechanical equipment being provided are compatible with the electric power circuits specified; if in doubt consult Engineer.
- D. Wiring for H&V temperature controls is specified under Division 23 but shall be supervised by and wired to the standards of this section. Coordinate electrical work with controls requirements to provide a complete and operating system.
- E. Supervise installation of wiring provided under Division 23 to ensure that such wiring is installed according to the standards of Division 26. Report discrepancies to Engineer.

1.5 WIRING STANDARD

- A. Follow wiring coding as indicated on the drawings. Use only the approved wiring methods for circuit applications as indicated in Table 1 (unmarked items are not permitted):
- B. Where specifically detailed on drawings, follow wiring method indicated.
- C. In the event an application location is encountered that is not listed in the wiring standards, consult Engineer for instructions.

TABLE 1

		Building Wire & Cables in Raceway							Cable	
	Application Location	RSC	EMT	PVC	Cable Tray	Surface Raceway	Liquidtight	Flex	MC	NM
1	Underground, 5' away from foundation - Primary, concrete encase - Secondary, no concrete	SFBC		BC SFBC SF						
2	In/under concrete slab to 5' away from foundation	SFBC		SFBC						
3	In slab above grade	BC		BC						
4	Exposed outdoor	SFBC								
5	Wet Interior	SFBC	SFBC							
6	Concealed dry interior Wall stud spaces Ceiling void	FBC FBC	FBC FBC							
7	Accessible dry interior Ceiling void Lighting fixture whip Casework	SFBC	FBC				BC BC	BC BC	BC BC	
8	Exposed dry interior Finished space Unfinished space	SFBC	BC			BC				
9	Motor/equipment connection						B	B	B	

Key: S=Secondary Service, F=Feeders, B=Branch Circuits, C=Control Circuits

1.6 SUBSTITUTIONS

- A. Any proposal for a substitution shall be made in writing, including full details for consideration by Engineer. Substitutions will be permitted only by written acceptance of the Engineer.
- B. Acceptance of a proposed substitution by the Engineer shall not relieve the Contractor from his responsibility to provide a satisfactory installation of the Work in accordance with the intent of the plans and specifications and shall not affect his guarantee covering all parts of the work.
- C. Any material or equipment submitted for acceptance which is arranged differently or of a different physical size from that shown or specified shall be accompanied by shop drawings indicating the different arrangements of size and the method of making the various connections to the equipment. The final results shall be compatible with the system as designed.

- D. Electrical materials and equipment have generally been specified by referencing one or more manufacturer's standard product. Materials of similar quality by listed "Acceptable Manufacturers" will generally not be considered a substitute and will be reviewed for conformance with these specifications. Materials not of similar quality, or by manufacturers not listed as acceptable, will be considered a substitute.
- E. In the event a proposed substitution for material or equipment has been rejected, Engineer will only review subsequent submittals for that material or equipment that are not substitutes.

1.7 PROJECT/SITE CONDITIONS

- A. Install work in locations shown on drawings, unless prevented by project conditions.
- B. Prepare drawings showing proposed rearrangement of work to meet project conditions, including changes to Work specified in other sections. Obtain permission of Engineer before proceeding.

1.8 ASBESTOS ABATEMENT

- A. If during the course of work, the existence of asbestos or asbestos containing materials is encountered or suspected in the structure or building, promptly notify the Owner and Engineer. The Owner will consult with his Asbestos Consultant regarding removal and encapsulation of the asbestos material. Do not perform any work prior to receipt of special instructions from the Owner.

1.9 WORKMANSHIP

- A. Workmanship shall be by licensed electricians well skilled in the trade. A Master Electrician licensed in the State of Maine shall be on site and supervise all work.
- B. Install all work according to the best practices of the trade and in accordance with NECA -1-2000, "Standard Practices for Good Workmanship in Electrical Construction."
- C. In the event of a conflict with required codes or an obvious misapplication of equipment, material, wiring practice, or other installation, before proceeding, promptly notify the Engineer. In no event shall any work be installed that is contrary to applicable codes.

1.10 DEVIATIONS AND DISCREPANCIES

- A. The drawings are intended to indicate only diagrammatically the extent, general character, and approximate locations of the electrical work. Work indicated, but having minor details obviously omitted, shall be furnished complete to perform the functions intended without additional cost to the Owner. Follow the architectural, structural, and mechanical drawings so that work under this section is properly installed and coordinated with other sections.
- B. The drawings and specifications are complementary each to the other and what is called for in one shall be as binding as if called for by both. In the event of conflicting information on the electrical drawings, or between or within drawings and specifications, or between trades, that which is better, best, most stringent, or most expensive will govern, except as may otherwise be permitted by Engineer.
- C. Bidders shall study plans and specifications and in the event there are any apparent errors, omissions, conflicts, or ambiguities, shall contact Engineer for clarification prior to submitting their bid.

1.11 CHANGE ORDERS

- A. No change shall be made from the work, equipment, or materials under this section except as directed in writing by Engineer.
- B. All requests for change in contract price and scope shall be accompanied by a breakdown list of materials with unit and extended prices and labor hours with unit and extended price, plus markups that have been applied.

1.12 RECORD DRAWINGS

- A. Keep in good condition at the job, apart from all other prints used in actual construction, one complete set of diazo blue-line or white print electrical drawings. Record on these drawings, completely and accurately, any and all differences between the work as actually installed and the design as shown on the drawings. Record all changes within one week of the time that the changes are authorized. Record drawings shall be maintained in site construction office and be available for inspection by Engineer. At the completion of the work, deliver Record Drawings in accordance with requirement for submittals.

1.13 TESTING AND TRAINING

- A. Conduct operating test for approval in presence of Engineer. The electrical work shall be demonstrated to operate as specified. Furnish instruments, materials, and personnel required for tests. Notify Engineer at least 10 days in advance of proposed test date.

END OF SECTION

SECTION 26 05 00 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Existing work
2. Grounding and bonding
3. Connection of utilization equipment
4. Supports
5. Identification
6. Conduit and fittings
7. Surface raceway
8. Wireway
9. Electrical boxes
10. Wire and cable
11. Cords and caps
12. Wiring devices
13. Service fittings
14. Electrical tape
15. Terminations
16. Firestopping

B. Related Sections:

1. Drawings, Division 00, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
2. Section 26 00 10, Basic Electrical Requirements.
3. Section 31 23 00, Earthwork for Utilities.
4. Section 03 30 00, Cast-in-Place Concrete.

1.2 REFERENCES

- A. Conform to requirements of National Electrical Code (NEC) ANSI-C1/NFPA 70-2011.
- B. Conform to requirements of National Electrical Safety Code (NESC) ANSI 2007.
- C. Furnish products listed by Underwriters Laboratories, Inc., or other testing firm acceptable to authority having jurisdiction.

1.3 SUBMITTALS

A. Product Data: Provide catalog data for the following:

1. Grounding and bonding devices
2. Supports
3. Anchors
4. Conduit and fittings
5. Surface raceway
6. Wireway
7. Electrical boxes
8. Wire and cable

9. Wiring devices
10. Mounting brackets/ceiling channels
11. Service fittings
12. Firestop Materials

- B. Submit product data and shop drawings in booklet form with a separate sheet for each product. Indicate clearly on each sheet product manufacturer, catalog number, product description and other pertinent data.
- C. Test reports.
 1. Grounding system continuity and resistance test.
 2. Conductor continuity and insulation resistance test.

1.4 PROJECT CONDITIONS

- A. Existing project conditions indicated on drawings are based on casual field observation and existing record documents.
- B. Verify field measurements and circuiting arrangements are as shown on drawings.
- C. Verify removal of existing electric work.
- D. Report discrepancies to Engineer before disturbing existing installation.

1.5 COORDINATION

- A. Obtain and review shop drawings, product data, and manufacturer's instructions for equipment furnished under other sections to determine connection locations and requirements.
- B. Sequence rough-in of electrical connections to coordinate with installation and start up of equipment furnished under other sections.

PART 2 - PRODUCTS

2.1 GROUNDING MATERIALS

- A. Ground Rod: Copper clad steel, 3/4" diameter x 10' length. Die-stamp each near the top with the name or trademark of the manufacturer and the length of the rod in feet. The rods shall have a hard, clean, smooth, continuous, surface throughout the length of the rod.
 1. Galvanized steel rods are permitted where required by Utility Company.
- B. Mechanical Connectors: Bronze.
- C. Compression set connectors and components: Burndy "Hyground" compression system, or approved equal.
- D. Thermit Welds: Cadweld.

2.2 BASIC MATERIALS

- A. Steel Channel: Galvanized or painted steel.
- B. Anchors:

1. Masonry Anchors: Rawl-Stud, Lok-Bolt, Saber-Tooth, or equal by Arro, Diamond, or Redhead.
2. Hollow-Wall Anchors: Toggle bolt by Rawl or equal by Arro, Diamond, or Redhead.
3. Anchors shall have sufficient holding power for intended use.
4. Plastic anchors and powder actuated anchors are not permitted.

C. Miscellaneous Hardware: Treat for corrosion resistance.

D. Nameplates: Engraved three layer laminated plastic (lamicoid), white letters on black background. Embossed plastic adhesive tape labels, with 3/16" white letters on black background.

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

2.3 METAL CONDUIT

A. Acceptable Manufacturers:

1. Allied Tube and Conduit
2. Wheatland Tube Company
3. Jones and Laughlin
4. Republic Steel
5. Triangle PWC

B. Conduit:

1. Metal Conduit and Tubing: Hot dipped galvanized or sheradized steel.
2. Flexible Conduit: Galvanized steel.
3. Liquidtight Flexible Metallic Conduit: Flexible metal conduit with PVC jacket.

2.4 PLASTIC CONDUIT

A. Acceptable Manufacturers:

1. Carlon
2. National
3. American Pipe & Plastics, Inc.

B. Plastic Conduit:

1. Plastic Conduit: NEMA TC 2; PVC. Use Schedule 40 conduit.

2.5 FITTINGS

A. Manufacturers:

1. Appleton
2. Bridgeport
3. O-Z/Gedney
4. Raco
5. Steel City
6. Thomas and Betts
7. Carlon
8. American Pipe & Plastics, Inc.

B. Conduit Fittings:

1. Metal Fittings and Conduit Bodies: NEMA FB 1.
2. Plastic Fittings and Conduit Bodies: NEMA TC 3.

3. Fittings and Conduit Bodies for RSC: Galvanized steel or malleable iron, couplings and fittings threaded.
4. Fittings for EMT: Watertight compression or set screw type as appropriate for the application.
5. Conduit Bodies for EMT: Cast aluminum, galvanized iron or malleable iron bodies.
6. Insulated Bushings: Appleton "BBU".
7. Grounding Bushings: O-Z/Gedney "BLG".
8. Conduit Sealing Bushings: OZ Gedney Type CSB, or approved equal.
9. Fittings for Liquidtight Flexible Metallic Conduit: Galvanized steel or malleable iron, couplings and fittings threaded.
10. Fittings for Liquidtight Flexible Non-Metallic Conduit: High strength, chemical resistant, glass filled thermoplastic compression nut & ferrule assembly, Carlon Carflex or approved equal.
11. Conduit Clamps: Galvanized malleable iron equivalent to O-Z/Gedney 14-G and 15-G Series with clamp back spacer for RSC, and single hole #15-75G malleable or #15-75S galvanized steel clips for EMT.

2.6 SURFACE METAL RACEWAY

- A. Manufacturers:
 1. Walker/Wiremold
- B. Description: One piece surface metal, Wiremold 500 & 700, and suitable for use as surface raceway.
 1. Size: As shown on drawing.
 2. Finish: Ivory enamel.

2.7 ELECTRICAL BOXES

- A. Manufacturers:
 1. Appleton
 2. Crouse Hinds
 3. Hoffman
 4. Killark
 5. Lee Products
 6. Raco
 7. Square D
 8. Steel City
- B. Boxes:
 1. Sheet Metal: NEMA OS 1; galvanized steel, 4" x 4" x 2" with raised plaster ring and non-gangable 3" H x 3 1/2" D x 2" W per section masonry boxes. Gangable or sectionalizing boxes are not permitted.
 2. Cast Metal: Aluminum or cast alloy, deep type "FD", gasket cover, threaded hubs, "Bell" boxes not permitted.
- C. Mounting Brackets and Adjustable Ceiling Channels: Galvanized steel of substantial construction to support boxes by bridging between hollow wall studs or ceiling channels, like Caddy #SGB24 screw gun bracket, Caddy #H4 mounting bracket, and B-Line #BA-12 box hanger, or approved equal.
- D. Pull Boxes: Code gauge galvanized steel, no prepunched knockouts.

- E. Hinged Cover Enclosures: NEMA 250, Type 1, steel enclosure with manufacturer's standard enamel finish and continuous hinge cover, held closed by flush latch operable by screwdriver.

2.8 SERVICE FITTINGS

- A. Manufacturer:
 - 1. Hubbell
 - 2. Walker
- B. Gymnasium/Multi-Purpose Room Floor Boxes: Hubbell #B4314 shallow cast iron; provide complete with matching cover and required devices.
- C. Multi-Service Floor Boxes: Hubbell #3FBSS stamped steel for above grade applications, and #3SFBC cast iron on/below grade, recessed metallic multi-service floor box, with outlet mounting service plates, and ABS plastic cover #3SFBCXX, Architect to select color to match carpet.
- D. Large Capacity Floor Boxes: Hubbell #LCFBSS stamped steel for above grade applications, and #LCFBC cast iron on/below grade, recessed metallic multi-service floor box, with outlet mounting service plates, and ABS plastic cover #LCFBCXX, Architect to select color to match carpet.
- E. Flush Floor Box Covers:
 - 1. Walker Omni-Box 880 series or approved equal.
 - 2. Cover Material: Brass.
 - 3. Duplex Convenience Receptacle: Duplex flap opening.
 - 4. Communications: 2-1/8" x 1" combination threaded opening.
 - 5. Provide brass finish.
 - 6. Service Connection: Model 896CK by Walker.
- F. Poke Through Fittings: Fire rated poke through device terminated in junction box, with integral surface type service fitting.

2.9 WIRE AND CABLE

- A. Manufacturers:
 - 1. Anaconda
 - 2. Rome Cable
 - 3. General Cable
 - 4. Okonite
 - 5. Phelps Dodge Cable
 - 6. Southwire
 - 7. Triangle PWC
- B. Building Wire:
 - 1. Feeders and Branch Circuits Larger Than 6 AWG: Stranded annealed copper conductor, 600 volt insulation, XHHW.
 - 2. Feeders and Branch Circuits 6 AWG and Smaller: Annealed copper conductor, 600 volt insulation, THHN/THWN or XHHW, stranded conductor; use compression set terminals.
 - 3. Control Circuits: Copper, stranded conductor, 600 volt insulation, THHN/THWN.
- C. Metal Clad Cable:

1. Metal Clad Cable, Size 12 through 10 AWG: Interlocked galvanized steel armor, stranded annealed copper conductor, 600 volt insulation, rated 60E C, with separate green ground wire, NEC Type MC.

D. Remote Control and Signal Cable:

1. Control Cable for Class 1 Remote Control and Signal Circuits: Copper conductor, 600 volt insulation, rated 60E C, individual conductors twisted together, shielded, and covered with PVC jacket.
2. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 60E C, individual conductors twisted together, shielded, and covered with PVC jacket; UL listed.
3. Plenum Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 60E C, individual conductors twisted together, shielded, and covered with nonmetallic jacket; UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums.

2.10 TAPE AND TERMINATIONS

A. Manufacturers, Tape:

1. 3M Co., Scotch #33 and #88

B. Manufacturers, Terminations:

1. Dossert
2. Ideal
3. 3M Co.
4. Thomas and Betts

C. Wire Connection Devices/Terminations: Compression set or twist-on type with integral molded insulation and internal metallic compression ring or spiral screw-on connecting device. Twist-on type shall be like Ideal "Wing Nut" series. Push-on type wire terminals are not acceptable.

D. Wire Terminals, Butt Splices: Crimp set with integral insulated sleeve, electro tin plated, fully annealed copper.

2.11 WIRING DEVICES AND WALL PLATES

A. Manufacturers:

1. Bryant
2. Hubbell
3. Arrow-Hart
4. Pass and Seymour
5. General Electric
6. Leviton

B. Wall Switch: AC general use, specification grade, quiet operating snap switch rated 20 amperes and 120/277 volts AC, with plastic toggle handle, ivory color, Hubbell Model 1221.

1. Pilot Light Type: Lighted handle, Model 1221-1L manufactured by Hubbell, or strap mounted lamp in adjacent gang, Model 48071-R manufactured by Bryant.

C. Receptacle:

1. Provide straight blade receptacles to NEMA WD 1.

2. Provide locking blade receptacles to NEMA WD 5.
 3. Convenience Receptacle Configuration, general use: Type 5-20 R, specification grade, plastic face, ivory color, Bryant Model 5352.
 4. GFCI Receptacle, general use: Specification grade duplex convenience receptacle with integral ground fault current interrupter, ivory color, Bryant Model GFR53FT.
 5. Specific Purpose Receptacle: Configuration indicated on drawings with ivory nylon face.
- D. Decorative Cover Plate: Smooth rigid nylon or high impact plastic.
- E. Weatherproof Covers: Die cast aluminum, gasketed, duplex receptacle cover, weatherproof when attachment plug is inserted.
- 2.12 CORDS AND CAPS
- A. Straight-blade Attachment Plug: NEMA WD 1.
 - B. Locking-blade Attachment Plug: NEMA WD 5.
 - C. Attachment Plug Configuration: Match receptacle configuration at outlet provided for equipment.
 - D. Cord Construction: Oil resistant thermoset insulated Type SJOW multiconductor flexible cord with identified equipment grounding conductor, suitable for extra hard usage in damp location.
 - E. Cord Size: Suitable for connected load of equipment and rating of branch circuit overcurrent protection.
- 2.13 FIRESTOPPING MATERIALS
- A. Use only through-penetration firestop products that have been tested for specific fire resistance rated conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire rating required for the application:
 1. Latex Sealants: Single component latex formulations that when cured do not re-emulsify during exposure to moisture.
 2. Firestop Devices: Factory assembles steel collars lined with intumescent material sized to fit a specific outside diameter of penetrating item.
 3. Firestop Putty: Intumescent, non-hardening, water resistant putties containing no solvents, inorganic fibers or silicone compounds.
 4. Wrap Strips: Single component intumescent elastomeric strips faced on both sides with a plastic film.
 5. Silicone Sealants: Moisture curing, single component, silicone elastomeric sealant for horizontal surfaces (pourable or non-sag) or vertical surface (non-sag).
 6. Silicone Foam: Multi-component, silicone based, liquid elastomers that when mixed expand and cure in place to produce a flexible, non-shrinking foam.
 - B. Firestop systems shall be UL classified and rated for the type of construction where it is applied.

PART 3 - EXECUTION

3.1 EXISTING ELECTRICAL WORK

- A. Disconnect existing electrical systems in walls, floors, and ceilings indicated for removal.
- B. Coordinate utility service outages and reconnections with Utility Company and Owner.

- C. In any area requiring the work of other trades, carefully remove, store and protect any electrical items in the path of the work and re-install and re-connect after the completion of the other trade's work.
 - D. In areas where painting is required, remove all electrical items including, but not limited to, lighting fixtures, devices and cover plates, then reinstall after painting has been completed. In the event any electrical items that were not removed become painted, clean the items, or replace if cleaning cannot be suitably cleaned.
 - E. Provide temporary wiring and connections to maintain existing systems in service during construction until replacement circuits and systems are ready for service, including circuits and systems that serve other areas.
 - 1. Existing electrical feeders and branch circuits.
 - 2. Existing telecommunications system.
 - F. Remove, relocate, and repair existing installations to accommodate new construction.
 - 1. Remove abandoned wiring to source of supply, and/or back to the serving panelboard and turn off breaker and mark as spare in the panelboard directory.
 - 2. Remove exposed abandoned conduit and boxes, including abandoned conduit above accessible ceiling finishes.
 - 3. Disconnect abandoned outlets and remove devices.
 - 4. Provide blank cover for abandoned outlets which are not removed.
 - 5. Disconnect and remove abandoned panelboards and distribution equipment.
 - 6. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
 - 7. Disconnect and remove abandoned luminaires, brackets, stems, hangers, and other accessories.
 - 8. Disconnect and remove underfloor wiring, cut raceways flush with floor and patch and restore floor surfaces.
 - G. Repair adjacent construction and finishes damaged during removal of existing electrical work.
 - H. Maintain access to existing, active electrical installations.
 - I. Existing wiring, the need for which remains, found in good condition, properly located, and conforming to the specified wiring standard, may continue in service.
 - J. Clean and repair existing materials and equipment within limits of work which remain or are to be reused.
 - 1. Panelboards: Clean and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Revise circuit directory.
 - 2. Luminaires: Clean exterior and interior surfaces. Replace lamps and broken parts.
 - 3. Do not reuse conduit, wire, and other materials except as specifically noted on the drawings.
 - K. Extend existing installations using materials and methods compatible with existing electrical installations, and as specified.
- 3.2 EXAMINATION AND PREPARATION
- A. Verify that the interior of the building has been physically protected from weather.
 - B. Verify that supporting surfaces are ready to receive work.

- C. Electrical boxes are shown on drawings, locations are approximate unless dimensioned.
 - 1. Obtain verification from Engineer of floor box locations, and locations of outlets in office and work areas, prior to rough-in.
 - 2. Elevator System: Determine location of outlets for lights, cab circuits, machines, and equipment installed in elevator pit, shaft, and machine rooms with elevator system installer prior to rough-in.
- D. Make electrical connections to utilization equipment in accordance with equipment manufacturer's instructions.
 - 1. Verify that wiring and outlet rough-in work is complete and that utilization equipment is ready for electrical connection, wiring, and energization.
 - 2. Make wiring connections in control panel or in wiring compartment of prewired equipment. Provide interconnecting wiring where indicated.

3.3 GROUNDING

- A. Install grounding electrodes and conductors at locations indicated. Install additional rod electrodes as required to meet Regulatory Requirements.
- B. Provide ground bonding as indicated and to meet Regulatory Requirements. Include a separate green ground wire in each branch and feeder circuit and bond to grounding system.
- C. Maintain isolation between neutral and ground conductors in accordance with NEC.
- D. Install grounding system so all conductive materials operate at ground potential and there is a low impedance path to ground in the event of a fault.
- E. Test grounding system for resistance to earth using fall-to-potential method in accordance with IEEE Std. 81. Maximum ground to earth resistance shall not exceed 25 ohms.
- F. Test grounding system continuity resistance (megger); resistance shall not exceed 0.1 ohms.
- G. Submit test reports for ground/earth resistance and continuity resistance.

3.4 SUPPORT SYSTEMS

- A. Install support systems sized and fastened to accommodate weight of equipment and conduit, including wiring, which they carry.
 - 1. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors, beam clamps, and spring steel clips as appropriate for the application.
 - 2. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.
 - 3. Do not fasten supports to piping, ceiling support wires, ductwork, mechanical equipment, or conduit.
 - 4. Do not use powder actuated anchors.
 - 5. Do not drill structural wood or steel members.
 - 6. Fabricate supports from structural steel or steel channel.
 - 7. Install free standing electrical equipment on concrete pads.
 - 8. Install surface mounted cabinets and panelboards with minimum of four anchors.
 - 9. Provide steel channel supports to stand cabinets 1" off wall in wet locations.

10. Bridge studs top and bottom with channels to support flush mounted cabinets and panelboards in stud walls.

3.5 CONDUIT

- A. Size raceways for conductor type installed or for type THW conductors, whichever is larger.
 1. Minimum Size Conduit: 3/4".
 2. Maximum Size Conduit in Slabs Above Grade: 1"; for conduits larger than 3/4", route so they do not cross each other.
- B. Install all conduit concealed in walls or above finished ceilings except where specifically indicated to be surface mounted. Arrange conduit to maintain headroom and to present neat appearance. Install conduit in accordance with the following:
 1. Route exposed raceway parallel and perpendicular to walls and adjacent piping.
 2. Maintain minimum 6" clearance to piping and 12" clearance from parallel runs of flues, steam pipes, and heating appliances. Install horizontal raceway runs above water and steam piping.
 3. Complete raceway installation before installing conductors.
 4. Maintain required fire, acoustic, and vapor barrier rating when penetrating walls, floors, and ceilings. Where indicated on drawings, sleeve penetrations through concrete walls, floors, and ceilings.
 5. Route conduit through roof openings for piping and ductwork where possible; otherwise, route through roof with pitch pocket.
 6. Group in parallel runs where practical and install on steel channel support system. Maintain spacing between raceways or derate circuit ampacities to NFPA 70 requirements.
 7. Use conduit hangers and clamps; do not fasten with wire or perforated pipe straps.
 8. Use conduit bodies to make sharp changes in direction.
 9. Terminate conduit stubs and box connections with insulated bushings.
 10. Steel conduit joints shall be threaded; clamp on or set screw fittings are not permitted.
 11. Use suitable caps to protect installed raceway against entrance of dirt and moisture.
 12. Provide No. 12 AWG insulated conductor or suitable pull string in empty raceways, except sleeves and nipples.
 13. Install expansion joints where raceway crosses building expansion joints, and where necessary to compensate for thermal expansion.
 14. Install plastic conduit and tubing in accordance with manufacturer's instructions; thermoweld or cement PVC joints..
 15. Use flexible or liquidtight conduit, short as possible, maximum 72 inches, for motor and equipment hookup; always include a separate green ground wire.
 16. Use liquidtight conduit for flexible connections in damp or wet locations.
 17. Install conduit so condensation will drain and not be trapped.
 18. Prevent lodgement of dirt, trash, and mortar; swab all raceways prior to installation of wire and cable.
- C. Surface Raceways and multi-outlet assemblies:
 1. Always install as inconspicuously as possible following corners wherever possible, mount plumb and level.
 2. Securely anchor to mounting surfaces using methods specified in Section 26 05 00.
 3. Use fittings and accessories designed for use with raceway system, and install in accordance with manufacturer's instructions.

4. Use suitable insulated bushings and inserts at connections to outlets and corner fittings in metal raceway.

3.6 BOXES

A. General:

1. Install electrical boxes where shown on the drawings, and as required for splices, taps, wire pulling, equipment connections, and regulatory requirements.
2. Locate and install electrical boxes to maintain headroom and to present neat mechanical appearance.
3. Align wall mounted outlet boxes for switches, thermostats, and similar devices.
4. Coordinate mounting heights and locations of outlets above counters, benches, and back splashes.
5. Install lighting outlets to locate luminaires as shown on reflected ceiling plan.
6. Use expansion anchors, shields, or toggle bolts to fasten boxes in place. Do not use explosive powder driven anchors, except where specifically permitted by Engineer. Do not use nails or wire for permanent support.
7. Secure boxes to interior wall and partition studs, accurately positioned to allow for surface finish thickness; select raised cover depth to assure proper fit.
8. Do not install boxes back-to-back in walls; provide 6" minimum separation, except provide 24" separation, in acoustic rated walls.
9. Use hinged cover enclosure for interior pull and junction boxes larger than 12 inches in any dimension. Install in an accessible location that will allow easy access.
10. Field punch openings in pull boxes using punch/dies of appropriate size. Provide knockout closures for unused openings.

B. Surface mounted applications:

1. Use cast "FD" outlet boxes for all surface mounted applications to 10 feet above finished floor, and for exterior and wet locations.
2. Where pull boxes must be installed in finished areas, consult Engineer to select location, style, and finish. The location shall always be as inconspicuous as possible.

C. Concealed above ceilings:

1. Install 4" x 4" x 2" or larger steel boxes for general wiring.
2. Octagon boxes, 3 1/2" or 4" by 1 1/2" or larger depth, are permitted for flush mounted lighting fixture outlets, use adjustable steel channel fasteners for support.
3. Locate and install electrical boxes to allow access. Provide access panels where required for practical access, and as required by the NEC.

D. Concealed in Masonry Walls:

1. Install 4" x 4" x 2" steel box; select raised plaster ring and set box so that outer edge is not less than 1/8" below finished wall surface.
2. For applications more than 3 gang wide, 3 3/4" h x 3 1/2" d x 2"/gang wide non-gangable masonry boxes are permitted.
3. Locate boxes to require cutting corner only. Coordinate masonry cutting to achieve neat openings for boxes, mortaring and plastering shall completely seal the box walls to the wall surface and solidly secure the box in place. Coordinate with masonry and plastering sections to accomplish this requirement.

E. Concealed in GWB or plaster walls:

1. Install 4" x 4" x 2" steel box; select raised plaster ring and set box so that outer edge is not less than 1/8" below finished wall surface.
2. Use stamped steel mounting bracket for flush outlet/device boxes in hollow stud wall.
3. Align wall mounted outlet boxes for switches, thermostats, and similar devices.
4. Coordinate mounting heights and locations of outlets above counters, benches, and back splashes.

F. Floor boxes and service fittings:

1. Set boxes level and flush with finish flooring material, in accordance with manufacturer's instructions.
2. Install service fittings in accordance with manufacturer's instructions.
3. Drill floor opening and install poke through fittings in accordance with manufacturer's instructions.

3.7 INSTALLATION OF WIRES AND CABLES

- A. Verify that interior of building has been physically protected from weather, that mechanical work which is likely to injure conductors has been completed and completely and thoroughly swab raceway system before installing conductors.
- B. Use wire not smaller than 12 AWG for power and lighting circuits, and not smaller than 14 AWG for control wiring.
 1. Use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 75 feet; and for 20 ampere, 277 volt branch circuit home runs longer than 200 feet.
- C. Neatly train and secure wiring inside boxes, equipment, and panelboards.
- D. Use UL listed wire pulling lubricant for pulling 4 AWG and larger wires.
- E. Install wiring according to the Wiring Standard, Section 26 00 10, or in another Division 26 Section, or as directed in applicable section. Protect and support exposed cables (where allowed) above accessible ceilings to keep them from resting on ceiling tiles. Use channel, or running boards as necessary to provide support. Do not support wiring on ceiling support wires, unless ceiling installer has provided certification that ceiling support system is rated to carry the additional load of the cables. Install cables to run parallel and perpendicular to building lines; do not run diagonally, leave ample slack cable at turns.
- F. Make splices, taps, and terminations to carry full ampacity of conductors without perceptible temperature rise.
- G. Terminate spare conductors with electrical tape.
- H. Color code all service, feeder, branch, control, and signalling circuit conductors. Color shall be green for grounding conductors and white for neutrals, except where neutrals of more than one system are installed in same raceway or box, the other neutral shall be white with a colored (not green) stripe. Color code ungrounded conductors operating at 120 volts to ground black, red, and blue for Phases A, B, and C and at 277 volts, brown, orange, and yellow respectively.
- I. Terminate all wire joints #10 AWG or smaller with crimp set or twist-on wire terminating device. Use crimp set or bolted "Burndy" or suitable alternate bolted or crimp set device for conductors larger than #10 AWG.
- J. Cover all joints made with non-insulated connecting devices with electrical tape; use Type #88 at any time or #33 whenever the temperature of the joint or the room is above 60EF. Triple wrap joints, each wrap having a 50% overlay.

3.8 CORDS AND CAPS

- A. Install prefinished cord set where connection with attachment plug is indicated or specified, or use attachment plug with suitable strain relief clamps.
- B. Provide suitable strain relief clamps for cord connections to outlet boxes and equipment connection boxes.
- C. Make wiring connections in control panel or in wiring compartment of prewired equipment in accordance with manufacturer's instructions. Provide interconnecting wiring where indicated.
- D. Install disconnect switches, controllers, control stations, and control devices such as limit switches and temperature switches as indicated. Connect with conduit and wiring as indicated.

3.9 DEVICES

- A. Install wiring devices in accordance with manufacturer's instructions.
 - 1. Install wall switches 48" above floor, OFF position down.
 - 2. Install wall dimmers 48" above floor. Derate ganged dimmers as instructed by manufacturer. Do not use common neutral.
 - 3. Install convenience receptacles 18" above floor, 6" above counters and backsplash or as indicated, with grounding pole on top.
 - 4. Install specific purpose receptacles at heights shown on Drawings.
 - 5. Install cord and attachment plug caps on equipment. Size cord for connected load and rating of branch circuit overcurrent protection.
- B. Install wall plates flush and level.
 - 1. Install decorative plates on switch, receptacle, and blank outlets in finished areas, using oversized plates for outlets installed in masonry walls.
 - 2. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

3.10 FIRESTOPPING

- A. Install through penetration firestop systems in accordance with firestop system manufacturer's written installation instructions for products and applications indicated.
- B. Engage an experienced installer who is trained, certified, licensed, or otherwise qualified by the firestop system manufacturer to install the firestop products.
- C. Coordinate construction of openings and penetrating items to ensure that firestop systems are installed according to specified requirements.
- D. Provide firestop systems that are compatible with one another, with the substrates forming openings, with the items penetrating the firestop system, and under the conditions of service for the application being considered.
- E. Provide components for each firestop system that are needed to install fill materials. Use only components specified by the firestop system manufacturer and approved by the qualified testing agency for the designated system.
- F. Keep areas of work accessible until inspection by the AHJ has been completed.
- G. Inspecting Agency: Owner may engage a qualified independent inspecting agency to inspect the completed firestop system. The independent agency shall comply with ASTM E 2174 requirements including inspecting personnel qualifications, method of conducting inspections, and preparation of test reports.

- H. Where deficiencies are found, repair or replace the firestop systems so that they comply with requirements. Proceed with enclosing firestop systems with other construction only after inspection reports are issued and the firestop installations comply with requirements.
- I. Protect the firestop system during and after installation to insure that the systems do not deteriorate and are not damaged during the remaining period of construction. In the event damage or deterioration occurs, remove affected firestop system and replace with new materials in compliance with this specification.

3.11 IDENTIFICATION

- A. Identify electrical distribution and control equipment, and loads served, to meet regulatory requirements and as scheduled.
 - 1. Degrease and clean surfaces to receive nameplates and tape labels.
 - 2. Secure nameplates to equipment fronts using screws, rivets, or adhesive, with edges parallel to equipment lines. Secure nameplate to inside face of recessed panelboard doors in finished locations.
 - 3. Use embossed tape nameplates with 3/16" lettering to identify individual switches and circuit breakers, wall switches, receptacle circuits, and loads served.
 - 4. Use lamicoid nameplates with minimum 1/4" lettering to identify distribution and control equipment.
 - 5. Nameplate information shall suitably identify the device or circuit. Any nameplate that is not suitably descriptive in the opinion of the Engineer shall be replaced as directed.
- B. Install wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connections.
 - 1. Use branch circuit or feeder number to identify power and lighting circuits.
 - 2. Use control wire number as indicated on schematic and interconnection diagrams and equipment manufacturer's shop drawings to identify control wiring.

3.12 FIELD QUALITY CONTROL

- A. Perform field inspection and testing of wiring as follows:
 - 1. Inspect wire and cables for physical damage and proper connection.
 - 2. Torque test conductor connections and terminations to manufacturer's recommended values.
 - 3. Perform continuity and insulation resistance (megger) test on all power and equipment feeder and branch circuit conductors. Submit test report tabulating the test performed and the results.
 - 4. Verify proper phasing connections; check rotation of all motors.
- B. Perform field inspection and testing of devices as follows:
 - 1. Test for proper polarity and ground continuity.
 - 2. Test GFCI operation according to manufacturer's written instructions.
 - 3. Replace defective units and retest.
 - 4. Submit test report.

END OF SECTION

SECTION 26 20 00 - SERVICE AND DISTRIBUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Service entrance and metering
2. Panelboards
3. Enclosed switches
4. Fuses
5. Enclosed circuit breakers
6. Motor starters
7. Contactors

B. Related Sections:

1. Division 00, including General and Supplementary Conditions, Division 01 Sections, and the Drawings, apply to this Section.
2. Section 26 00 10, Basic Electrical Requirements.
3. Section 26 05 00, Basic Electrical Materials and Methods.

1.2 REFERENCES

A. Conform to the requirements of the local Utility Company:

1. Central Maine Power Co., Handbook of Standard Requirements.

1.3 SYSTEM DESCRIPTION

- A. Electric Service System: 208/120 volts, three phase, four wire, 60 Hz.

1.4 SUBMITTALS

A. Provide submittals in accordance with Section 26 00 10 for the following:

1. Panelboards
2. Overcurrent devices
3. Disconnects
4. Motor starters
5. Contactors
6. Meter cabinets
7. Enclosed circuit breakers

- B. Shop Drawings: Indicate relevant information on switchboards, panelboards, and busways. Indicate circuit breaker arrangement in panelboard, type, size, number of poles, interrupting rating, size of enclosures, and quantities.

- C. Product Data: Provide data on enclosed switches and circuit breakers, fuses, panelboards, motor starters, and contactors.

- D. Upon request, submit samples for inspection.

- E. Test Reports: Submit for field inspection and testing. Include description of procedures, duration, instruments used, and test values obtained. Present information in table comparing acceptable values to actual values.
- F. Operating and Maintenance Instructions:
 - 1. Panelboard: Submit NEMA PB 2.1

PART 2 - PRODUCTS

2.1 METER CABINETS

- 1. Manufacturers: As approved by utility company.
- 2. Provide to meet utility company specification.

2.2 PANELBOARDS

- A. Manufacturers:
 - 1. General Electric
 - 2. ITE/Siemens
 - 3. Square D
 - 4. Cutler-Hammer/Westinghouse
- B. Main and Distribution Panelboards: NEMA PB 1; circuit breaker type.
 - 1. Enclosure: Type 1.
 - 2. Provide flush or surface cabinet front, as indicated, with hinged lockable door in hinged and screwed door, keyed alike, two keys per panelboard.
 - 3. Bus: Copper or tin plated aluminum.
 - 4. Ground Bus: Copper.
 - 5. Voltage: 208/120 volts, three phase.
 - 6. Minimum Integrated Equipment Rating: 30,000 amperes rms symmetrical for 240 volt panelboards; 25,000 amperes rms symmetrical for 480 volt panelboards, or as shown on drawings.
 - 7. Nameplate: Lamicoid, white letters on black background.
 - 8. Provide Arc Flash and Shock Hazard labels in accordance with NFPA 70.
- C. Lighting and Appliance Branch Circuit Panelboards: NEMA PB 1; circuit breaker type and similar to type referenced on drawings.
 - 1. Enclosure: NEMA PB 1; Type 1.
 - 2. Provide flush or surface cabinet front, as indicated, with screw cover and hinged lockable door, keyed alike, two keys per panelboard.
 - 3. Bus: Copper or tin plated aluminum.
 - 4. Ground Bus: Copper.
 - 5. Voltage: 208/120 volts, three phase, 4 wire.
 - 6. Minimum Integrated Equipment Rating: As shown on drawings.
 - 7. Provide Arc Flash and Shock Hazard labels in accordance with NFPA 70.
- D. Panelboard design shall be such that individual circuit breakers can be removed without disturbing adjacent units or removing supplemental insulation installed to obtain clearances required by UL. Where space only is indicated, make provisions for future installation of breakers of size indicated.

- E. Circuit Breakers: Thermal and magnetic, bolt-on, trip free, trip elements in each pole and single common handle or factory applied handle tie. For GFCI breakers, provide push-to-test button, visible indication of tripped condition, and ability to detect and trip on current imbalance of approximately 6 milliamperes or greater per requirements of UL 943 for Class A GFCI devices. Tripping of GFCI breakers to occur instantaneously without delays.
 - 1. Provide fully rated circuit breakers; series ratings are not permitted unless specifically noted on the drawings
- F. Panelboard Tubs: Code gauge galvanized steel, prepunched knockouts not permitted.

2.3 ENCLOSED SWITCHES

- A. Manufacturers:
 - 1. General Electric
 - 2. ITE/Siemens
 - 3. Square D
 - 4. Cutler-Hammer/Westinghouse
- B. Enclosed Switch Assemblies: NEMA KS 12; Type HD.
 - 1. Fuse clips: Designed to accommodate Class R fuses.
- C. Enclosures: NEMA KS 12; Type 12 or as indicated on drawings.
- D. Motor Disconnect Switches: General duty for up to 240 volts and 1.5 HP, heavy duty for over 240 volts or 1.5 HP, quick make/break type, fused or nonfused (NF) as indicated. For 1/6 HP or less, motor rated toggle switches are permitted.

2.4 FUSES

- A. Manufacturers:
 - 1. Bussman
 - 2. Gould
- B. Fuses 600 Amperes and Less: Current limiting, time delay, one-time fuse, 250 volts, UL Class RK 1.
- C. Fuses Larger Than 600 Amperes: Current limiting, time delay, one-time fuse, 600 volt, UL Class L.
- D. Fuse Interrupting Rating: 200,000 rms amperes.

2.5 ENCLOSED CIRCUIT BREAKERS

- A. Manufacturers:
 - 1. General Electric
 - 2. ITE/Siemens
 - 3. Square D
 - 4. Cutler-Hammer/Westinghouse
- B. Circuit Breaker: NEMA AB 12.
 - 1. Ratings: As indicated on the drawings.
 - 2. Enclosure: NEMA AB 12; as indicated on the drawings, NEMA 4X stainless steel for kitchen applications.
 - 3. Accessories: As indicated on the drawings.

2.6 MOTOR STARTERS

- A. Manufacturers:
 - 1. Allen-Bradley
 - 2. General Electric
 - 3. ITE/Siemens
 - 4. Square D
 - 5. Cutler-Hammer/Westinghouse
- B. Manual Motor Starter:
 - 1. NEMA ICS 2; AC general purpose Class A manually operated, full voltage controller with overload relay, red pilot light, NO and NC auxiliary contact, and push button or toggle operator.
 - 2. Fractional Horsepower Manual Starter: NEMA ICS 2; AC general purpose Class A manually operated, full voltage controller for fractional horsepower induction motors, with thermal overload unit, red pilot light, and toggle operator.
 - 3. Enclosure: NEMA ICS 6; Type 1.
- C. Magnetic Motor Starter: NEMA ICS 2.
 - 1. Full Voltage Motor Starters: AC general purpose Class A magnetic controller for induction motors rated in horsepower with integral thermal overload elements.
 - 2. Two Speed Starters: Include integral time delay transition between FAST and SLOW speeds.
 - 3. Coil Operating Voltage: 120 volts, 60 Hz.
 - 4. Extra Auxiliary Contacts: 2 normally open or closed, field convertible.
 - 5. Control Power Transformers: 120 volt secondary, or as required by ATC subcontractor, 100 VA or larger as needed.
 - 6. Enclosure: Type 12 lockable for indoor and NEMA 3R for outdoor applications.
- D. Provide as specified or indicated with unit packaged equipment provided under other sections.
- E. Combination Motor Starters: Provide motor starters with integral thermal overload and motor circuit protector (MCP) or non-fusible or fusible switch in single enclosure, as indicated. Size starter in accordance with manufacturer's ratings, or as indicated. Include control transformer, manual-off-automatic (MOA) switch, and red motor run pilot light.
- F. For all starters, provide thermal overload protection in each phase wire of motor circuit to automatically interrupt all phases upon activation of overload sensor in any phase, and manual reset mechanism.
- G. Overload protection for motors 1/4 HP and smaller may be integral with the motor.

2.7 CONTACTORS

- A. Manufacturers:
 - 1. General Electric
 - 2. ITE/Siemens
 - 3. Square D
 - 4. Cutler-Hammer/Westinghouse
 - 5. Allen Bradley
- B. General Purpose Contactors: NEMA ICS 2; electrically held.
 - 1. Coil Operating Voltage: 120 volts, 60 Hz.

2. Enclosure: NEMA ICS 6; Type 1.
- C. Lighting Contactors: NEMA ICS 2; electrically operated, mechanically held, or as indicated.
 1. Coil Operating Voltage: 120 volts, 60 Hz.
 2. Enclosure: NEMA ICS 6; Type 1.
 3. Provide bus terminals suitable for mounting in panelboard.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

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

3.2 INSTALLATION

- A. Install utility services in accordance with utility company instructions and as indicated.
 1. Install service entrance conduits and conductors to building service entrance equipment as indicated on the drawings.
 2. Utility company will provide primary conductors and make final connection of contractor furnished spades, left loose, on transformer secondary terminals.
- B. Install equipment in accordance with manufacturer's instructions.
- C. Install switchboard to NEMA PB 2.1.
- D. Install proper fuses in each fused switch.
- E. Install panelboards and load centers to NEMA PB 1.1.
- F. Mount panelboards, disconnects, starters, and enclosed circuit breakers 6'-6" AFF to top of cabinet on steel channel of sufficient length to bridge studs, except where indicated otherwise or approved by Engineer.
- G. Set flush mounted panelboards such that tub flanges extend within 1/8" of wall surface at all points, covers rest firmly against wall, and completely close all openings to interior of cabinet.
- H. Provide a minimum of three 3/4" spare capped conduits stubbed to accessible ceiling void for future use on all flush mounted panelboards.
- I. Panelboard circuiting has been worked out with breakers numbered and increasing in size and number of poles from top to bottom. If this is not retained, the Contractor shall be responsible for revising contract drawings and paying to have it done. This is not to prohibit an occasional revision approved by Engineer and properly marked on as-built drawings for correction by others.
- J. For each branch circuit panelboard, provide a typewritten tabulation indicating fixture outlets, devices, machines, or apparatus served by each breaker and their room location. This shall follow coding on the drawings with breakers numbered from top to bottom. Mount tabulation inside the door in a frame for the purpose with a transparent plastic cover.
- K. Coordinate installation with other sections. It is the responsibility of this section to ensure that mechanical ducts and piping maintain code required clearances around electrical equipment and that walls have sufficient thickness to accept recessed panelboards.

3.3 GROUNDING

- A. Bond system neutral and all ground conductors together at the service. Bond all feeder conduits to ground at the service and at the main distribution switchboard. Bond service to water and sprinkler mains on street side of water meter and to heating main.
- B. Bond separately derived systems such as dry transformers and generators to building steel and water main.
- C. Provide grounding and bonding to NFPA 70, include a separate green grounding conductor in each circuit. Bond all panelboards, cabinets, and equipment to service ground.
- D. On all but service equipment and separately derived systems, the neutral bus shall be isolated from ground except for the common bond at the main distribution.

3.4 FIELD QUALITY CONTROL

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- B. Measure ground resistance from system neutral connection at service entrance to convenient ground reference point by passing minimum current of 10 amperes DC and measuring voltage drop. Maximum resistance: 10 ohms.

3.5 CLEANING

- A. Clean equipment finishes to remove paint and concrete splatters.

END OF SECTION

SECTION 26 51 00 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Luminaires and lamp holders
2. Lamps
3. Ballasts
4. Exit signs
5. Emergency lighting units
6. Lighting relay panels

B. Related Documents

1. Drawings, Division 00, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
2. Section 26 00 10, Basic Electrical Requirements.
3. Section 26 05 00, Basic Electrical Materials and Methods.

1.2 REFERENCES

- A. Furnish products listed by Underwriters Laboratories, Inc., ETL Testing Laboratories, or other testing firm acceptable to the Owner.
- B. Conform to requirements of ANSI/NFPA 70.
- C. Conform to requirements of NFPA 101.
- D. Consortium for Energy Efficiency, Inc. (CEE)

1.3 SUBMITTALS

A. Submit shop drawings, product data, test data, warranties, and other information as appropriate for the following:

1. Luminaires
2. Lamps
3. Ballasts
4. Emergency lighting units
5. Exit signs
6. Dimmers
7. Dimming systems
8. Occupancy sensors
9. Time switch
10. Photocell controls
11. Lighting relay panels

B. Shop Drawings: Indicate construction details for products which are not manufacturer's standard, when product data does not adequately describe fixture physical characteristics, or upon request by Engineer.

- C. Product Data: Provide product data for each luminaire and lighting unit.
- D. Submit written warranty for extended warranty items such as batteries and ballasts.
- E. Submit luminaire shop drawings in booklet form with a separate sheet for each luminaire type. Indicate clearly on each sheet the proposed luminaire "type" designation, manufacturer, luminaire, lamp, and ballast designation.
- F. Submittals shall indicate materials, finishes, metal gauges, overall and detail dimensions, sizes of electrical and mechanical connections, fasteners, welds, joints, end conditions, provisions for the work of others and similar information.
- G. A photometric test report showing photometric candlepower distribution, brightness, coefficients of utilization, and paint reflectance shall be included for all fluorescent and HID fixtures. Photometric reports shall be prepared for actual fixture, lamp, lens, and ballast combination. Certify data as that taken under National Bureau of Standards calibrated test conditions according to standards of the Illuminating Engineering Society; upon request, submit photometric test of proposed fixture prepared by an independent testing laboratory such as ETL.
- H. The submittals shall state whether or not the fixture, as an assembly, has been UL tested and approved.
- I. Upon request, submit sample products for inspection. Provide luminaires identical with approved samples; retain approved samples at site for comparison until after all other luminaires have been shipped to site and installed. Transportation charges for samples shall be paid by Contractor. Unapproved samples will be returned at Contractor's expense. Upon notification of disapproval, immediately submit new samples that meet contract requirements.
- J. Upon request by Engineer, provide computerized illumination calculation data for specified interior or exterior areas in digital or isofootcandle format and in such detail as requested.
- K. Operating and Maintenance Instructions: Provide maintenance and operating instructions for battery powered lighting units. Include technical data sheets and parts ordering information for components used in all luminaires.

1.4 QUALITY ASSURANCE

- A. Warrant all lighting and components for one year after acceptance of the work and at no additional cost to the Owner, promptly provide and install replacements for luminaires or components which are defective in materials or workmanship; or repair installed equipment at the job site as necessary to restore first class operating condition. For any time during the warranty period that luminaires are not fully functional due to defects in materials or workmanship, provide, install, and remove suitable temporary lighting. Warrant replacement luminaires in a similar manner for a period of one year following replacement including replacement of defective replacements.
- B. Warrant ballasts, batteries, and occupancy sensors as further specified herein.
- C. Provide products of firms regularly engaged in the manufacture of interior luminaires or components of similar types and ratings to those required. Such products shall have been in satisfactory use in similar applications for not less than two years.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver luminaires and their components to job site, factory assembled and wired to the greatest extent practical, in strict accordance with approved shop drawings, samples, certificates and catalog cuts.

- B. Protect exposed finishes during manufacture, transport, storage and handling; replace damaged materials.
- C. Luminaires shall be stored under cover, above the ground, in clean, dry areas, and be tagged and/or marked as to type and site destination.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide lighting fixtures as listed on the Lighting, Lamping, and Fixture Schedule on the drawings and as specified herein that meet the physical, performance and quality standard exhibited by that fixture. Substitutes shall be equal in all respects including mechanical, electrical, physical, performance, photometric, and quality characteristics except minor variances in construction details which do not affect overall quality or performance are permitted.
- B. Accessories: Provide required accessories for mounting and operation of each luminaire as indicated.
 - 1. Recessed Luminaires: Provide trim type suitable for ceiling system in which luminaire is installed; design fixtures to operate in a 140EF environment.
 - 2. Thermal Protection: Provide thermal protection devices to meet NFPA 70 requirements.
 - 3. Disconnecting Means: Provide disconnecting means in fluorescent luminaires that utilize double-ended lamps and contain ballast(s) that can be serviced in place.
 - 4. Surface Luminaires: Provide spacers and brackets required for mounting; design for a minimum ambient temperature of 92EF.
 - 5. Pendant Luminaires: Provide swivel hangers, pendant rods, tubes, chains, and other hardware as required and/or indicated to install luminaire at appropriate height.

2.2 FLUORESCENT TROFFERS

- A. Provide luminaires with UL or ETL label indicating fixture meets applicable UL 1570 requirements.
- B. Bodies: Form from code gauge steel. After fabrication, treat metal parts with a five stage coating of zinc phosphate and finish coat with white polyester powder paint and bake.
 - 1. Light reflecting surfaces of the fixture shall have a minimum initial reflectance of 88% in the visible range of 400-700 nanometers per ASTM Method E-424-71, and shall not yellow or fade with age. Test for fading by covering one half of sample and expose remaining half to a 150 watt sunlamp placed ½" above reflective surface for 72 hours. Comparison of exposed and unexposed sides shall show no visible fading or deterioration in appearance or reflectance. The percentage of Specular Gloss shall be a minimum of 80% as determined by ASTM Method D-523-T, Procedure A.
- C. Design ballast mounting to effectively dissipate heat and allow ballast replacement without the need for special tools. Construct luminaire with a minimum number of joints using only welds, brazing, or screws.
- D. Provide fixture enclosures with an easily operated and reliable latch. Enclosure shall hang from fixture body when unlatched and be readily removable for cleaning. Fixture shall be designed to allow relamping without the use of tools. Construct luminaire to be free from light leaks by the inherent design of body and frame. Where gaskets are necessary, securely bond to body or enclosure frame.

- E. Enclosure Lenses: Extruded or injection molded as indicated, 100% clear virgin acrylic, minimum transmittance of 80%, photometric performance within +/- 5% of the published photometric data given for the referenced fixture, meeting the following:
 - 1. Lenses designated "A12" or "A12.125" shall be nominal 0.125" overall thickness with either 1/8" or 3/16" male or female prisms with non-curved prism faces. Female prism shall have a maximum depth of 0.053" for 1/8" prisms and 0.080" for 3/16" prisms. Male prisms shall have a minimum unpenetrated thickness of 0.090" or thicker. Lens shall be minimum of 7.5 oz. per square foot and show no visible evidence of sagging in the installed position, be strain free, uniform in appearance, and destaticized.
 - 2. Lenses designated "A19" shall comply with the above except provide minimum 0.1875" nominal overall thickness, minimum unpenetrated thickness of .100".
- F. Lamp holders shall be designed to securely hold lamp in place, provide for easy lamp removal and installation, and have low resistance contact to lamp pins suitable for electronic ballasts.
- G. Mark fixture with proper lamp characteristics, i.e. "Use lamps only". Affix lamp marking in a location not visible from normal viewing angles, but readily visible to maintenance personnel.
- H. Provide wiring between fluorescent lamp holders and associated operating and starting equipment in compliance with UL 1570 and NEC.
- I. Provide electronic ballasts and arrange for switching control as indicated on the drawings. Use multiple lamp ballasts wherever possible; use tandem wiring between fixtures such that the use of one lamp ballasts are limited to single odd fixtures in a room or circuit, except where wiring distances over 10 feet or switch groups make it impractical. In tandem configurations, wire inboard lamps to one ballast and outboard lamps to the other. Ballasts shall be of the same type and manufacturer for ease of stocking replacements.

2.3 FLUORESCENT WRAPAROUND FIXTURE

- A. Provide with 15" minimum width heavy duty prismatic acrylic diffuser, which meets, as a minimum, the requirements for "A12" lenses specified above. Linear side prisms shall control visual brightness and direct light onto adjacent ceiling.
- B. Housing shall be heavy duty code gauge steel, embossed for maximum rigidity, include embossed mounting projections to allow direct mounting on low density cellulose ceilings.

2.4 FLUORESCENT WET LOCATION FIXTURE

- A. Bodies: High impact and UV resistant reinforced polyester housing, UL listed for horizontal mounting in wet locations, equip with wet location fittings.
- B. Enclosures: High impact acrylic diffuser, secured to fully gasketed housing by six captive cam-action latches per four foot unit.
- C. Finish metal parts with five stage iron phosphate pretreatment and paint with high gloss baked enamel or polyester paint.

2.5 FLUORESCENT STRIP

- A. Bodies: Form from code gauge steel; after fabrication treat metal parts with a five stage coating of zinc phosphate, and finish coat with white polyester powder paint and bake.

2.6 EXIT SIGNS

- A. LED Exit Sign Fixture with Battery Backup:

1. Lamps: Manufacturer's standard, light emitting diode (LED) type designed to NFPA 101 and 70 marking of egress requirements. Warrant lamps for 5 years full replacement.
2. Input Voltage: 120 volts for normal power, equip with self-contained battery, solid state charger with brown out protection, and test switch.
3. Battery: Sealed nickel cadmium, warrant for five years full replacement, plus additional 7 years prorata.

B. Construction:

1. Housing: High strength cast aluminum, equip with low profile canopy mount.
2. Housing and Lens in High Abuse Areas: Injection molded polycarbonate.
3. Face: Aluminum or white painted steel stencil face with red letters, 6" high x 3/4" stroke.
4. Directional Arrows: Universal type for field adjustment.
5. Mounting: Universal, for field selection.
6. Mounting in High Abuse Areas: Ceiling or wall as indicated.

2.7 EMERGENCY LIGHTING UNITS

A. Self-contained emergency lighting unit.

1. Input Voltage: 120 volts.
2. Battery: Lead calcium maintenance free type, 3 year full, plus 7 year prorated (total 10 year) warranty. Gelled electrolyte batteries are not permitted.
3. Battery Charger: Dual rate type, solid state, with low voltage and brown out protection.
4. Lamps and Lamp holder: LH3-12V halogen, 12 watt.
5. Housing: Steel with manufacturer's standard finish.

B. Indicators and Controls: AC ON, RECHARGING; TEST switch, battery charge voltmeter.

C. Electrical Connection: Hardwired.

2.8 LAMPS

A. Manufacturers:

1. General Electric
2. Osram/Sylvania
3. Venture
4. Phillips

B. Provide type and color indicated on the Lighting, Lamping, and Fixture Schedule.

C. Manufacturers: Osram/Sylvania, Octron XPS, Ecologic extended performance super T8 fluorescent lamps, #FO32/841XPS/ECO.

1. Initial lumen rating: 3150, mean lumen rating 2992.
2. Rated lamp life shall be 35,000 hours when operating on Osram Quicktronic Prostart ballast in rapid start mode.
3. Color temperature shall be 3,500°K and color rendering index 85 or better.

D. T-8, 1" diameter, nominal 32 watt lamps:

1. Lamps shall only be operated on ballasts designed for T-8 lamps.
2. Initial rated lumen output shall be at least 2,850 lumens.
3. Rated lamp life shall be at least 15,000 hours and 20,000 hours, per IES LM 40-87 operating on an instant start or rapid start mode, respectively.
4. LLD shall be a minimum mean lumen value of at least 90% of the initial lamp lumens at 40% of rated life and 84% at 70% of rated life.

5. Lamp life shall be rated minimum 20,000 hours, color temperature shall be 3500°K, and color rendering index shall be 75 or better.
- E. Rapid start medium bipin T-12 U-bent or 2G11 base single-ended twin tube lamps:
1. Lamp shall be rated at nominal 40 watts, bent in a "U" shape with nominal 6" spacing between legs, minimum initial rated lumen output 3,050 lumens, and minimum rated lamp life 12,000 hours, based on three-hour starts and tested in accordance with IES LM 40-87.
 2. LLD shall be a minimum mean lumen value of 87% of the initial lamp lumens at 40% of rated life, and 81% at 70% of rated life.
 3. Lamp life, color temperature, and color rendering index shall be as specified above for 32 watt lamp.
- F. T-8 U-Tube, 1" diameter, 31 watt, 6" leg spacing Lamps:
1. Lamps shall only be operated on ballasts designed for T-8 lamps.
 2. Rated lamp life shall be at least 15,000 hours or 20,000 hours, per IES LM 40-87, operating in an instant start or rapid start mode, respectively.
 3. LLD shall be a minimum mean lumen value of at least 90% of the initial lamp lumens at 40% of rated life and 84% at 70% of rated life.
 4. Lamp life, color temperature, and color rendering index shall be as specified above for 32 watt lamp.
- G. Compact Fluorescent-General:
1. Lamp shall be rare earth phosphor type with a correlated color temperature (CCT) of 3500 Kelvin, and color rendering index (CRI) of 80 or greater (NEMA designation RE 735).
 2. Minimum LLD shall be a mean lumen value of 85% at 40% of rated life.
 3. Installation shall conform to application manufacturers' recommendations for enclosed or open operation; of both lamps and ballasts.
- H. Compact Fluorescent (Twin or Quad) Tube Lamps for Use with Preheat Ballasts and Starters:
1. Lamps shall be designed for operation with ballasts/starters system provided with luminaire.
 2. Lamp wattage and lumen rating shall be as indicated on the drawings.
- 2.9 ELECTRONIC FLUORESCENT BALLASTS
- A. Acceptable Manufacturers: High Performance per CEE requirements, Osram/Sylvania, Quicktronic Prostart PSX T8 universal voltage or equal, select for lamp and switching configuration indicated on the drawings.
- B. Where relevant, ballasts shall conform to UL 935, "Fluorescent Lamp Ballasts"; ANSI C82.1, "Ballasts for Fluorescent Lamps - Specification"; ANSI C82.2, "Methods of Measurement of Fluorescent Lamp Ballasts"; ANSI NFPA/70; and Public Law 100-357 National Appliance Energy Conservation Amendment of 1988, as applicable.
- C. Ballasts shall not exhibit excessive noise during start-up or steady state operation. Any ballast or group of ballasts in a space which contribute more than 1 db to the background room noise level when measured with a sound meter calibrated to the "A" scale will be considered defective.
- D. Ballasts shall:
1. Withstand line transients as defined in ANSI/C62.41.

2. Contain no polychlorinated biphenyls (PCBs) and shall be labeled "NO PCBs."
 3. Safely and reliably operate in a room ambient temperature from 50°F to 105°F for an input voltage of plus or minus 10 percent about the center design voltage. Provide low temperature fluorescent ballasts having a minimum starting temperature of -20°F in luminaires located where the ambient temperature may fall below 32°F.
 4. Operate the lamps at a frequency between 20 and 40 KHz from an input frequency of 60 Hz.
- E. Mark the ballast to indicate the required supply voltage, frequency, RMS current, current surge during starting, input watts, power factor at the design center voltage, open circuit voltage, crest factor and efficacy.
- F. Performance:
1. Voltage: As scheduled.
 2. Power factor corrected to at least 95% lagging, maximum Total Line Current Harmonic Distortion 10%.
 3. Tests shall be made in fixtures designed only for the number of lamps being tested.
 4. For other applications (higher ambients, etc.) the tests should be operated with equivalent lamp wall temperatures plus or minus 4°C.
 5. The light output shall not vary by more than plus or minus 15 percent for a plus or minus 10 percent variation of the input voltage about the center design voltage.
 6. The ballast shall operate the lamps in a manner that will not adversely curtail the normal life of the lamp.
 7. The ballast shall be able to withstand a single input surge of 6,000 volts from a 50 ohm 50 KHz damped sinewave source.
 8. Flicker shall be less than 5 percent.
 9. Audible noise levels shall be equivalent to the Class A rating of CBM certified ballasts.
 10. Ballasts shall meet the requirements of the Federal Communications Commission Rules and Regulations, Chapter 18, Part C (RF Lighting Devices), regarding radio frequency interference (RFI) and electromagnetic interference (EMI).
 11. Ballasts shall safely operate the specified lamps for two, three, or four lamp combinations in accordance with its rating. Failed lamps shall not affect ballast life.
 12. Power factor shall be not less than 90 percent, crest factor not more than 1.6, and total harmonic content not more than 10 percent of input current.
- G. Certifications: Ballasts shall be certified, labeled or listed by UL, CBM or ETL. Upon request, submit a test report from an independent testing laboratory certified by a qualified registered professional engineer upon request showing that the electronic ballasts meet or exceed all the performance requirements in this specification.
- H. Warrant ballast and lamp system in accordance with Osram/Sylvania "Quick 60 Limited Warranty with ballast warranted for 60 months and lamp for 36 months.
- I. Lamp/ballast efficacy shall meet or exceed the minimum Lamp/Ballast Efficacy values shown in the table below.

Minimum 2-Lamp Ballast (120 and 277 V)	Lamp	(BEF)	(Lumens)	Lamp/Ballast Efficacy
Electronic	F40T12 40W	1.24	3200	79.0
Electronic	F40T12 34W	1.46	2800	81.5
Electronic	F32T8 32W	1.52	2850	86.4
Electronic	T-5 22.5" 38-40W	1.30	3150	81.6

2.10 COMPACT FLUORESCENT BALLASTS

- A. Ballasts and related hardware shall be designed to operate on the voltage system to which they are connected and be UL listed for operating the specified lamps in accordance with ANSI C82.1 and C78, as applicable, or in accordance with the specified lamp manufacturer's recommendations where no ANSI standards exist.
- B. Ballasts for indoor use shall start lamps at a starting temperature of 50°F. For outdoors applications or where ambient temperatures may fall below 50°F, manufacturers' minimum starting temperatures for lamps and ballasts shall be -20°F.
- C. Design ballasts to withstand line transients as defined in IEEE Publication 587, Category A, provide Class P thermal protection and sound rating of "A" for interior applications.
- D. Ballasts shall not contain polychlorinated biphenyls (PCBs).
- E. Lamp current crest factor shall not exceed 1.7 when tested with the lamps specified.
- F. Warrant for two years, follow applicable manufacturers' recommendations for enclosed or open operation of both lamps and ballasts.
- G. Electronic rapid or instant start ballasts for use with Compact Fluorescent Lamps without Integral Starters shall comply with the following:
 - 1. Ballasts shall comply with 2.11.A-F, above.
 - 2. Ballasts shall be designed expressly to operate the lamps specified.
 - 3. Ballasts shall meet the requirements of the Federal Communications Commission Rules and Regulations, Chapter 18, Part C (RF Lighting Devices), regarding radio frequency interference (RFI) and electromagnetic interference (EMI).
 - 4. Ballasts shall have a frequency of operation of 20 KHz or greater and incorporate adequate 60 Hz filtering in order to operate with less than 5% flicker (maximum 0.20 Flicker index) with any rare earth phosphor lamp suitable for the ballasts.
 - 5. Ballasts shall be high power factor type with a power factor of 0.9 or greater.
 - 6. Ballast total harmonic distortion shall not exceed 10%.
 - 7. Light output (ballast factor) shall be no less than 0.85 when tested with a compatible lamp.

2.11 LIGHTING RELAY CONTROL PANELS

- A. Acceptable Manufacturers:
 - 1. General Electric
 - 2. Hubbell Building Automation, Inc.
 - 3. Powerline Communications, Inc.

- B. The lighting relay control panel shall be comprised of a panelboard style assembly including low voltage relays, microprocessor control system, operator interface, and related items, like Hubbell CX Lighting Control Panel. Provide panels with control capabilities indicated and specified.
- C. Mounting Panel: Flush mounted modular design with hinged lockable (all panels keyed alike) cover similar to circuit breaker panelboards. Design panels so that power wiring is contained in a separate compartment and external low voltage control wiring enters panel in the control compartment. Provide wiring/relay schedule card mounted inside door for circuit identification.
- D. Relays: Rated 20 amperes, 277 volts, low voltage electrically operated, mechanically latched, like Hubbell CXR Relays, or electrically held which carry a 10-year warranty and do not exhibit any noticeable hum or chatter when energized.
- E. Low Voltage Switches: Specification grade momentary pushbutton type with cover plates to match those specified for switches and outlets in Section 26 05 00.
- F. Automatic Control Panel: Provide microprocessor control modules to allow time of day, day of week, control functions for each lighting circuit.
 - 1. Control shall allow a different schedule for each relay or group of relays.
 - 2. Provide each circuit with the means to incorporate external override control by manual switches and/or photocell control as indicated on the drawings.
 - 3. Provide 40 character x 8 line backlit LCD display and function specific keypad; programming functions shall be easily accomplished by nontechnical personnel.
 - 4. The system shall include a reliable backup power source capable of maintaining system time for a minimum of 48 hours after loss of power. Operating program and stored time schedules shall be nonvolatile such that upon restoration of prime power, the system shall resume normal functions without operator intervention.
 - 5. Each panel may contain its own control modules and operate independently, or a single control may be used to control all panels. If a single control is used, provide appropriate cabling for this purpose.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine adjacent surfaces to determine that surfaces are ready to receive work.
- B. Install wiring in accordance with Section 26 00 00.
- C. Install luminaires and accessories in accordance with manufacturer's instructions, as indicated, with equipment, materials, parts, attachments, devices, hardware, hangers, cables, supports, channels, frames and brackets necessary to make a safe, complete, and fully operative installation.
- D. Install luminaires plumb, square, and level with ceiling and walls, in alignment with adjacent luminaires, and secure in accordance with manufacturers' directions and approved shop drawings. Conform to the requirements of National Electrical Code ANSI/NFPA 70.
 - 1. Specified or indicated mounting heights are to be to the bottom of each luminaire for suspended and ceiling mounted luminaires, and to the center of each luminaire for wall mounted luminaires. Obtain approval of exact mounting for luminaires on the job before installation is commenced and, where applicable, after coordinating with type, style, and pattern of ceiling being installed.

2. Provide pendant accessory to mount suspended luminaires and exit signs at height indicated. Use swivel hanger on sloped ceilings.
 3. Support surface mounted luminaires from ceiling grid tee structure; provide auxiliary support laid across top of ceiling tees and fasten to prohibit movement.
 4. Install recessed luminaires to permit removal from below and install earthquake clips.
 5. For lighting fixtures mounted in or on suspended ceilings, provide two support hangers per fixture so that each is independently supported from the building structure.
 6. Provide two support hangers for the minimum security fixtures so that each is independently supported from the building structure.
 7. Install lamps in luminaires and lamp holders.
 8. Ground non current carrying parts of electrical equipment in accordance with UL and NEC provisions.
- E. Install lighting fixtures where indicated on the plans; plans may be scaled for approximate locations; minor adjustments are permitted to avoid conflicts. Fixture placement that does not conform to the layout indicated shall be corrected; if in doubt about correct placement consult Engineer prior to roughing in. Install all lighting so that it is securely fastened, rows are uniformly spaced and in alignment, and fixture rests flat on mounting surface.
- F. Install ballasts and fixtures to avoid amplifying hum. Any ballast or fixture which develops an excessive hum within one year shall be replaced.
- G. Where multilevel switching is indicated, all outer lamps shall be switched together and all inner lamps together.
- H. Install 2 x 2 fixtures for consistent lamp orientation within each room.
- I. Perform insulation resistance and ground continuity test.
- 3.2 ADJUSTING AND CLEANING
- A. Align luminaires and clean lenses and diffusers at completion of work.
 - B. Aim adjustable luminaires and lamp holders as indicated or as directed.
 - C. Adjust directional arrows on exit signs to meet approval of authority having jurisdiction.
 - D. Clean paint splatters, dirt, and debris from installed luminaires.
 - E. Touch up luminaire and pole finish at completion of work.
 - F. Relamp luminaires which have failed lamps at completion of work.

3.3 OWNER INSTRUCTION

- A. Provide on-site training of Owner's personnel in operation of controls systems by a factory trained manufacturer's representative. Include instruction in programming time controls to obtain required control functions. Provide one follow-up visit if necessary.

END OF SECTION

SECTION 27 10 00 – TELEPHONE AND DATA WIRING SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes, but is not limited to, the following:
1. Coordinate backer board provided under Sections 06100 and 09900.
 2. Furnish underground duct from riser pole to backer board.
 3. Furnish a system of conduits and pull boxes for trunk cables.
 4. Furnish outlets and wiring for telephone and data distribution outlets.
 5. Test outlet wiring for circuit integrity.
 6. Cooperate with Owner's telephone equipment supplier.
- B. Related Documents:
1. Drawings, Division 00, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
 2. Section 06 10 00, Rough Carpentry.
 3. Section 09 91 00, Painting.
 4. Section 26 00 10, Basic Electrical Requirements.
- C. Work Not Included:
1. Telephone equipment and its installation.
 2. Telephone service entrance cables.

1.2 REFERENCES

- A. Comply with the latest revisions of the following:
1. ANSI/NFPA 70, National Electrical Code.
 2. ANSI/TIA/EIA-568-B, Commercial Building Telecommunications Standard.
 3. TIA/EIA-607, Commercial Building Grounding and Bonding Requirements for Telecommunications.
 4. BICSI Telecommunications Distribution Methods Manual.

1.3 SUBMITTALS

- A. Submit catalog cuts in accordance with Section 26 00 10 for the following:
1. Telephone and Data Cable
 2. Fiber Optic Cable.
 3. Telephone/Data Outlet and Cover Plate
 4. Patch Panels
- B. Submit factory certification that cable has been tested and meets the specified standards.
- C. Submit test report for installed cables and terminations.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Telephone backer boards shall be 3/4 inch AB grade fir plywood with two coats black enamel paint. Backer board shall be minimum 48" x 96", or as indicated, install 6'-6" AFF to top of board.

2.2 TELEPHONE/DATA OUTLETS

- A. Acceptable Manufacturers:
 - 1. AT&T
 - 2. Hubbell
 - 3. Leviton
 - 4. Panduit
- B. Data Jacks: RJ-45, eight pin modular, UL verified and listed Category 6, UL 1863, meeting FCC Part 68.5, gold plating over nickel under plating (50 micro-inch) beryllium copper jack contacts, phosphor bronze (100 micro-inch) tin/lead plating over nickel under plating IDC 110 contacts, TIA/EIA-568-A configuration, Hubbell HXJ6 series, Blue color, or approved equal.
- C. Telephone Jacks: RJ-45, eight pin modular, UL verified and listed Category 6, similar to Data Jack, TIA/EIA-568-A configuration, gray color.
- D. Mounting Plate: High impact 94 V-O rated gray thermoplastic (Noryl) flush cover plate with labels stenciled by thermal ink transfer, Hubbell FPL series, or approved equal. Provide blank cover for unused openings. Note: System is sized for future expansion; do not use single or dual position plates with no blanks.

2.3 CABLE

- A. Acceptable Manufacturers:
 - 1. Alpha
 - 2. Belden
 - 3. Berk-Tek
 - 4. Commscope
 - 5. Mohawk/CDT
 - 6. West Penn
- B. Data and Telephone Horizontal Cables: Inside cable, non plenum applications, NEC Type CM, CMG; riser applications Type CMR; UL Listed Category 6, unshielded 4-twisted pair solid 24 AWG copper conductors with polyvinyl chloride or polyolefin insulation and polyvinyl chloride sheath, factory certified to conform with EIA/TIA-568-A and Addenda TSB-36 and TSB-40-A, 100 ohms characteristic impedance, designed to support Gigabit Ethernet Standard of 250 MHz with maximum insertion loss (attenuation) of 33db and NEXT minimum of 36db. For plenum applications provide cable with CMP (plenum) rating and FEP Teflon insulation for both jacket and individual conductors.
- C. Intrabuilding Backbone Cable: Inside cable, 25 pair, NEC Type CM, CMG; riser applications Type CMR; Category 5e, unshielded 4-twisted pair solid 24 AWG copper conductors with polyvinyl chloride or polyolefin insulation and polyvinyl chloride sheath, 100 ohms characteristic impedance, attenuation 8db @ 1 Mhz, 27.4db @ 100Mhz, per 1000 feet; Ethernet and IBM compatible. For plenum applications provide cable with CMP (plenum) rating and FEP Teflon insulation for both jacket and individual conductors.
- D. Fiber Optic Cable: FDDI rated 62.5/125 micron graded index multimode, Halar outer covering, maximum 3.75 db/km attenuation, AT&T LGBC-006A PX Comcode 104-272-502, or approved equal.

2.4 EQUIPMENT

- A. Data and Telephone Patch Panels: Category 6, "110" termination, Hubbell #P6XXU series, provide ports as required for installed cables, plus 10 percent spares, or approved equal. Use for terminating all Category 6 cables.
- B. Terminal Blocks: "66" blocks, Reliable Electric #R66MN-25DAF9, 25 and 50 pair as appropriate, with double clips and female connectors. Provide #R89-1-25 standoff bracket.
- C. Provide Telecommunication Main Grounding Busbar, min. of 4" x 6" x 1/4" copper, in the Electrical Room bonded to the service neutral and a Telecommunications grounding busbar, min. 4" x 6" x 1/4" copper in the Main Distribution Facility with min. #6 AWG grounding conductor back to the TMGB.
- D. Fiber Optic Terminations: Twelve port SC panel, rack mounted with swing out fiber management tray like Hubbell #FPR012SCM.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install wiring in conduit as specified for branch circuits, Section 26 00 00, except use D rings and hooks above accessible ceilings.
- B. All conduit installed for telephone wiring shall have no more than two 90° bends in any run unless one or more accessible, appropriately sized pull boxes are provided.
- C. Installers shall be well trained, experienced, and familiar with TIA/EIA-568-A and its application in the installation of communication wiring. Run Category 5e cables in strict compliance with TIA/EIA-568-A. Observe bending radius rules, do not staple cable, and do not exert excessive tension when installing in raceway.
- D. Fiber Optic Cable: Do not exceed cables minimum manufacturers specified bending radius and/or maximum tensile rating during installation. Install all fiber cable in inner duct, minimum 1 1/4" trade size, install duct to minimize bends and twists. Secure all exposed sections with cable ties; do not allow the cable ties to bear the cable's weight.
- E. Make up telephone jacks to cables in accordance with TIA/EIA-568-verify 568-A or B with Owner prior to installing standards and test for opens, shorts and grounds at each pin. Cooperate with Owner's telephone equipment installer, who will install trunk cables and telephone equipment, and aid in troubleshooting cable problems. Correct defects in circuits supplied under this section.

3.2 TERMINATIONS

- A. Voice Riser (trunks): Terminate on AT&T or equivalent 110 type insulation displacement connection (IDC) termination blocks, with the shield grounded. Maintain pair twists to within 1/2" of the termination points.
- B. Data Riser: Terminate fiber strands using the appropriate ST/SC connectors.
- C. Station Outlets: Flush mounted four position faceplate with unused positions covered with blank off insert. Terminate cables on jack inserts, install voice jack in top position, data jack(s) in bottom position(s).
- D. Station Terminal Fields:

1. Terminate voice station cables on AT&T, or equivalent, 110 type insulation displacement connection (IDC) termination blocks. Maintain pair twists to within ½” of the termination points.
 2. Terminate data station cables on Category 6 modular patch panels having 110 type insulation displacement connection termination for the station cable, and RJ-45 style eight (8) position jacks wired in TIA-T-568-A pin configuration. maintain pair twists to within ½”, or less, of the termination points.
- E. Ground patch panels via a bond connection to the appropriate telecommunications grounding busbar.

3.3 LABELING REQUIREMENTS

- A. Number both ends of each cable with labels of waterproof materials and indelible ink text information, using either mechanical or waterproof adhesive attachment.
- B. The MDF and IDF’s termination blocks, patch panels, cables, and wall plates shall be numbered using the following scheme. The scheme is intended to insure that no two labeled items of the same type will have the same number.
- C. Wall Plate Marking:
 1. Wall Plate ID = FTNN Where F= Floor Designator
T= Terminal Identifier (i.e. “A”, “B”)
N= Sequential station placement drop number (Keyed to room number)
 2. Example: G-A-1024.3-3 = Ground floor, IDF A, Room 1024.3-Outlet number 3 in this room.
 3. This designation must be permanently and indelibly marked on the wall plate in a clear and legible manner. The designation must also be marked on the terminal block or patch panel of the associated distribution frame location (MDF/IDF).
 4. Record the wall plate number on the building floor plan record diagram.

3.4 GROUNDING REQUIREMENTS

- A. Extend service equipment ground to service backer board using min. #6 AWG copper. In exposed locations, install ground wire in EMT. Bond all telecommunications raceway to form a continuous path to ground.
- B. Ground patch panels, equipment racks and other telecommunications’ equipment via a min. #6 AWG bond connection to the appropriate telecommunications grounding busbar.
- C. Provide appropriate grounding for the protection of personnel, materials and equipment conforming to all applicable regulations, codes and standards.

3.5 FIRE STOPPING

- A. Apply UL 1479 listed cementitious fire stop materials conforming to ASTM E-814 F and T ratings, in full hours, compatible with the rating of the penetrated fire barrier.

3.6 TESTING

- A. Voice Circuits: Test for opens, shorts, grounds, and pair compliance at each pin. Correct defects and retest as necessary to obtain error free circuits. No defective pairs are permitted in station cables. A pair is defective if:
 1. Either or both conductors are open.

2. Either or both conductors are shorted to ground or another conductor.
 3. Tip and ring are reversed.
 4. Foreign voltages are present.
- B. Riser (trunk) Circuits: Test each pair end to end after termination. In the event of defective conductors, or pairs, replace the cable.
- C. Data Circuits: Test and certify all Category 6 cable runs to conform to TIA/EIA-568-B and UTP Addenda TSB-36, TSB-40A, 569, and 606. Runs shall support the Gigabit Ethernet Standard for 250 Mhz with maximum insertion loss (attenuation) of 33db and NEXT minimum of 36db. Perform bi-directional test using a network analyzer, Microtest Penta scanner, or approved equal. Defective pairs are not permitted; runs which do not meet this requirement shall be replaced or suitably repaired and retested. Submit a computer generated test report listing results for each run.
- D. Fiber Optic Riser: Test each strand in accordance with ANSI/TIA/EIA-526-7, Method A.1, one reference jumper. Test in one direction at 1310 and 1550 nm wavelengths; attenuation shall not exceed 1.0db/km at both wavelengths. Connector loss shall not exceed 1.5db per connector pair. No defective fiber strands, or splices of any type, are permitted in a riser cable. Replace any cable containing defective strands. Submit test report summarizing test results.
- E. Submit a typed test report indicating test results for each circuit, including station circuits and trunk cables.

END OF SECTION

SECTION 28 31 00 – FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. New building fire alarm system, including materials, labor, and services of a manufacturer trained installer, and related work.
2. Final adjustment and test of system.
3. Letter certifying that system has been properly installed and operates in accordance with applicable codes and these specifications.

B. Related Documents:

1. Drawings, Division 00, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
2. Section 26 00 10, Basic Electrical Requirements.
3. Section 26 05 00, Basic Electrical Materials and Methods.

1.2 REFERENCES

1. NFPA 70, National Electrical Code, 2011.
2. NFPA 72, Fire Alarm Code, 2010.
3. NFPA 101, Life Safety Code, 20012.

1.3 SUBMITTALS

A. Deliver submittals as directed in Section 26 00 10 for:

1. Fire alarm control panel
2. Manual stations
3. Smoke detectors
4. Duct smoke detectors
5. Heat detectors
6. Monitor modules
7. Control modules
8. Audible/visual devices
9. Telephone dialer
10. Wire and cable

B. Provide shop drawings and product data to indicate system components, size of components, location, floor plan drawings, and full one line schematic of wiring system showing every fire device and building and operation details. Indicate every fire alarm device, wire type, wire size, number of conductors, device location and room name for approval by the local Fire Department, Engineer, and Owner's representative.

C. Subject to authorization of Owner, Engineer may provide building floor plans and device locations in AutoCAD “Dwg” format for use by contractor in preparing shop drawings. If such drawing files are offered, it will be with the understanding that contractor is responsible for any necessary format changes, and that contractor will remove any information not pertinent to contractor’s work, and as may be requested by the Engineer. Contractor’s drawings shall be issued with Contractor’s title block and logo; use of A/E’s title block is prohibited. No extra

cost shall accrue to Owner in the event such files are not offered or for format and/or editing work that may be required.

- D. Submit manufacturer's descriptive literature, operating instructions, and maintenance and repair data.
- E. Have manufacturer submit, on completion of system verification, a point by point check list indicating the date and time of each item inspected and issue a certificate, confirming that the inspection has been completed and the system is installed and functioning in accordance with the specifications.
- F. Submit final test report and letter signed by an authorized representative of the manufacturer and installing company.

1.4 QUALITY ASSURANCE

- A. Approvals:
 - 1. The system shall have proper listing and approval by Underwriters Laboratories, Inc. (UL), and meet UL Standard 864.
- B. Regulatory Requirements:
 - 1. Installation subject to approval, inspection, and test by manufacturer certified installer.
 - 2. Provide equipment listed by UL and FM, tested by a nationally recognized fire test laboratory, and compatible with the integrated fire alarm system.
 - 3. Equipment, wiring, and installation shall meet the requirements of NFPA 70, 72, 101, and Americans with Disabilities Act (ADA).

1.5 WARRANTY

- A. All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one year from the date of acceptance. The full cost of maintenance, labor and materials required to correct any defect during this one year period shall be included as part of the work.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Acceptable Manufacturers
 - 1. Fire Control Instruments
 - 2. Honeywell
 - 3. Notifier
 - 4. Simplex
- B. System: Analog/addressable, annunciated, 24 volt DC, Notifier AFP-200, or approved equal, containing a microprocessor based Central Processing Unit (CPU). The CPU shall communicate with and control system equipment such as intelligent detectors, addressable modules, printer, annunciators, and other system controlled devices.
- C. Fire alarm system components shall be by a single acceptable manufacturer, except as specifically approved by Engineer for unusual accessories.
- D. Provide fully supervised wiring and manual fire alarm stations, smoke detectors, audio/visual alarms, station detectors, annunciated circuits, and sprinkler devices.

- E. Design system to operate upon alarm initiation input from manual stations, automatic detectors and sprinkler circuits as follows:
 - 1. Actuate control panel to cause all evacuation alarm horns to sound in a three pulse temporal pattern per ANSI S3.41, Audible Emergency Evacuation Signal, and evacuation alarm lights to flash throughout the building.
 - 2. Indicate the zone in alarm on the front of the fire alarm control panel.
 - 3. Shut down heating and ventilating equipment fans.
 - 4. Summon the local fire department.
 - 5. Close doors that are held open electrically.
 - 6. Activate audible/visual communications for areas of rescue assistance.
 - 7. Monitor and control computer room pre-action sprinkler system.
- F. Operating power failure or disarrangement of the supervised circuits shall cause an audible signal to sound, and lamp to indicate, until all circuits are restored to normal, except equip the audible signal with a silencing switch. The audible signal shall re-activate in the event of a subsequent trouble event on another circuit.
- G. In the event commercial power is lost, the system shall automatically transfer to standby battery power. Transfer shall not cause disarrangement except trouble lamp shall indicate loss of prime power.
- H. Basic Performance:
 - 1. Encode alarm, trouble and supervisory signals from all intelligent reporting devices on an NFPA Style 4 (Class B) Signaling Line Circuit (SLC).
 - 2. Wire Initiation Device Circuits (IDC) to Class A (NFPA Style D) standard.
 - 3. Wire Notification Appliance Circuits (NAC) to Class A (NFPA Style Z).
 - 4. Digitized electronic signals shall employ check digits or multiple polling.
 - 5. A single ground or open on the system SLC shall not cause system malfunction, loss of operating power or the ability to report an alarm.
 - 6. Alarm signals arriving at the main FACP shall not be lost following a power failure until the alarm signal is processed and recorded.
- I. Manufacturer, or manufacturer's authorized representative shall have a minimum of five years experience and maintain a full-time service office within 150 miles of the building site. Service office shall be staffed with trained technicians and stocked with sufficient spare parts so as to provide repairs within 24 hours of time reported outage.

2.2 CONTROL PANEL

- A. Steel construction, painted manufacturer's standard finish, hinged front cover, key locked, semi-flush mounted with transparent pane(s) to view system status indicators.
- B. Equip panel with:
 - 1. Door mounted, 80 character, backlit LCD display, annunciator.
 - 2. Separate trouble light for each supervised circuit.
 - 3. Trouble buzzer light and trouble silence switch.
 - 4. Separate pilot lamp to supervise standby power.
 - 5. System reset switch.
 - 6. Alarm horn silence switch.
- C. Provide supervision of system as follows: A break or a ground on any supervised circuit causes trouble signal and trouble lamp illumination. Trouble signal silence switch silences buzzer but lamp remains illuminated. On restoration of the system, the trouble signal to remain energized

until trouble signal silence switch is restored to normal. On loss of normal AC power, the trouble alarm operates and illuminates emergency power supervisory pilot lamp. Operation of the trouble alarm silence switch silences trouble signal but power supervisory lamp remains illuminated. On restoration of normal power, trouble alarm remains energized until the silence switch is restored to normal.

- D. Provide analog maintenance alert to warn when smoke detector dust accumulation is excessive, and three level (low, medium, high) manual individual detector sensitivity adjustment.
- E. Design control panel with integral digital communicator capable of reporting up to 56 zones or 198 points to a Central Station.
- F. System Capacity and General Operation:
 - 1. Include capability to monitor up to 198 intelligent/addressable devices.
 - 2. Provide Form-C alarm and trouble relays rated at a minimum of 2.0 amps @ 30 VDC. It shall also include four Class B (NFPA Style Y) programmable Notification Appliance Circuits.
 - 3. The system shall support up to 99 programmable EIA-485 driven relays for an overall system capacity of 301 circuits.
 - 4. Include a full featured operator interface control and annunciation panel that shall include a backlit Liquid Crystal Display, individual, color coded system status LEDs, and an alphanumeric keypad for the field programming and control of the fire alarm system.
 - 5. All programming or editing of the existing program in the system shall be achieved without special equipment and without interrupting the alarm monitoring functions of the Fire Alarm Control Panel.
- G. Provide the following features in the FACP:
 - 1. Drift Compensation to extend detector accuracy over life.
 - 2. Sensitivity Test, meeting requirements of NFPA 72, Chapter 5.
 - 3. Maintenance Alert to warn of excessive smoke detector dirt or dust accumulation.
 - 4. System Status Reports to display or printer.
 - 5. Alarm Verification, with verification counters.
 - 6. PAS presignal, meeting NFPA 72 3-8.3 requirements.
 - 7. Rapid manual station reporting (under 2 seconds).
 - 8. Non-Alarm points for general (non-fire) control.
 - 9. Periodic Detector Test, conducted automatically by software.
 - 10. Pre-alarm for advanced fire warning.
 - 11. Cross Zoning with the capability of: counting two detectors in alarm, two software zones in alarm, or one smoke detector and one thermal detector.
 - 12. March time and temporal coding options.
 - 13. Walk Test, with check for two detectors set to same address.
 - 14. UL 1076 Security Monitor Points.
 - 15. Control-By-Time for non-fire operations, with holiday schedules.
 - 16. Day/Night automatic adjustment of detector sensitivity.
- H. Central Microprocessor:
 - 1. The Microprocessor shall communicate with, monitor, and control all external interfaces with the control panel. It shall include EPROM for system program storage, non-volatile memory for building-specific program storage, and a "watch dog" timer circuit to detect and report microprocessor failure.
 - 2. The microprocessor shall contain and execute all control-by-event programs for specific action to be taken if an alarm condition is detected by the system. Control-by-event

equations shall be held in non-volatile programmable memory and shall not be lost even if system primary and secondary power failure occurs.

3. The microprocessor shall also provide a real-time clock for time annotation of system displays, printer, and history file. The time-of-day and date shall not be lost if system primary and secondary power supplies fail. The real time clock may also be used to control non-fire functions at programmed time-of-day, day-of-week, and day-of-year events.
- I. Field Wiring Terminal Blocks: Panel I/O wiring terminal blocks shall be a removable, plug-in type and be designed for 18 to 12 AWG wire. Terminal blocks which are permanently fixed are not acceptable.
 - J. Operator's Controls:
 1. Acknowledge Switch:
 - a. Activation of the control panel acknowledge switch in response to new alarms and/or troubles shall silence the local panel sounder, change the alarm and trouble LEDs from flashing mode to steady-on mode. If multiple alarm or trouble conditions exist, depression of this switch shall advance the 80-character LCD display to the next alarm or trouble condition.
 - b. The Acknowledge switch shall also silence all remote annunciator sounders.
 2. Signal Silence Switch: Activation of the Signal silence switch shall cause all programmed alarm notification appliances and relays to return to the normal condition after an alarm condition. The selection of notification circuits and relays that are silenceable by this switch shall be fully field programmable as permitted by applicable standards. The FACP software shall include silence inhibit and auto-silence timers.
 3. System Reset Switch: The system reset switch shall cause all electronically-latched initiating devices, appliances or software zones, as well as all associated output devices and circuits, to return to their normal condition.
 4. Holding the system RESET switch shall perform a lamp test function.
 5. Drill (Evacuate) Switch: The drill switch shall activate all notification appliance circuits. The drill function shall latch until the panel is silenced or reset.
 - K. Field Programming:
 1. The system shall be programmable, configurable and expandable in the field without the need for special tools or electronic equipment and not require field replacement of electronic integrated circuits.
 2. All programming can be done using the standard FACP keypad.
 3. All field defined programs shall be stored in non-volatile memory.
 4. The programming function shall be enabled with a password that may be defined specifically for the system when it is installed. Two levels of password protection shall be provided in addition to a key-lock cabinet. The lower level password is used for status level changes such as zone disable or manual on/off commands, and the higher-level is used for actual change of program information.
 5. Program edit shall not interfere with normal operation and fire protection. If a fire condition is detected during programming operation, the system shall exit programming and perform fire protection functions as programmed.
 6. Provide a special program check function to detect common operator errors.
 7. Include an Auto-Program (self-learn) function to quickly install initial functions and make the system operational.
 8. Provide an off-line programming with batch upload/download function.

9. Specific System Operations:
 - a. Smoke Detector Sensitivity Adjust: Provide a means to adjust the sensitivity of any or all analog intelligent smoke detectors in the system from the control panel. Sensitivity range shall be within the allowed UL window.
 - b. Alarm Verification: Each intelligent addressable smoke detector in the system shall be independently selected and enabled to be alarm verified. The alarm verification delay shall be programmable from 5 to 30 seconds. The FACP shall keep a count of the number of times that each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.
 - c. Point Disable: Any device in the system may be enabled or disabled through the system keypad.
 - d. Point Read: The system shall be able to display or print the following point status diagnostic functions:
 - 1) Device status.
 - 2) Device types.
 - 3) Custom device labels.
 - 4) View analog detector values.
 - 5) Device zone assignments.
 - 6) All program Parameters.
10. System Status Reports: Upon command by operator, generate a printed status report listing system status.
11. System History Recording and Reporting: Provide a history buffer capable of storing up to 650 system alarms/troubles/operator actions, including time and date stamp of the activation. The contents of the History Buffer may be manually reviewed, one event at a time, or printed in its entirety.
12. Although the foreground history buffer may be cleared for user convenience, a background, non-erasable buffer shall be maintained which provides the last 650 system events.
13. The History Buffer shall use non-volatile memory. Systems that use volatile memory for history storage are not acceptable.
14. Automatic Detector Maintenance Alert: The FACP shall automatically interrogate each intelligent smoke detector and analyze the detector responses over a period of time.
 - a. If any intelligent smoke detector in the system responds with a reading that is below or above normal limits, then the system will enter the Trouble Mode, and the detector will be annunciated on the system display, and printed on the optional printer. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.
15. Pre-alarm Function: The system shall provide two levels of pre-alarm warning to give advance notice of a possible fire situation. Both pre-alarm levels shall be fully field adjustable. The first level shall give an audible indication at the panel. The second level shall give an audible indication and may also activate control relays. The system shall also have the ability to activate local detector sounder bases at the pre-alarm level, to assist in avoiding nuisance alarms.
16. Software Zones: The FACP shall provide 99 software zones. All addressable devices may be field programmed to be grouped into software zones for control activation and annunciation purposes.

L. Display :

1. Provide all the controls and indicators used by the system operator to program all system operational parameters.
2. Include status information and custom alphanumeric labels for all intelligent detectors, addressable modules, and software zones.
3. Provide an 80-character back-lit alphanumeric Liquid Crystal Display (LCD). It shall also provide 5 Light-Emitting-Diodes (LEDs), that will indicate the status of the following system parameters: AC POWER, SYSTEM ALARM, SYSTEM TROUBLE, SIGNAL SILENCED, SUPERVISORY, and PRE-ALARM.
4. Provide a 21-key touch key-pad with control capability to command all system functions, entry of alphabetic or numeric information, and field programming. Two different password levels shall be provided to prevent unauthorized system control or programming.
5. Include the following operator functions: SIGNAL SILENCE, RESET, DRILL, and ACKNOWLEDGE.

M. Signaling Line Circuit (SLC) Interface:

1. The SLC interface shall provide power to and communicate with up to 99 intelligent detectors (Ionization, Photoelectric, or Thermal) and 99 intelligent modules (monitor or control) for a system capacity of 198 devices. This shall be accomplished over a single SLC loop and shall be capable of supporting NFPA 72 Style 4, Style 6, or Style 7 wiring.
2. The loop interface shall receive analog information from all intelligent detectors on the loop to determine whether normal, alarm, or trouble conditions exist for each detector. The software shall automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information shall also be used for automatic detector testing and for the automatic determination of detector maintenance requirements.
3. The detector software shall meet NFPA 72, chapter 7 requirements and be certified by UL as a calibrated sensitivity test instrument.
4. The detector software shall allow manual or automatic sensitivity adjustment.

N. Serial Interfaces:

1. Provide an EIA-232 interface between the Fire Alarm Control Panel and UL Listed Electronic Data Processing (EDP) peripherals.
 - a. Supports the use of printers, CRT monitors, and PC compatible computers.
 - b. Include special protocol methods that allow off-site monitoring of the FACP over standard dial-up phone lines. This ancillary capability shall allow remote readout of all status information, including analog values, and shall not interfere with or degrade FACP operations when used. It shall allow remote FACP Acknowledge, Reset, or Signal Silence in this mode. It shall also allow adjustment of detector sensitivity and readout of the history file.
2. Provide an EIA-485 interface for the serial connection of remote annunciators and LCD displays that may be used for network connection to a Proprietary Receiving Unit.
3. Protect all interfaces and associated equipment so that they will not be affected by voltage surges or line transients, consistent with UL standard 864.

O. Universal Digital Alarm Communicator Transmitter (UDACT):

1. The UDACT is an interface for communicating digital information between a fire alarm control panel and a UL-Listed central station.
2. It shall be compact in size, and mount in a standard module position of the fire alarm control cabinet.

3. Include connections for dual telephone lines (with voltage detect), per UL/NFPA/FCC requirements, with the ability of split reporting of panel events to up to three different telephone numbers.
4. Completely field programmable from a built-in keypad and 4 character red, seven segment display.
5. Capable of transmitting events in at least 15 different formats. This ensures compatibility with existing and future transmission formats.
6. Communication shall include vital system status such as:
 - a. Independent Zone (Alarm, trouble, non-alarm, supervisory)
 - b. Independent Addressable Device Status
 - c. AC (Mains) Power Loss
 - d. Low Battery and Earth Fault
 - e. System Off Normal
 - f. 12 and 24 Hour Test Signal
 - g. Abnormal Test Signal (per UL requirements)
 - h. EIA-485 Communications Failure
 - i. Phone Line Failure
7. The UDACT shall support independent zone/point reporting when used in the Contact ID format. In this format the UDACT shall support transmission of up to 2,040 points. This enables the central station to have exact details concerning the origin of the fire or response emergency.
8. An optional module shall be available which provides 8 Form-C relays rated at 5.0 amperes. The relays shall track programmable software zones.

2.3 Power Supply:

- A. Provide power supply unit as part of control panel or as separate unit to automatically maintain standby battery bank fully charged under normal conditions and sized to recharge standby batteries in 12 hours maximum, following emergency operation. Power supply shall operate the system when batteries are disconnected.
 1. The Power Supply shall operate on 120 VAC, 60 Hz, and provide all necessary power for the FACP.
 2. It shall produce 5.0 amps of usable Notification appliance power, using a switching 24 VDC regulator. An 3.0 amp Notification expansion power supply shall be available for UL 1971 and ADA devices, for a total system capacity of 8 amps.
 3. Battery charger shall be dual-rate charging type for fast battery recharge and be power-limited per 1995 UL864 standards.
 4. Provide a very low frequency sweep earth detect circuit, capable of detecting earth faults.
 5. Provide optional meters to indicate battery voltage and charging current.
- B. Provide sealed nickel cadmium or lead acid batteries of sufficient capacity to operate system under supervised load conditions without recharging for 24 consecutive hours and then have sufficient power left to operate sounding devices for fifteen minutes. Batteries shall be warranted for 5 years full plus 5 years pro rata, total of 10 years. Mount batteries in the bottom of the FACP or in a steel locked enclosure located 6 inches minimum or 6 feet maximum above floor in a dry, clean location where ambient temperatures will be 40 degrees F maximum. Protect enclosure so that spillage of electrolyte will not damage FACP interior.

2.4 ADDRESSABLE DEVICES - GENERAL

- A. Detectors shall be intelligent and addressable, and connect with two wires to the Fire Alarm Control Panel Signaling Line Circuits.
- B. Provide decade (numbered 0 to 9) rotary decimal switches for address-setting.
- C. Addressable Devices shall use simple to install and maintain type address switches. Devices which use a binary address setting method, such as a dip switch, are not an allowable substitute.
- D. Provide dual alarm and power LEDs on addressable smoke and thermal detectors.
 - 1. Both LEDs flash under normal conditions to indicate that the detector is operational and in regular communication with the control panel.
 - 2. Both LEDs shall continuously illuminate indicating that an alarm condition has been detected.
 - 3. The flashing mode operation of the detector LEDs shall be optional through the system field program.
 - 4. Provide an output connection in the base to connect an external remote alarm LED.
- E. Provide detector sensitivity adjustment through field programming of the system. Sensitivity shall be automatically adjusted by the panel on a time-of-day basis.
- F. Provide automatic detector compensation for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72, Chapter 7.
- G. The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature.
- H. Provide the means to test detectors and report to the FACP by activating a built-in magnetic switch, or be initiated remotely on command from the FACP.
- I. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL).

2.5 ADDRESSABLE FIRE ALARM BOXES

- A. Manual: Non-coded, single action, flush mounted in new construction, surface mounted on matching back box (do not mount on standard electrical box) in existing construction. Station shall remain in actuated position until reset by key access.
- B. Back Boxes: For recessed applications, provide 4" x 4" x 2.5" deep, or larger, flush back box. For surface mounted applications, provide matching back box so that face of manual station does not overhang the box.
- C. Addressable pull boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status. Provide a key operated test-reset lock to restor device to normal use.
- D. Manual stations shall be solidly constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches or larger.

2.6 INTELLIGENT HEAT DETECTORS

- A. Thermal detectors shall be intelligent addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute. It shall connect via two wires to the fire alarm control panel signaling line circuit.

- B. Detectors: Fixed temperature, combined fixed temperature rate of rise as indicated, 135E F for normal locations, 190E F for boiler room applications, complete with plug-in detector base for surface mounting on outlet box.
- C. Rate of Rise: 14E F per minute.
 - 1. For elevator shunt trip applications, provide temperature rating 10° lower than adjacent sprinkler head rating.
- D. Resetting: Provide fixed temperature detectors of automatic reset type.

2.7 INTELLIGENT PHOTOELECTRIC SMOKE DETECTORS

- A. The detectors shall use the photoelectric light-scattering principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.
- B. Capable of detecting products of combustion without requirements for presence of heat or smoke, unaffected by changes in environmental temperature, humidity, and pressure; semi flush mounted, with indicator lamp, provision for remote mounting, designed for operation on 24 volts DC. Provide complete with plug-in detector base for surface mounting on outlet box.
- C. Furnish duct mounting units complete with duct mounting enclosure and sampling tubes.
- D. Equip detectors with 30 mesh insect screen and closed back to prevent entry of dust and air turbulence and shield electronics to prevent false alarms caused by EMI and RFI.
- E. Design detector to be easily disassembled to facilitate cleaning.

2.8 ADDRESSABLE DRY CONTACT MONITOR MODULE

- A. Provide addressable monitor modules to connect one supervised IDC zone of conventional alarm initiating devices (any N.O. dry contact device) to one of the fire alarm control panel SLCs.
- B. The monitor module shall mount in a 4-inch square, 2-1/8 inch deep electrical box.
- C. The IDC zone shall be suitable for Style D or Style B operation. Include an LED status light as specified above for addressable devices.

2.9 ADDRESSABLE CONTROL MODULE

- A. Provide addressable control modules to supervise and control conventional NACs of compatible, 24 VDC powered, polarized audio/visual notification appliances or for other auxiliary functions, such as fan shutdown, which require a dry contact relay.
- B. The control module shall mount in a standard 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box, or to a surface mounted backbox.
- C. The control module NAC may be wired for Style Z or Style Y (Class A/B) with up to 1 amp of inductive A/V signal, or 2 amps of resistive A/V signal operation, or as a dry contact (Form-C) relay. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.
- D. Audio/visual power shall be provided by a separate supervised power circuit from the main fire alarm control panel or from a supervised, UL listed remote power supply.

- E. The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC.

2.10 ADDRESSABLE RELAY MODULE

- A. Provide addressable relay modules for HVAC control and other building functions as needed. The relay shall be form C and rated for a minimum of 2.0 Amps resistive or 1.0 Amps inductive. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.

2.11 AUDIBLE/VISUAL ALARM DEVICES

- A. Provide combination vibrating horn/flashing strobe alarm devices mounted on a common housing, except where indicated, provide strobe unit without horn. Provide matching back box for all surface mounted units; do not mount on standard electrical box. In flush mounted applications, provide matching back box, or standard electrical box as needed.
- B. Design horns for parallel type operation semi-flush mounted, with audio output of not less than 95 db at 10 feet on axis except 87 db rating may be used where the higher rated output is excessive.
- C. Strobes shall be Xenon flash tube type meeting UL 1971 and NFPA 72 and having a minimum flash intensity of 15 candela polar distribution, or higher where indicated on drawings, with a maximum pulse duration of 0.2 second and maximum duty cycle of 40 percent. Strobes shall meet the ADA required 75 candela on axis distribution. The flash repetition rate shall be a minimum of 1 and maximum of 2 per second. Provide synchronizing control so that strobes in a common area flash simultaneously. Provide higher flash intensity units as indicated and/or as necessary to meet the requirements of NFPA 72 in large spaces.
- D. Back Boxes: For recessed applications, provide 4" x 4" x 2.5" deep, or larger as needed, flush back box. For surface mounted applications, provide matching back box so that face of a/v unit does not overhang the box.

2.12 SPRINKLER DEVICES

- A. Monitor tamper switches for each OS&Y valve in sprinkler system.
- B. Monitor flow and pressure switches and control pre-action sprinkler valve.
- C. Provide with power on indicator and three position test switch.

2.13 MAGNETIC DOOR HOLDERS

- A. Wall/Door mounted, 24 volts DC, 25 lb. minimum holding force, low power consumption, Simplex #2088 series, provide matching backbox for surface mounted applications.

2.14 WIRE AND CABLE

- A. Provide number and size of wires as recommended by the manufacturer of the alarm system, but not less than #18 AWG for initiating device circuits and #14 AWG for notification appliance circuits.
- B. Wire in conduit:
 - 1. Type THHN building wire, minimum #14 AWG, stranded copper conductor, per Section 26 05 00.

2. Twisted or twisted shielded pair, as required by fire alarm system manufacturer, minimum #18 AWG, stranded copper conductor for digital circuits, and #16 AWG for alarm notification circuits, include overall PVC jacket.
- C. Power Limited Fire Alarm System Cable
1. Fire rated cable, UL rated, Type FPL, minimum #16 AWG stranded copper conductor.
 2. Cable marked type FPLP shall be used in ducts, plenums, and other space used for environmental air.
 3. Cable marked type FPLR shall be used in riser and all other applications.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install as recommended by the equipment manufacturer and in accordance with NFPA 70, NFPA 72 and local and State codes.
- B. The stations, detectors, audiovisual units, control panel, and batteries are approximately located on the drawings. Minor rearrangements to adjust for appearance and structural conditions are to be expected. Detectors have been arranged on floor plan to meet or exceed code required minimum spacing. Provide additional detectors where location adjustments prevent meeting these requirements. Provide additional audiovisual units as required to meet minimum evacuation alarm audible sound level requirements.
- C. Install fire alarm wires and cable in conduit per Section 26 00 10, except where indicated, fire rated cable is permitted above accessible ceilings in accordance with Section 26 00 10.
- D. Paint all fire alarm junction boxes red and stencil "FIRE ALARM" on each box cover, including existing boxes.
- E. Fire alarm conductor terminations in control panel and splice cabinets shall be made on terminal strips with a separate point for each conductor. All such strips to be number identified as shown in wiring diagram attached to inside of door of control panel. Connect wiring neatly to terminal strips; bundle wires, neatly arrange in straight runs with square corners and secure with nylon cable straps or lace with jute cord. Set up termination of cabling so that sections of the system may be isolated or shorted out for servicing.
- F. Mount end-of-line resistor for each circuit in control panel.
- G. Provide signal connection to elevator controller.
- H. Mount fire alarm boxes centered at 48 inches above finished floor. Fire alarm boxes shall not protrude more than 0'-4" from the mounting surface, and shall not protrude beyond the sides of the backbox..
- I. Protect smoke detectors from contamination due to construction dust or the like. In the event of false alarms due to dirty detectors, remove all detectors and clean or replace them and reinstall at no extra cost to Owner.
- J. Mount audiovisual devices 6'-8" AFF to underside of visual device, but not less than 1'-0" below ceilings. Any wall mounted device mounted less than 6'-8" AFF shall not protrude more than 0'-4" from the mounting surface.

3.2 FIELD QUALITY CONTROL

- A. Provide the service of a competent and NICET certified factory-trained technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72, Chapter 7.
- B. Technician shall make a thorough inspection of the complete installed fire alarm systems including operation of all components such as manual stations, thermal detectors, smoke detectors, sprinkler flow valves, and controls, and open each circuit at its most remote point to ensure the following:
 - 1. Complete and functional system.
 - 2. Underwriters Laboratories requirements.
 - 3. Installed in accordance with manufacturer's instructions.
 - 4. Regulations covering supervision of components are adhered to.
 - 5. Make changes necessary to conform to Items 1, 2, 3, and 4 with technical assistance from the manufacturer.
- C. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation and perform the following:
 - 1. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.
 - 2. Verify activation of all flow switches.
 - 3. Open initiating device circuits and verify that the trouble signal actuates.
 - 4. Open and short signaling line circuits and verify that the trouble signal actuates.
 - 5. Open and short Notification Appliance Circuits and verify that trouble signal actuates.
 - 6. Ground all circuits and verify response of trouble signals.
 - 7. Check presence and audibility of tone at all alarm notification devices.
 - 8. Check installation, supervision, and operation of all intelligent smoke detectors using the Walk Test.
- D. Introduce each of the alarm conditions that the system is required to detect. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.
- E. At the final inspection, technician shall demonstrate that the systems functions properly in every respect.

3.3 INSTRUCTION:

- A. Provide a typewritten "Sequence of Operation" and instruction as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.
- B. Have fire alarm technician prepare a test report certifying that the system has been successfully tested in accordance with these specifications and regulatory requirements.
- C. Submit manufacturer's warranty for equipment and wiring to be free from mechanical and electrical defects for a period of one year from the date of acceptance. At the conclusion of the warranty period, manufacturer's technician shall re-inspect and service the system and furnish a letter to the Owner certifying that 100% of the system is operating properly.

END OF SECTION