

**ELECTRICAL SPECIFICATIONS – TABLE OF CONTENTS**

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**ELECTRICAL SPECIFICATIONS****16000- ELECTRICAL SYSTEMS DESCRIPTION**

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- 1.1 Specification includes
- A. Electrical systems for the following applications: Refer to individual specification sections following for detailed requirements.
    - 1. Power and distribution.
    - 2. Packaged equipment definitions.
    - 3. Lighting, including exit and emergency lighting.
    - 4. Emergency generator.
    - 5. Fire alarm and life safety.
    - 6. Security.
    - 7. Lightning protection.
    - 8. Telephone.
    - 9. Computer / local area network.
    - 10. Empty conduit system.
    - 11. Power connections for HVAC and plumbing equipment.
    - 12. Power connections for specialty equipment.
  - B. Products
    - 1. Systems, products, and standards are listed in individual specification sections, which follow.

**16010 - ELECTRICAL BASIC REQUIREMENTS**

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- 1.1 Specification
- A. General requirements specifically applicable to Division 16, in addition to Division 1 provisions.
  - B. Division 15 lists requirements for motors, pressure switches, solenoid valves, motorized valves, damper operators and other devices, which may be furnished under division 15, but installed, connected and tested under Division 16.
- 1.2 Quality Assurance
- A. ANSI/NFPA 70-1996 National Electric Code.
  - B. ANSI/ IEEE C2 - National Electrical Safety Code.
  - C. Local Codes.
  - D. The 1996 BOCA National Building Code.
  - E. MIOSHA.
  - F. NECA - Standard of Installation.
  - G. NEC
  - H. NEMA
  - I. ANSI

- J. IPCEA
- K. ASTM
- L. American Standard Safety Code for Elevators.
- M. Lansing Board of Water and Light Utility Service Standards
- N. MEC
- O. HEW (Dept. of Health, Education and Welfare)
- P. EPA, NES
- Q. DNR
- R. UL (United Laboratory)

### 1.3 Products

- A. Furnish and install products, acceptable to the authority having jurisdiction as suitable for the use intended, from Square D, Cutler Hammer, G.E. or Westinghouse manufacturers having a history of successful installation and operation of the equipment proposed.
- B. Manufacturer's Nameplates: Aluminum or type 304 stainless steel not less than 20 gauge thick, permanently engraved or punched, riveted or bolted to all equipment.
- C. Field Nameplates: Provide engraved melamine plastic, 1/8" thick engraved in block capital lettering to expose white lettering on black face.

### 1.4 Packaged Equipment

- A. Packaged equipment shall be defined as architectural, mechanical, civil, or other trades equipment specified in other divisions of this specification, which shall be furnished and installed complete up to power source wiring connections, provided by this contractor.
- B. Packaged equipment shall include but not be limited to control wiring, control device, fused switch, combination magnetic starter control transformer, interlocks, relays, conduits, wiring and device identification for all integral device, to leave ready for operational start-up except for single incoming power service by this contractor under the provisions of Division 16000 of these specifications.
- C. Any special work to be provided under this division outside the package equipment definition shall be noted on the contact drawings accompanying these specifications.
- D. Packaged equipment shall be defined as follows:
  - 1. Elevators, passenger and freight.
  - 2. Escalators.
  - 3. Man-lifts.
  - 4. Dock levelers.
  - 5. Hoists.
  - 6. Cranes or winches.
  - 7. Automatic or motor operated doors.
  - 8. Incinerators.
  - 9. Temperature controls.
  - 10. Kitchen and laboratory equipment.
  - 11. Chemical water treatment
  - 12. Water softeners, water booster pumps
  - 13. Building and control air compressors and dryers

14. Refrigeration units, compressors or self-contained air conditioner.
15. Fire and jockey pumps
16. Boilers, boiler feed and condensate pumps
17. Penthouse air handling units, return and exhaust fans
18. Walk -in coolers, refrigerator freezers.
19. Fire extinguishing systems
20. Drinking fountains.
21. Traffic signal equipment.
22. Aircraft warning and signal equipment.

## **16110 - RACEWAYS, CABLE TRAYS, AND BOXES**

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### 1.1 Project Includes

- A. Electrical conduit, tubing, embedded raceways, wireways, cable trays, boxes, and cabinets for electrical power and signal distribution.

### 1.2 Products

#### A. Wiring Methods:

1. Exposed Indoor Wiring: Electrical metallic duct below finished floor; galvanized steel conduit in plenum, 10' - 0' above finished floor.
2. Concealed Indoor Wiring: Electrical metallic tubing except that all feeder circuits shall be installed in rigid galvanized conduit.
3. Exposed Outdoor Wiring: Galvanized rigid steel conduit. If local environmental conditions are not suitable for exposed galvanized steel, rigid non-metallic or PVC coated rigid steel conduit may be considered.
4. Concealed Outdoor Wiring: Provide same as required for exposed outdoor wiring.
5. Underground Wiring, Single Run: Rigid nonmetallic conduit.
6. Underground Wiring, Grouped: Rigid nonmetallic conduit. Utility service, or conduits below roads, grouped or single shall be encased in concrete with not less than 3" thickness beyond conduit wall. Steel reinforced under drives and parking lot.
7. Connection to Vibrating Equipment: Flexible metal conduit, liquid tight at exterior.

#### B. Metal Conduit and Tubing:

1. Rigid steel Conduit ANSI Conduit: ANSI C80.1.
2. PVC Externally coated Rigid Steel Conduit and Fittings: ANSI C80.1 and NEMA RN1.
3. Electrical Metallic Tubing (EMT) and fittings: ANSI C80.3.
4. PVC Externally Coated Electrical Metallic Tubing and Fittings: ANSI C80.3 and NEMA RN 1.
5. Flexible Metal Conduit: UL1 zinc-coated steel.
6. Liquid tight Flexible Metal Conduit and Fittings: UL 360.

#### C. Nonmetallic Conduits and Ducts:

1. Electrical Nonmetallic Tubing (ENT): NEMA TC 13.
2. Rigid Nonmetallic Conduit (RNC): NEMA TC2 and UL 651, Schedule 40 or 80 PVC.
3. Underground PVC and ABS Plastic Utilities Duct: NEMA T6, Type I for encased burial in concrete, Type II for direct burial.

4. PVC and ABS Plastic Utilities Duct Fittings: NEMA TC9.
  5. Liquid tight Flexible Nonmetallic Conduit and Fittings: UL 1660.
- D. Raceway Accessory Materials:
1. Conduit Bodies: NEC Requirements.
  2. Wireways: NEC requirements
  3. Surface Raceways, Metallic: Galvanized, painted steel, with snap-on covers.
  4. Sub-surface raceways metallic, under floor, junction boxes, support couplers, service fittings: galvanized or enamel painted steel with snap on covers.
  5. Surface raceways, Nonmetallic: Rigid PVC, UL 94.
- E. Cable Trays:
1. Materials: Mill galvanized steel, hot-dip galvanized steel or aluminum.
  2. Configuration: Ladder type, trough-type, solid bottom type, channel type.
  3. Covers: solid type, louvered type, and ventilated-hat type.
- F. Boxes and Fittings:
1. Cabinet boxes: UL 50, sheet steel, NEMA 1.
  2. Pull and junction boxes: UL 50, steel boxes.
  3. Metal Outlet, Device and Small Wiring Boxes: UL 514A and OS 1.
  4. Nonmetallic Outlet, Device and Small Wiring Boxes: NEMA OS 2.

## **16118 - UNDERFLOOR RACEWAYS**

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- 1.1 Project Includes:
- A. Pathways with the upper being galvanized steel duct or plastic under floor raceway similar to the “panduit”, under floor system. Top layer grouped in runs of 3 each (telephone communications and data) spaced on 6’-0” centers and set in floor mounted j-box of the type which allow communications, data and telephone outlets to be installed in separate assembly. The lower level shall be closed conduit or trench duct having a junction box with removable covers installed on the floor surface at each 6’-0” intervals for clean and dirty power. at each quad-plex junction box with isolated ground.
- 1.2 All open Office Area Shall Utilize Raised Access Flooring:
- A. All ducts, cells, and trenches shall be sized to allow a spacing of up to one work station per each 120 SF with each work station requiring (for planning purposes) one 4-pair telephone cable, one four pair data cable, two general power duplex receptacles and one dedicated circuit isolated ground duplex receptacle for clean power. The engineer shall provide electrical load calculations to justify wire capacity of the under floor distribution system.
- 1.3 Products:
- A. Under floor Raceway Components
1. Flat-Top Underfloor Raceway: Steel or galvanized 1-1/2” deep welded.
  2. Trench-Type Underfloor Raceway: Steel bolt on or welded, with removable steel covers that will not permanently deflect under normal traffic loads.
  3. Service Fittings: Flush, preset inserts, power outlets, communications outlets in modular pattern.

**16119 - UNDERGROUND DUCTS AND UTILITY STRUCTURES**

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## 1.1 Specifications include:

- A. Underground conduits and ducts, duct banks, pull boxes and hand holes, manholes, and other underground utility structures.
- B. Primary service transformer shall be utility owned and serviced, oil filled, outdoor with double ended service or per Landing Board of Water and Light grid connection standards.

## 1.2 Products:

## A. Underground duct applications:

- 1. Electrical Utility Service: Plastic PVC utilities duct encased in concrete.
- 2. Electrical Feeders: Direct buried rigid PVC plastic conduit.
- 3. Telephone Utility Service: Plastic utilities duct encased in concrete.
- 4. Communications Circuits: Plastic underground conduit encased in concrete.

## B. Conduit and Duct:

- 1. Rigid Steel Conduit: ANSI C80.1, galvanized.
- 2. Plastic-Coated Rigid Steel Conduit and Fittings: NEMA RN 1.
- 3. Rigid Plastic Conduit: NEMA TC 2, Schedule 40 PVC.
- 4. PVC Conduit and Tubing Fittings: NEMA TC 3.
- 5. Rigid Plastic Underground Conduit: UL 651A, Type A PVC.
- 6. Rigid Plastic Underground Conduit: UL 651A, Type EB PVC.
- 7. Rigid Plastic Underground Conduit: High-density polyethylene, Schedule 50.
- 8. Rigid Plastic Underground Conduit: Fiberglass-reinforced epoxy.
- 9. Plastic Utilities Duct: NEMA TC 6.
- 10. Plastic Utilities Duct Fittings: NEMA TC 9.
- 11. Plastic Communications Duct and Fittings: NEMA TC10.

## C. Pull Boxes and Hand holes:

- 1. Cast Metal Boxes: Cast aluminum with gasketed cover with nonskid finish.
- 2. Fiberglass Hand holes: Molded fiberglass with weatherproof cover with nonskid finish.

## D. Precast Concrete Utility Structures:

- 1. Precast Units: Interlocking, mating sections.
- 2. Structural Design and Fabrication: ASTM c 857, class as applicable.

## E. Accessories:

- 1. Duct Supports: Rigid PVC.
- 2. Frames and covers: Cast iron with cast-in legend.
- 3. Sump Frame and Grate: FS RR-F-621, Type VII for frame and Type I for cover.
- 4. Components: Pulling in eyes in walls, pulling and lifting irons in floor, cable stanchions, arms and cable support insulators, ladder.

**16120 - WIRES AND CABLES**

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## 1.1 Specification Includes:

- A. Wires, cables, and connectors for power, lighting, signal, control and related systems rated 600 volts and less.
  - B. S.E.R. cable shall not be used for any other direct burial wiring system. All underground power and communications shall be in PVC conduit, encased in concrete for protection.
- 1.2 Quality Assurance:
- A. Compliance: National Electrical Code: UL 4, 83, 486A, 486B, 854; NEMA/ICEA WC-5, WC-7, WC-8; IEEE 82.
- 1.3 Products:
- A. Wire Components:
    - 1. Conductors for Power and Lighting Circuits: Solid conductors for No. 10 AWG and smaller; stranded conductors for No. 10 AWG and smaller; stranded conductors for No. 8 AWG and larger.
    - 2. Conductor Material: Copper.
    - 3. Insulation: THHN/THWN for conductors size 500MCM and larger and No. 8 AWG and smaller; THW, THHN/THWN or XHHW insulation for other sizes based on location.
    - 4. Insulation Voltage Rating: 600 volts.
    - 5. Jackets: Factory-applied nylon or PVC.
  - B. Cables:
    - 1. Metal-Clad Cable (prefabricated wiring systems) from Raceway Outlet Boxes to Lighting Fixtures: UL Type MC.
    - 2. Control/Signal Transmission Media: Single conductor coaxial type with polyethylene core; twisted pair, aerial, plenum and video types.
    - 3. Fiber Optic Cables: Single Channel low-loss glass type, fiber optic multi-mode graded-index cables, including connectors, couplers, transmitters, receivers, sources and detectors.
  - C. Connectors: UL listed solder less metal connectors with appropriate temperature ratings.
  - D. Color Coding:
    - 1. All No. 12 and No. 10 conductors shall have continuous insulation colors as follows:  
280Y/120Volts, 3ph, 4W 480Y/277 Volts, 3 ph, 4W  
Phase A - Black  
Phase A - Brown  
Phase B - Red  
Phase B - Orange  
Phase C - Blue  
Phase C - Yellow  
Neutral - White Neutral - Gray  
Equipment Ground - Green  
Equipment Ground - Green
    - 2. All Phase conductors larger than No. 10 shall be taped with corresponding colors in panel-board gutters, pull boxes and at load connections or any connection points.
    - 3. Where prefabricated wiring systems are used, wiring shall be color coded to match above.

**16140 - WIRING DEVICES**

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## 1.1 Specification Includes:

- A. Wiring devices for electrical service.

## 1.2 Quality Assurance:

- A. Compliance: National Electric Code, NEMA WD 1, UL.

## 1.3 Products:

## A. Wiring Devices and Components:

1. Receptacles: UL 498, NEMA WD 1 and FS W-C 596. Receptacles shall be specification grade rated for the load supplied, however no receptacles less than 20 ampere rating shall be used on the project. General convenience receptacles shall be NEMA 5-20R configuration. Receptacles connected to emergency systems shall have red bodies, receptacles for computer service shall be provided with isolated grounds and have an orange body, general use receptacles may be architects choice use of colors.
2. Ground Fault Interrupter (GFI) Receptacles: Each ground-fault type receptacle shall be specification grade having an independent ground-fault interrupter unit with integral duplex receptacle having an NEMA 5-20R configuration.
3. Snap-Switches: UL 20, NEMA WD 1 and FS W-S 896, AC switches shall be quiet type, toggle handle, specification grade, rated 20 amperes, 120-277 volt. Motor starter switches, rated for motor starting loads may be used for motor loads under ½ HP.
4. Dimmer Switches, Incandescent Lamps: NEMA WD 1, solid state modular dimmer switches, 120 volts, 60 Hertz, adjustable rotary or slide type.
5. Dimmer Switches, Fluorescent Lamps: Full wave modular type AC dimmer, electronic type, with electronic filters.
6. Wall Plates: Single and combination types, stainless steel or plastic type plate with integral color. Where color plates are used, color may be architects choice except that where used with receptacles having a special color requirement, plates shall match the color of the receptacle.
7. Occupancy Sensors: Provide passive infrared, ultrasonic or dual technology sensors that are required for the best operations in the space controlled. All sensors shall have LED indicators, adjustable sensitivity and adjustable time of 30 seconds to 30 minutes. All occupancy sensors shall have at least a five-year warranty and shall be provided by a manufacturer who has been making sensors for a period of five or more years.
8. Provide timers, special devices or specific purpose receptacles as required for the project having quality similar to the above.

**16400 - SERVICE AND DISTRIBUTION**

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## 1.1 Specification Includes:

- A. Electrical service and distribution including service entrance, switchboards, low-voltage power switch gear, grounding, transformers, bus ways, panel boards, over current devices, and motor controllers.

- B. Service and Distribution Requirements: An Adequate underground service shall be provided at 480Y/277 volts to supply the building maximum demand plus at least 25% spare capacity above maximum demand. Should local conditions make a service at another voltage, or above ground, appear more appropriate for installation, a different voltage may be considered after receipt of written justification for the change and after written approval by the state.

## 1.2 Products

### A. Service Entrance:

1. Circuit Breakers: Air circuit breakers, current limiting circuit breakers, molded-case circuit breakers, solid state trip circuit breakers, or insulated case circuit breakers. Where service entrances are 2,000 amperes or larger, main and feeder circuit breakers of the main switchboard shall be draw out construction with electrically operated air circuit breakers, or electrically operated insulated case circuit breakers.
2. Meter Sockets: Provided for the local utility company for contractor installation. Pulse meter required for interconnection to BAS

### B. Switchboards:

1. Switchboard type: Front and rear accessible section for draw out or fixed main device, branches and sections.
2. Enclosure: NEMA 1, indoor.
3. Utility Metering Compartment: Acceptable to local utility company.
4. Buses and Connections: Three-phase four-wire type, uniform capacity entire length of switchboard, copper only.
5. Over Current Protective Devices: (Circuit Breakers): Ratings, characteristics and settings suitable for use. Provide two levels of ground fault protection.
6. Circuit Control and Protective Devices: Provide surge arrestors.
7. Instrument Transformers: NEMA EI 21.1, IEEE C57.13.
8. Ratings: Nominal system voltage, continuous main bus amperage, short-circuit current rating suitable for use.
9. Instrumentation: Provide solid state instrumentation on each main breaker to show digital readings of phase to phase to neutral voltages, phase amperage, KVA, power factor, KW and accumulative KWH. Instrumentation shall also provide for remote indication through the building automation system.

### C. Low-Voltage Power Switchgear:

1. Low Voltage Switchgear Assemblies: IEEE C37.20.1 and UL 1558. Nominal system voltage, main continuous amperage suitable for use. Short-time and short-circuit-current ratings same as highest rated circuit breaker in switchgear assembly. Provide copper only construction materials.
2. Low Voltage Draw out Power Circuit Breakers: IEEE C37.13 and UL 1066. Continuous current, interrupting, and short-time current ratings for each circuit breaker suitable for use. Voltage and frequency rating same as switchgear.
3. Provide other features similar to that required for switchboards.

### D. Grounding:

1. Grounding Equipment: UL 467; copper conductors; NEC table 8 wire and cable conductors; connectors.
2. Grounding Electrodes: Copper clad steel ground rods minimum 10 ft length.

- E. Transformers:
1. Dry Type Transformers: NEMA ST 20, copper windings, 2 winding type; enclosure type, insulation class, insulation temperature rise suitable for use; Sound level ratings shall not be greater than allows by NEMA TR-27. For electronic and computer loads, transformers shall be rated K-13 or greater as required by the load and shall be provided with electrostatic shielding.
  2. Drive Isolation Transformers: NEMA ST 1, UL 506, self-cooled, two winding dry type; continuous duty rating; enclosure type, insulation class suitable for use.
  3. Buck-Boost Transformers: NEMA ST 1, UL 506, self-cooled, two-winding dry type; continuous duty rating.
- F. Busways:
1. Busways: Feeder and plug-in type, ANSI/UL 857, NEMA BU 1, enclosed, non-ventilated, suitable for indoor installation, copper conductors with ground bars and 10% neutrals.
  2. Plug-In Devices: Circuit breaker plugs and combination started plugs; compatible with connected busway.
- G. Panelboards:
1. Panelboards: NEMA PB 1, UL 50, 61, with bolted on circuit breakers and enclosure suitable for use, copper bus, compression type main and neutral lugs.
  2. Panelboard Type: Load-center-type panelboards; lighting and appliance branch circuit panelboards; distribution panelboards. Minimum of 20% spare capacity.
  3. Panelboards serving electronic and computer loads shall be rated for non-linear loads, have neutrals rated at 100% of the phase current rating and shall be provided with an insulated isolated ground bus in addition to the equipment grounding bus. Minimum of 10% spare breakers of each size in panelboards.
- H. Over Current Protective Devices:
1. Over Current Protective Devices:
    - a. Integral to panelboards, switchboards, and motor control centers.
    - b. Fused Power Circuit Devices: UL 977, operation suitable for use; open fuse trip device; minimum fault current rating suitable for use.
    - c. Molded Case Circuit Breakers: UL 489, NEMA AB 1; combination circuit breaker and ground fault circuit interrupters type; current limiting circuit breaker type, integrally fused circuit breaker type; solid-state trip device circuit breaker type; rating suitable for use.
- I. Fuses:
1. Cartridge Fuses: ANSI/IEEE FU 1, noninterchangeable type.
  2. Spare Fuse Cabinet: Wall-mounted 18 gauge steel unit.
- J. Motor Controllers:
1. Manual Motor Controllers: Quick-make, quick-break toggle action.
  2. Magnetic Motor Controllers: Full-voltage non-reversing, across the line, magnetic controller, multi-speed type, NEMA size 1 or larger.
  3. Multi-Speed Motor Controllers: Full-voltage non-reversing, across the line, magnetic controller multi-speed type, NEMA size 1 or larger.
  4. Reduced-Voltage Motor Controllers:

5. Star Delta magnetic type or part winding magnetic type or solid-state type.
6. Solid State, Variable Speed Motor Controllers: Variable speed control for NEMA Design B, 3 phase induction motor; ratings, control interfaces, internal adjustability, multiple motor capability, motor circuit protection features suitable for use.
7. Combination Controller/Disconnect: Provide with motor controllers as described above and having circuit breaker type disconnects (thermal/magnetic or MPCs) suitable for use.

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**16482 - MOTOR CONTROL CENTERS**

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## 1.1 Specification Includes

- A. Motor control center for use on AC circuits rated 600V or less. Provide where five or more motors are grouped near each other.

## 1.2 Products

- A. Motor control center (MCC) Components:
  1. MCC Features: Modular motor controllers with motor circuit protectors or thermal magnetic circuit breakers, control devices, Over Current protective devices, transformers, panelboards, instruments, indicating panels, blank panels and accessory items mounted in MCC compartment.
  2. MCC Wiring Classification: Class I, Type B
  3. MCC Enclosure: NEMA Type I.
  4. Buses: Plated copper only, ampacity rating AIC rating as required for the project.

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**16515- INTERIOR LIGHTING**

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## 1.1 Specification Includes

- A. Interior lighting fixtures, lamps, ballasts, emergency lighting units, and accessories.

## 1.2 Quality Assurance

- A. Compliance: NFPA 70 "National Electrical Code"

## 1.3 Products

- A. Interior Lighting Components:
  1. Florescent Fixtures: Fixtures UL 1570; ballasts UL 935, high frequency electronic type with ballast factor of 89% or greater, harmonic distortion less than 20%, and shall maintain full voltage light output at plus or minus 5% of standard with less than 5% flicker at cold start. Provide for both standard and dimming ballasts; lamps, T8, rare earth phosphor, 3500°, CRI 75 or greater; air handling fixtures at 35% minimum return air volume.
  2. High Intensity Discharge (HID) Fixtures: UL 1572; blasts, UL 1029; instant restrike device.
  3. Incandescent Fixtures: UL 1571.
  4. Fixtures for Hazardous Locations: UL 844.
  5. Track Lighting Systems: UL 1574.
  6. Exit Signs: UL 924, LED type.

7. Emergency Lighting Units: UL 924.
8. Emergency Fluorescent Power Supply: UL 924.
9. Lamps: ANSI standards, C78 series.
10. Suspended fixture support Components: Stem, rod, and hook hangers. Provide seismic bracing if seismic conditions of project warrant this construction.

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**16525 - EXTERIOR LIGHTING**

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- 1.1 Specification includes
  - A. Exterior lighting fixtures: Fixtures, UL 1570; ballasts, UL 935, high frequency electronic types.
- 1.2 Quality Assurance
  - A. Compliance: NFPA 70 “National Electrical Code”
- 1.3 Products
  - A. Exterior Lighting Components:
    1. Fluorescent Fixtures: Fixtures, UL 1570; ballasts, UL 935, high frequency electronic types.
    2. High Intensity Discharge or Metal Halide (HID) Fixtures: UL 1572; ballasts, UL 1029; instant restrike device.
    3. Incandescent fixtures: UL 1571.
    4. Lamps: ANSI Standards, C78 series.
    5. Fixture Support Poles, Mast Arms and Brackets: Steel or Aluminum.

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**16620 - PACKAGED ENGINE GENERATOR SYSTEMS**

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- 1.1 Specification Includes
  - A. Packaged diesel engine generator system.
  - B. Generator facility to be exterior to occupied office building.
- 1.2 Quality Assurance
  - A. Compliance: NFPA 110.
- 1.3 Products
  - A. Packaged Engine Generator System Characteristics:
    1. Type: Standby rated automatically started diesel engine coupled to an AC generator unit.
    2. Ratings: Voltage, frequency, and power output output ratings suitable for use.
    3. Maximum Transfer Time to Assume Full Load: 10 seconds.
    4. Fuel Supply: 72 hours of operation. Above ground storage
  - B. Packaged Engine Generator System Components:
    1. Engine: NFPA 37.
    2. Engine Fuel: Diesel fuel oil grade DF-2.

3. Cooling System: Closed Loop, liquid cooled, radiator mounted on generator set base with coolant heater for cold weather start.
4. Fuel Supply System: NFPA 30, 37; day tank for 4 hours full load, redundant high level fuel shut off, fuel piping and storage tank, dual redundant pumping.
5. Engine Exhaust System: Critical Rated muffler, suitable for use.
6. Combustion-Air Intake System: Filter type air intake silencer, intake duct and connections.
7. Starting System: DC electric with negative ground. Provide heavy duty diesel starting batteries (minimum of two) and suitable adjustable charge with full wave rectifier, current limiting, dual rate, float/equalize, DC voltmeter and ammeter, alarms for charger failure and low battery voltage including signals for remote monitoring by BAS,
8. Control and Monitoring: Operation and safety indications, protective devices, basic system controls, engine gauges. Provide a fill option remote monitoring panel.
9. Generator, Exciter, and Voltage Regulator: NEMA MG 1, direct drive.
10. Governor: Solid State isochronous type to maintain engine speed within plus or minus 0.25 HZ, with recovery to steady state within 2 seconds following sudden load changes.
11. Outdoor Generator Set Enclosure: Weatherproof steel housing, wall-in enclosure, louvers, dampers and miscellaneous equipment included.
12. Transfer Switches: Automatic, 4 poles, applicable to service required.

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**16660 - GROUND FAULT PROTECTION SYSTEMS**

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**1.1 Specification Includes**

- A. Ground fault sensing, relaying, tripping and alarm devices for installation in distribution switchboards and panelboards rated 600 volts and less.

**1.2 Products**

- A. Ground Fault Sensing Devices:
  1. Outgoing Circuit Current Sensors: Current transformer with circuits requiring outgoing circuit sensing method.
  2. Ground Return Current Sensors: Current transformer for encircling main bonding jumper connection.
  3. Short Circuit Rating: 200,000 amperes RMS symmetrical.
  4. Outputs: Compatible with relay inputs.
- B. Ground Fault Relay: Solid State type without external electrical power supply required for relay. Provide two levels of ground fault protection.
- C. Monitor Panels: Ground fault indicators, test and reset buttons.

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**16670 - LIGHTING PROTECTION SYSTEMS**

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**1.1 Specification Includes**

- A. Lightning Protection Systems for buildings and associated structures.

**1.2 Quality Assurance**

- A. Compliance: NFPA 78; UL 96; Provide a UL master Label System.

### 1.3 Products

- A. Lightning Protection Systems Components:
  1. Metal Type: Copper or Aluminum, with solid air terminals.
  2. Air Terminals: Copper or Aluminum points.
  3. Ground Rods: Copper clad steel.
  4. Accessory Components: Bonding plates, conductors, connectors, conductor straps, fasteners, grounding plates, rod clamps, fasteners, grounding plates, rod clamps, splicers. All underground cables shall be copper and all underground connections shall be made with an exothermal welding process. Down conductors shall be installed in non-metallic conduit concealed within the building.

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## 16721 - FIRE ALARM SYSTEMS

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### 1.1 Specification includes

- A. Zoned, non-coded, addressable, microprocessor-based fire detection and alarm system with manual and automatic alarm initiation, analog addressable smoke detectors, and automatic alarm verification for alarms initiated by designated smoke detector zones.
- B. Note: If the building proposed is not a high rise building, a basic fire alarm system will be required including horns, strobes, graphic enunciator and other control equipments, If the building proposed is classified a high rise building, a communications/firefighters alarm voice telephone system with CRT monitors and printer shall be provided and the equipment shall be housed in a console installed in a building command center placed on the ground floor for speedy access by the local fire department.

### 1.2 Quality Assurance

- A. Compliance: NFPA 70, 71, 72, 72E 72G, 72H.

### 1.3 Products

- A. Fire Alarm System Characteristics:
  1. Signal Transmission: Dedicated multiplex signal transmission.
  2. Audible alarm indication: Horns and bells for basic system, tone signals and voice alarm messages on fire system rated speakers for high rise systems.
  3. Visual Alarm Indicator: Strobe lights.
  4. Interface: Smoke Removal systems' smoke dampers, air handling units control, elevator recall system, fire door holders, door locks.
  5. Reporting and Annunciation: sound and LED LCD visual indication on main panel and remote annunciator panel with off-site reporting of alarms and trouble for basic system. Sound and CRT with keyboard and with a local and remote hard copy printer, along with displayed floor plans with off-site reporting of alarms and trouble for high rise systems.
- B. Fire Alarm System Components:
  1. Manual pull Stations: Red single action type, metal. Restoration of the unit shall require removal of the front cover with a tool or replacement of a broken glass or plastic rod.

2. Smoke Detectors: UL 268, self-restoring type with visual indicator, photoelectric type.
3. Thermal Detectors: Fix temperature and rate of rise type.
4. Flame Detectors: Ultraviolet type with delay.
5. Fire Alarm Bells: electric vibrating under-dome type.
6. Fire Alarm Horns: Electric vibrating polarized type.
7. Visual Alarm Devices: Xenon strobe lights having an intensity of 100 candela minimum with a flash rate of 1 HZ to 3 HZ. Provide with a clear plastic lens with the word "FIRE" in red letters on the lens.
8. Voice/Tone Speakers: UL 1480 type with 25 volt line matching transformer for each unit with taps a ¼ watt, ½ watt, 1 watt, 2 watts and 5 watts. Provide a minimum sound rating of 82dbA at 10 feet when tapped at 1 watt. Provide one amplifier for each speaker circuit with a minimum of two speaker circuits per floor. Speakers shall be wired and shielded in conduit such that every other speaker is on a different circuit, such that failure of a single circuit can only affect half the speakers on a floor, but the entire area of the floor will still be covered.
9. Fire Fighters Telephones: Red telephone handset dedicated supervised communication lines. Handsets shall have separate speaker and microphone coils. Provide ten standard telephone handsets with 6 foot coiled retractor cords stored in a flush mounted cabinet with hinged transparent door. Provide a fixed emergency telephones in code required locations at each three floor levels in each stairwell consisting of a telephone set in a cabinet with a hinged door, plainly marked an emergency telephone.
10. Device location Indication Lights: System voltage indication lights.
11. Magnetic Door Holders: Wall or floor mounted type.
12. Fire Alarm Control Panel: UL 864 with lockable steel enclosure and alphanumeric display ad system controls.
13. Graphic Annunciator: LED indicator on graphic building floor plan.
14. System Printers: Ink jet or laser jet type with standard EIA RS 232 ports. The unit shall receive standard paper widths abd length up to 14" wide. Each unit shall include an adjustable tractor feed. Character set shall be the standard ASCII set. Line width shall be 128 characters, minimum.
15. Transmitter: auto dialer type.
16. Emergency Power Supply: Battery operated, 24-hour operation capacity, complete with battery charger.
17. Line Voltage and Low Voltage Circuits: Solid copper conductors with rated insulation, color-coded. Signal circuits shall be shielded in cable format.
18. Conduit; The entire fire alarm system wiring shall be in rigid steel conduit that is painted red after installation.
19. CRT: The CRTs shall be packaged in a standard enclosure with only the CRT screen and keyboard visible. The CRT shall have a nonglare screen with 24 display lines. The diagonal dimension of the screen shall not be less than 12 inches. The CRT shall operate on EIA RS-232-C or current loop interfaces using ASCII encoded transmission.
20. Keyboard: The CRT shall be provided with a keyboard and shall be the main machine interface to the CPU. The keyboard shall include the full 129 ASCII character set, including control functions. The keyboard shall also include one special function key for the purpose of acknowledging alarms and cursor control keys.

**16724 - SECURITY SYSTEMS**

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1.1 Specification includes:

- A. Intrusion detection system including sensors, signal equipment, controls, and alarm displays.

1.2 Quality Assurance:

- A. Compliance: UL 609, 681, 1023, 1076, 1641, FM approval as applicable.

1.3 Products .....

A. Intrusion Detection System Components:

1. Surge Protection: UL 1449.
2. Interference Resistance: Not affected by radiate radio frequency interference and electrical as applicable.
3. Tamper Protection: Tamper protection switches.
4. Intrusion Detection Deices: Types, features, accessories and mounting conditions as applicable.
5. Alarm Contact Arrangement: Single pole, double throw type.
6. Door Switches: UL 634.
7. Space Intrusion Detection Devices: UL 369, passive infrared, microwave, acoustical, glass break, vibration, and dual technology devices as applicable.
8. System Control Panel: UL compliance for type of unit.
9. Annunciator: Visual display and audible alarm.
10. Secure Access Control Stations: Keypad, display module, and key operated switch.
11. System Printer: Dot matrix type with NRTL label.
12. Wire and Cable: Stranded copper.

**16740 - TELEPHONE AND COMMUNICATION SYSTEMS**

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1.1 Specification Includes:

- A. Telephone and communication service entrance raceway.
- B. Equipment and terminal backboards.
- C. System Requirements: Provide conduit-encased raceway for telephone system from backboards to individual set outlet boxes. It is envisioned that much of the telephone distribution within the building will utilize an underfloor distribution system. Where wall mounted outlets are required, outlet boxes will cover plates shall be provided with conduit run in walls and overhead and voice/data with plenum rated cabling back to the telephone closet on each floor.
- D. Raceway types:
  1. Surface raceways consisting if base cover, couplings and elbow surface mounted directly on floor feeding comm..blocks at approximate 6”-0” centers, providing a continuous “daisy chain” or modular pathway. Telecommunication modular outlets are multiport wire blocks by vendor located in 6’-0” centers along the raceway.
  2. Multi-channel raceway provides perimeter pathways for different systems such as telephone, data fire, BAS and security. Ensure that the same relative location of each

channel is maintained for each system throughout the building. Within multichannel raceways, dividers separating compartments shall be bonded to ground.

## 1.2 Quality Assurance

- A. Compliance: FCC Regulations.

## 1.3 Products

- A. Telephone termination Backboards: Fire resistant plywood, sized at 4'-0" x 8'-0" x ¾" thick. Dual sheets required for multiplex systems.
- B. Digital switches, MDF and all voice/data equipment shall conform to EIA/TIA 568 standards.
- C. "Panduit" or equal raceway cable management systems shall conform to BICSI standards as applicable to open office area.

## 16780 - TELEVISION SYSTEMS

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### 1.1 Specification Includes

- A. Closed circuit television system (CCTV) for building surveillance and imaging applications.

### 1.2 Products

- A. CCTV System Components:
  - 1. Cameras: Silicon target, monochrome, CCD imaging type with ½" pickup tube capable of producing usable video images, resolving all 10 shades of gray of EIA resolution chart, using F/1.4 lens with subject illumination ranging from .5 lux to 100,000 lux.
  - 2. Lenses: Fixed lenses f/1.4 adjustable to f/22; motorized remote controlled zoom lenses.
  - 3. Camera Supporting Equipment: Minimum safety factor of 2.0; 100 mph wind for exterior units.
  - 4. Pan Units: Motorized automatic scanning units.
  - 5. Pan and Tilt Units: Motorized units for remote controlled aiming of camera panning rotation 0 to 355 degrees with adjustable stop, 90 degree tilt movement, 12 degrees per second speed.
  - 6. Accessories: Mounting brackets, steel dustproof housings for fixed cameras.
  - 7. Monitors: Monochrome, metal cabinet units designed for continuous operation.
  - 8. Visual Tape Recorder: Industrial time lapse type for continuous operation, video cassette tape format ½" using industrial grade T120 cassettes, minimum 400 lines resolution.
  - 9. Manual Switch Bank: low loss, high isolation multiple video switches.
  - 10. Sequential Switches: Automatically sequence outputs of multiple cameras, continuously adjustable, 5 to 20 seconds with manual override.
  - 11. Pan, Tilt, and Zoom Controls: Arranged for multiple camera control with selector switches.
  - 12. CCTV Master Control Station: Heavy-duty, freestanding, modular metal furniture with wiring to other building systems including telephone, communications, fire alarm, and other systems.

13. CCTV Coaxial Cable Connectors:
14. Type BNC, 75 ohms.

## 16915 - LIGHTING CONTROL EQUIPEMNT

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### 1.1 Specification Includes

#### A. Lighting controls Equipment:

1. Manual modular dimming systems.
2. Integrated multipreset modular dimming systems
3. Multichannel remote controlled dimming system
4. Programmable lighting control system

#### B. Products

##### 1. Lighting Control Equipment Components:

- a. Manual Modular Dimming System: Factory prefabricated, 1 to 4 channels of manual dimming control; common on/off switching, single flush wall plate.
- b. Integrated Multi preset Dimming System: Microprocessor based, solid state system, automatically changes variable dimmer settings of different groups of lights when push button is operated; control panel to adjust dimmer channel settings of different groups of lights when push button is operated; control panel to adjust dimmer channel settings; times cross-fading action when one preset scene is switched to another.
- c. Multi-channel Remote Controlled Dimming System: Microprocessor based, solid state system and low voltage control signals to change variable dimmer settings of different groups of lights from one preset scene to another; control panels adjust dimmer channel settings and command change; plug in type dimmer modules; power failure memory feature.
- d. Programmable Lighting Control System: UL 916, microprocessor based, solid-state 365-day timing and control unit with output circuits individually programmable.
- e. Surge Protection: UL 1449 solid state, line voltage equipment surge protection.
- f. Dimmers: UL 508.
- g. Contactors and Relays: NEMA ICS 2, electrically operated and mechanically held devices; pilot lights.
- h. Time Switches and Sensors: Solid State, electromechanically dial type time switches, UL 917. UL 773A photoelectric relays, solid state, with SPDT dry contacts for relay of contactor control, with time relay to prevent false operation.
- i. Occupancy Sensors: UL listed, Class 2, ultrasonic, infrared or combination technology ceiling mounted, motion detection type, with sensing head.

End of Specifications