

## Section 26 05 00 Electrical General Provision

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### PART 1 - GENERAL

#### 1.01 RELATED DOCUMENTS

- A. Except as modified in this Section, General Conditions, Supplementary Conditions, applicable provisions of Division 1 General Requirements, and other provisions and requirements of the Contract Documents apply to work of Division 16 Electrical.
- B. Applicable provisions of this section apply to all sections of Division 16, Electrical.

#### 1.02 CODE REQUIREMENTS AND FEES

- A. Electrical work shall comply with applicable inspection services:
  - 1. Underwriters Laboratories,
  - 2. National Fire Protection Association,
  - 3. State Health Department,
  - 4. Local Municipal Building Inspection Department adopted codes with amendments,
  - 5. National Electrical Code with local amendments.
- B. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract.
- C. Obtain all permits required & pay all fees for such permits.

#### 1.03 CONTRACTOR'S QUALIFICATIONS

- A. An approved contractor for the work under this division shall be:
  - 1. A specialist in this field and have the personnel, experience, training, and skill, and the organization to provide a practical working system.
  - 2. Able to furnish evidence of having contracted for and installed not less than three (3) systems of comparable size and type that have served their Owners satisfactorily for no less than three (3) years.

#### 1.04 WORKMANSHIP

- A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
- B. Perform work by persons qualified to produce workmanship of specified quality.
- C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking. Under no conditions shall material or equipment be suspended from structural bridging.
- D. Provide finishes to match approved samples; all exposed finishes shall be approved by the Architect / Engineer. Submit color samples as required.

#### 1.05 MANUFACTURER'S INSTRUCTIONS

- A. Comply with instructions in full detail, including each step in sequence.
- B. Should instruction conflict with Contract Documents, request clarification from Architect / Engineer before proceeding.

#### 1.06 MANUFACTURER'S FIELD SERVICES

- A. When required in individual Specification Sections, manufacturer shall provide a manufacturer's qualified personnel to observe:
  - 1. Field conditions.

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2. Condition of installation.
  3. Quality of workmanship.
  4. Start-up of equipment.
  5. Testing and adjusting of equipment.
- B. Manufacturer's qualified personnel shall make written report of observations and recommendations to Architect/Engineer.
- 1.07 CONTRACT DRAWINGS
- A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.
- B. Every effort has been made by the Engineer to indicate wiring of all receptacles, light fixtures, switches, telephone outlets, HVAC equipment, other equipment and all other devices / appliances requiring electrical power. It is the intent of the Engineer that all light fixtures be powered and controlled unless specifically noted on the plans; that all wiring devices (receptacles and direct connected equipment) be circuited to a power source of the correct voltage, unless specifically noted on the drawings; and that all HVAC and other equipment be properly wired to the correct voltage power source; that all communications devices and equipment are fully operational.
- 1.08 PROJECT RECORD DOCUMENTS
- A. Maintain at the job site a separate set of white prints (black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is significantly at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various major and minor feeders, equipment, and other pertinent items, as installed. Record underground and under slab service and feeders installed, dimensioning exact location and elevation of such installations.
- 1.09 SPACE REQUIREMENTS
- A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.
- 1.10 RELATION WITH OTHER TRADES
- A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements.
- B. Provide sleeves and inserts in forms as required for the work. Stub up and protect open ends of pipe before any concrete is placed. Furnish sizes of required equipment pads. Furnish and locate bolts and fittings required to be cast in them. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.
- 1.11 CONCEALED AND EXPOSED WORK
- A. When the word "concealed" is defined as hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is defined as open to view, in plain sight.
- 1.12 GUARANTEE
- A. Guarantee work for one (1) year from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. At the Owner's option, replacement of failed parts or equipment shall be provided.
- 1.13 MATERIAL AND EQUIPMENT

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- A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two (2) or more units of the same type or class of equipment are required, provide units of a single manufacturer.

### 1.14 NOISE AND VIBRATION

- A. Select equipment to operate with minimum noise and vibration. If noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, and judged objectionable by the Owner, Architect, or Engineer, rectify such conditions at no additional cost to the Owner. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

### 1.15 ACCEPTABLE MANUFACTURERS

- A. Manufacturers names and catalog number specified under sections of Division 16 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, materials, energy efficiency characteristics (where applicable) and lighting performance characteristics (where applicable) equal to that specified, manufactured by a named manufacturer shall be acceptable on approval. A request for prior approval of equipment not listed must be submitted seven (7) days before bid due date. Submit a marked-up set of the relevant specification section indicating all variances, a comparison to the specified product, and of construction and performance criteria, complete design and performance data for the specified product and the proposed substitution for comparison to the Engineer. The Architect issues approvals of acceptable manufacturers as addenda to the Construction Documents.

### 1.16 UTILITIES, LOCATIONS AND ELEVATIONS

- A. Examine the site and verify the location and elevation of all utilities and of their relation to the work.

### 1.17 WARRANTIES

- A. Submit three (3) copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

### 1.18 BUILDING CONSTRUCTION

- A. It shall be the responsibility of the sub-contractor to consult the Contract Drawings, details and specifications and thoroughly familiarize himself as to the construction and all job related requirements. All construction trades shall cooperate with the General Contractor / Construction Manager job site superintendent and lay out work so that all raceways and other items are placed in the walls, furred spaces, chases, etc., so that there shall be no delay in the job.

### 1.19 TEMPORARY FACILITIES

- A. General: Refer to Division 1 for general requirements on temporary facilities.
- B. Temporary Wiring: Temporary power and lighting for construction purposes shall be provided under this Division. Installation of temporary power shall be in accordance with NEC Article 527.
- C. Temporary facilities, wire, lights, and devices are the property of this Contractor and shall be removed by this Contractor at the completion of the Contract.

### 1.20 ELECTRICAL OPERATION AND MAINTENANCE MANUAL

- A. Content of Manual:
  - 1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.
    - a. Contractor, name of responsible principal, address and telephone number
    - b. A list of each product required to be included, indexed to content of the volume.
    - c. List with each product, name, address and telephone number of:

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- 1) Subcontractor or installer
  - 2) Maintenance contractor as appropriate
  - 3) Identify area of responsibility of each.
  - 4) Local source of supply for parts and replacement
  - d. Identify each product-by-product name and other identifying symbols as set forth in Contract Documents.
  2. Product Data:
    - a. Include those sheets pertinent to the specific product.
    - b. Annotate each sheet to:
      - 1) Identify specific product or part installed.
      - 2) Identify data applicable to installation.
      - 3) Delete references to inapplicable information.
  3. Drawings:
    - a. Supplement product data with drawings as necessary to illustrate:
      - 1) Relations of component parts of equipment and systems
      - 2) Control and flow diagrams
    - b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
    - c. Do not use Project Record Documents as maintenance drawings.
  4. Written text as required to supplement product data for the particular installation.
  5. Copy of each warranty, bond and service contract issued
    - a. Provide information sheet for Owner's personnel, giving:
      - 1) Proper procedures in event of failure
      - 2) Instances that might affect validity of warranties or bonds
  6. Shop drawings and product data as specified.
- B. Sections for Equipment and Systems:
1. Content for each unit of equipment and system as appropriate:
    - a. Description of unit and component parts:
    - b. Operating procedures:
      - 1) Start up, break-in, routine / normal operating instructions
      - 2) Regulation, control, stopping, shut down and emergency instructions
      - 3) Summer and winter operating instructions
      - 4) Special operating instructions
    - c. Maintenance procedures:
      - 1) Routine operations
      - 2) Guide to trouble-shooting
      - 3) Disassembly, repair and reassembly
      - 4) Alignment, adjusting and checking
      - 5) Routine service based on operating hours
    - d. Servicing and lubrication schedule
      - 1) List of lubricants required
    - e. Manufacturer's printed operating and maintenance instructions.
    - f. Copies of typed circuit directories of panel board to reflect actual room graphics numbers and room names (not architectural room numbers from the drawings).
      - 1) Electrical
      - 2) Controls
      - 3) Communications
    - g. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
      - 1) Predicted life of part subject to wear
      - 2) Items recommended to be stocked as spare parts
    - h. Schedule of fuses
    - i. Complete equipment field accessible internal wiring diagrams
    - j. Schedule of lamps
    - k. Schedule of ballasts
    - l. Each Contractor's coordination drawings
      - 1) As installed color coded piping diagrams.
    - m. List of original manufacturer's spare parts and recommended quantities to be maintained in storage
    - n. Other data as required under pertinent sections of the specifications

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2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications
4. Provide complete information for products specified in Division 16.
5. Provide certificates of compliance as specified in each related section.
6. Provide start up reports as specified in each related section.
7. Provide signed receipts for spare parts and material.
8. Provide training report and certificates.

### 1.21 SHOP DRAWINGS AND PRODUCT DATA

- A. Submittals shall not be combined or bound together with any other material submittal.
- B. Submittal Specification Information:
  1. Every submittal document shall bear the following information as used in the project manual:
    - a. The related specification section number
    - b. The exact specification section title
  2. Submittals delivered to the Architect / Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

## PART 2 - PRODUCTS – NOT USED

## PART 3 - EXECUTION

### 3.01 INSTALLATION OF ELECTRICAL CONNECTIONS FOR EQUIPMENT

- A. General: Install electrical connections as shown, in accordance with applicable portions of the NECA Standard of Installation, and industry practices.
- B. Conductors: Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Where possible, match conductors of the electrical connection for interface between the electrical supply and the installed equipment.
- C. Splice Insulation: Cover splices with electrical insulation equivalent to, or of a higher rating than, insulation on the conductors being spliced.
- D. Appearance: Prepare conductors by cutting and stripping covering, jacket, and insulation to ensure a uniform and neat appearance where cables and wires are terminated.
- E. Routing: Trim cables and wires to be as short as practical. Arrange routing to facilitate inspection, testing, and maintenance.
- F. Motor Connections: Where possible, terminate conduit in conduit boxes at motors. Where motors are not provided with conduit boxes, terminate the conduit in a suitable conduit, and make motor connections. Conduit passing through the housing on connected equipment shall pass through a cleanly cut hole protected with an approved grommet. Make terminations with split bolt connection.
- G. Coordination: Coordinate installation of electrical connections for equipment with equipment installation work.
- H. Identification: Refer to Electrical General Provisions for identification of electrical power supply conductor terminations with markers approved as to type, color, letter and marker size by the Architect. Fasten markers at each termination point, as close as possible to each connecting point.
- I. Equipment and Furnishings: Refer to Division 11 and 12. Coordinate power and control provisions shown for equipment and furnishings with the provisions required for the furnished equipment and

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furnishings. Where the power and control requirements are less than or equal to those specified, modifications to power and control provisions shall be made at no cost as a part of coordination. Where power and control requirements are in excess of those shown, notify the Architect in writing of the requirements.

### 3.02 IDENTIFICATION OF EQUIPMENT

- A. Identification of Equipment:
1. All major equipment shall have a manufacturer's label identifying the manufacturer's address, equipment model and serial numbers, equipment size, and other pertinent data. Take care not to obliterate this nameplate. The legend on all nameplates or tags shall correspond to the identification shown on the Operating Instructions.
  2. Three layer laminated plastic engraved identifying nameplate shall be permanently secured to each switchboard, distribution panel, motor control center, transformer, panelboard, safety disconnect switch, enclosed circuit breaker, wireway, busduct plug, terminal cabinet, surge protective device, capacitor, individual motor controller, contactor, fire alarm panels (main and remote booster), and communications (voice, data, video) cabinet or rack and rooftop equipment (ie: supply and exhaust fans, rooftop HVAC equipment) with stainless steel screws.
    - a. Identifying nameplates shall have ½-inch high, engraved letters for equipment designation and ¼-inch letters indicating source circuit designation, (i.e., "PANEL HA –served from MDP-6 located in Mech. Rm. 100").
    - b. Each switchboard, distribution panel, and motor control center branch circuit device shall have a nameplate showing the load and location of load served in ¼-inch high, engraved letters. Circuit breaker name and kirk key if applicable.
    - c. Each section of multiple section panelboards shall also indicate panelboard section number (i.e., Panel "HA-Section 2 – served from MDP-6 located in Mech. Rm. 100")
  3. Cardholders and directory cards shall be furnished for circuit identification in panelboards. Cardholder shall be located on inside of panel door and shall be in a metal frame with clear plastic front. Circuit lists shall be typewritten. Circuit descriptions shall include explicit description and identification of items controlled by each individual breaker, including final graphics room number or name designation and name of each item served. If no building appointed room number or name is given, list locations per the following examples – A. Storage in Rm 100 – B. Office in Rm 100 – C. Storage west of Rm. 100. List corridors as "corridors." Identify circuits controlled by contactors using a separate notation for each contactor used. List notation at bottom of schedule stating the circuits are controlled by a contactor, list exact location of contactor, and how switched. Do not use architectural room number designation shown on plans. Obtain final graphics room number identification from Architect's final room number graphics plan. All locations served by breakers shall be listed on schedule. Panel schedule shall be large enough to contain all information required. Also refer to Section 16 24 16.
  4. Permanent, waterproof, black markers shall be used to identify each lighting and power grid junction box. Clearly indicate the panel and branch circuit numbers available at that junction box.
  5. Transformers, Disconnect Switches, etc.: Field work each with a name plate showing identity, voltage and phase and identifying equipment connected to it. The transformer rating shall be shown on the panels or enclosures. For an enclosure containing a motor starter, the nameplate shall include the Owner's motor number, motor voltage, number of motor phases, motor load being serviced, motor horsepower, and motor full load current. Nameplates shall also indicate where panel is fed from.
- B. Prohibited Markings: Markings intended to identify the manufacturer, vendor, or other source from whom the material has been obtained are prohibited for installation in public, tenant, or common areas within the project. Also prohibited are materials or devices that bear evidence that markings or insignias have been removed. Certification, testing (e.g., Underwriters Laboratories), and approval labels are exceptions to this requirement.
- C. Warning Signs: Provide warning signs where there is hazardous exposure associated with access to or operation of electrical facilities. Provide text of sufficient size to convey adequate information

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at each location; mount permanently in an appropriate and effective location. Comply with industry standards for color and design.

- D. Wire and Cable Markers: Provide vinyl cloth markers with split sleeve or tubing type, except in manholes provide stainless steel with plastic ties.
- E. Wire and Cable Labeling: Provide wire markers on each conductor in all boxes, pull boxes, gutters, wireways, contactors, and motor controllers and load connection. Identify with panelboard / switchboard branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on equipment manufacturer's shop drawings for control wiring.

### 3.03 CUTTING AND PATCHING

- A. General: Comply with the requirements of Division 1 for the cutting and patching of other work to accommodate the installation of electrical work. Except as authorized by the Architect / Engineer, cutting and patching of electrical work to accommodate the installation of other work is not permitted.

### 3.05 INSTRUCTION OF OWNER'S PERSONNEL

- A. Prior to substantial completion, conduct an on-site training program to instruct Owner's operating personnel in the operation and maintenance of the electrical systems.
  - 1. Provide the training during regular working day.
  - 2. The Instructors shall be experienced in their phase of operation and maintenance of the electrical systems and with the project.
- B. Use operation and maintenance manuals as the basis of instruction. Review manual with personnel in detail. Explain all aspects of operation and maintenance.
- C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shut down of each item of equipment.
- D. Demonstrate equipment functions (both individually and as part of the total integrated system).
- E. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.
- F. Submit a report within one week after completion of training. List time and date of each demonstration, time devoted to the demonstration, and a list of people present.
- G. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he / she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.
- H. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operating and Maintenance Manual.

### 3.06 OPENINGS

- A. Framed, cast or masonry openings for boxes, equipment or conduits are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

### 3.07 OBSTRUCTIONS

- A. The drawings indicate certain information pertaining to surface and subsurface obstructions, which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.

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1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.

3.08 PROTECTION

- A. Protect work, equipment, fixtures, and materials per the manufacturer's requirements. At work completion, work must be clean and in original manufacturer's condition.
- B. Do not deliver equipment to this project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather shall be rejected, and the contractor is obligated to furnish new equipment of a like kind at no additional cost to the Owner.

3.10 EQUIPMENT BACKBOARDS

- A. Backboards: ¾ inch, fire retardant, exterior grade plywood, painted gray, both sides.
  1. Provide minimum of one 4 ft. by 8 ft. sheets of plywood for each new telephone equipment terminal location.

3.11 TESTING

- A. The contract will not be declared to be substantially complete until the functional operation of the subsystems have been demonstrated and verified and reports have been provided, reviewed and accepted.

3.14 LOAD BALANCING

- A. Balance load on all phases in each panel to within 10% of respective phase loads.

END OF SECTION



## Section 26 05 19 Conductors and Connectors

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### PART 1 - GENERAL

#### 1.01 WORK INCLUDED

- A. Provide electrical conductors, wire and connector work as shown, and specified.
- B. Types: The types of conductors and connectors required for the project include the following:
  - 1. 600V building conductors
  - 2. 600V building conductor connectors
- C. Application: The applications for conductors and connectors required on the project are as follows:
  - 1. Power distribution circuitry
  - 2. Lighting branch circuitry
  - 3. Appliance, receptacle, and equipment branch circuitry
  - 4. Motor branch circuitry
  - 5. Control wiring
  - 6. Line voltage
- D. Refer to other specific specification sections for voice, video, data, alarm and instrumentation cables.

#### 1.02 QUALITY ASSURANCE

- A. UL Label: Conductors and connectors shall be UL labeled.

#### 1.03 REFERENCES

- A. Refer to other specific specification sections regarding specialized wiring and connections.

### PART 2 - PRODUCTS

#### 2.01 CONDUCTORS AND CONNECTORS

- A. General: Except as indicated, provide conductors and connectors of manufacturer's standard materials, as indicated by published product information, designed and constructed as instructed by the manufacturer, and as required for the installation.
- B. Conductors: Provide factory-fabricated conductors of the size, rating, material, and type as indicated for each use. Conductors shall be soft or annealed copper wires meeting, before stranding, the requirements of ASTM B 3, Standard Specification for Soft or Annealed Copper Wire for Electrical Purposes, latest edition.
  - 1. Conductors for control wiring sized #14 AWG through #10 AWG shall be stranded.
  - 2. Conductors for power and lighting shall be stranded. Stranding shall be Class B meeting the requirements of ASTM B 8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, or Soft.
- C. Insulation for standard building conductors: Insulation shall meet or exceed the requirements of UL 83, Standard for Thermoplastic Insulated Wires.
  - 1. All wiring inside lighting fixtures shall be temperature rated per NEC.
  - 2. Insulation for copper conductors shall be UL Type THHN/THWN, 90 degrees C.

#### 2.02 COLOR CODES FOR CONDUCTORS FOR BRANCH CIRCUITS AND FEEDERS

- A. Provide color coding for conductors as required by NEC 210.5. Color coding for phase and voltage shall be as required by local codes and standards.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

- A. General: Install electrical conductors and connectors as shown, in accordance with the manufacturer's written instructions, the requirements of NEC, the NECA Standard of Installation,

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and industry practices.

- B. Coordination: Coordinate conductor installation work with electrical raceway and equipment installation work, as necessary for interface.
- C. Conductors:
  - 1. Provide a grounded (neutral) conductor for each branch circuit. Do not share grounded (neutral) conductors.
  - 2. No more than six phase conductors shall be installed in a single raceway.
  - 3. When any combination of four or more phase and grounded (neutral) conductors are installed in a raceway, the minimum size for all conductors including equipment ground conductor shall be #10 AWG, and they shall be de-rated accordingly.
  - 4. Any combination of phase conductors and grounded (neutral) conductors in any raceway shall not exceed nine.
  - 5. When more than three (3) conductors are size #10 AWG, they shall be installed in a one-inch conduit.
  - 6. Pull conductors together when more than one is being installed in a raceway. Whenever possible, pull conductors into their respective conduits by hand. Use pulling lubricant when necessary.
  - 7. No wire smaller than #12 AWG shall be permitted for any lighting or power circuit. No wire smaller than #14 AWG shall be used for any control circuit, unless shown otherwise.
  - 8. For 15 and 20 amp branch circuits operating at 150V or less, provide #10 AWG wire when the first outlet is over 75-feet from the panelboard. For branch circuits operating at 150 to 600 volts, provide #10 AWG wire when the first outlet is over 150-feet from the panelboard.
  - 9. Neatly train and lace wiring inside boxes, equipment and panelboards. Provide tie-straps around conductors with their shared neutral conductor where there are more than two neutral conductors in a conduit.
  - 10. Do not install a pull string in conduits containing conductors.
- D. Identification: Label each phase conductor in each junction box with corresponding circuit number, using self-adhesive wire markers.
- E. Splices and Joints:
  - 1. In accordance with UL 486A, C, D, E, and NEC.
  - 2. Aboveground Circuits (No. 10 AWG and smaller):
    - a. Connectors: Solderless, screw-on, reusable pressure cable type, rated 600 V, 220° F, with integral insulation, approved for copper and aluminum conductors.
    - b. The integral insulator shall have a skirt to completely cover the stripped wires.
    - c. The number, size, and combination of conductors, as listed on the manufacturers' packaging, shall be strictly followed.
- F. Aboveground Circuits (No. 8 AWG and larger):
  - 1. Connectors shall be indent, hex screw, or bolt clamp type of high conductivity and corrosion resistant material, listed for use with copper and aluminum conductors.
  - 2. Provide field-installed compression connectors for cable sizes 250 kcmil and larger with not less than two clamping elements or compression indents per wire.
  - 3. Insulate splices and joints with materials approved for the particular use, location, voltage, and temperature. Splice and joint insulation level shall be not less than the insulation level of the conductors being joined.
  - 4. Plastic electrical insulating tape: Per ASTM D2304, flame-retardant, cold and weather resistant.

### 3.02 TESTING

- A. Pre-Energization Check: Before energizing, check cable and conductors for circuit continuity and short circuits. Correct malfunctions.

END OF SECTION

## Section 26 05 26 Electrical Grounding

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### PART 1 - GENERAL

#### 1.01 WORK INCLUDED

- A. Grounding shall conform to the requirements of:
  - 1. National Electrical Code.
  - 2. Governing local codes.
  - 3. All Local Utility Companies
- B. Ground effectively and permanently.
  - 1. Neutral conductor at the main service disconnect and other separately derived systems.
  - 2. All conduit systems.
  - 3. All electrical equipment and related current carrying supports or structures.
  - 4. All metal piping systems.
  - 5. All building structural metal frames.
  - 6. All telephone/voice/video/CATV/data utilities

#### 1.02 REFERENCE STANDARDS

- A. ANSI/IEEE Standard 142 - "Recommended Practice for Grounding of Industrial and Commercial Power Systems."
- B. ANSI/UL 467 - "Safety Standard for Grounding and Bonding Equipment."
- C. Article 250 of the NEC (NFPA 70) for grounding.
- D. NECA – Standard of Installation
- E. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems
- F. EIA / TIA 607

### PART 2 - PRODUCTS

#### 2.01 ACCEPTABLE MANUFACTURERS

- A. Copperweld
- B. Cadweld
- C. Burndy
- D. O. Z Gedney

#### 2.02 GROUNDING ELECTRODES

- A. Driven Rod Electrode: UL Listed, 3/4" x 10'-0" copper clad grounding electrode.
- B. Metal Frame of Building.
- C. Foundation concrete encased rebar.

#### 2.03 DATA / VOICE COMMUNICATIONS CLOSET GROUND BAR

- A. Heavy-duty, two bolt type, copper alloy or bronze for grounding and bonding applications, in configurations required for particular installation.

#### 2.04 WIRE

## Section 26 05 26 Electrical Grounding

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- A. Stranded, copper cable
- B. Grounding Electrode Conductor: Size to meet NFPA 70 requirements

### PART 3 - EXECUTION

#### 3.01 GROUNDING AND BONDING

- A. In the service equipment, provide a separate (dedicated) ground bus.
  - 1. Bond the ground bus with copper bus bar or cable, of equal or greater current carrying capacity of the service grounding conductor, to the neutral bar.
  - 2. Resistance of neutral to ground shall not exceed 10 Ohms.
  - 3. Connect the electric service grounding electrode conductors to the incoming metal water pipe system (when available, using a suitable ground clamp) and to a supplemental electrode such as a ground rod or ground loop.
- B. Connect the grounding electrode conductor between the ground bus and the grounding electrode system.
  - 1. In rigid PVC conduit.
  - 2. Provide connection for each rod ground electrode.
    - a. All rod electrodes shall be located outside the building in non-paved areas where available. Access cover top shall be flush with finish grade or floor.
    - b. Install rod electrodes as indicated. Install additional rod electrodes as required to achieve specified resistance to ground.
    - c. The minimum distance between driven ground rod electrodes shall be 10'.
  - 3. The total ground resistance shall not exceed 10 Ohms for service entrance grounds and 25 Ohms for equipment grounds.
    - a. Where this condition cannot be obtained with one electrode, install a longer electrode, deep-driven sectional electrodes, or additional grounding electrodes until the required ground resistance is obtained.
- C. Provide an insulated equipment grounding conductor inside all conduits, raceways, surface raceways, gutters and wireways. The ground wire shall be bonded to each box to suitable lug, bus, or bushing. All bonding jumpers shall be routed inside conduit or raceway.
- D. Provide all conduit terminating in transformers, panelboards and voice/data outlets with grounding bushings, where required and ground wire extended to ground bus in equipment.

#### 3.02 MISCELLANEOUS REQUIREMENTS

- A. Continuity of the building equipment grounding system shall be maintained throughout the project. Equipment grounding jumpers shall be installed across conduit expansion fittings, liquid-tight flexible metal and flexible metal conduit, light fixture pigtails in excess of 6', and other non-electrically continuous raceway fittings.
- B. Equipment grounding conductors and grounding electrode conductor shall be stranded copper conductors and run in a suitable raceway. Grounding conductors and grounding electrode conductor shall be continuous, without joints or splices over their entire length, except as allowed by NFPA 70/NEC.
- C. For separately derived alternating current system grounds, bond the case and neutral of each transformer secondary winding directly to the nearest available effectively grounded structural metal member as required in NEC 250.
- D. Technology/Data/Voice Communications, CATV, CCTV, and MATV Equipment Grounding: Provide grounding electrode conductor from the communications service equipment to the building grounding system as required. Provide #6 ground conductor from telephone/voice/CATV/data company demarcation point to building electrical service entrance ground electrode connection and as required by all local utility companies.

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**Electrical Grounding**

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- F. Ground lighting fixture bodies to the conduit grounding system.
- G. Receptacles shall require a ground wire bonded to the conduit ground system, except where and insulated/isolated grounding receptacle or outlet is specified.
- H. Motor Frames: Ground the frame of each motor with a properly sized separate ground wire inside flexible conduit.
- I. Ground each panelboard by connecting the grounding conductors to the grounding stud.
- L. Ground each secondary dry-type transformer to the ground bus of the primary side panelboard. Provide a bonding jumper between the ground stud and the neutral only at one location either inside the transformer enclosure or at each transformer secondary overcurrent protection device. Ground transformer ground stud or the nearest structural steel member, or nearest member of the ground electrode system.
- M. Bond every item of equipment served by the electrical system to the building equipment ground system. This includes panelboards, disconnect switches, receptacles, fans, air handling units, pumps and flexible duct connections.

END OF SECTION

## Section 26 05 33 Conduit Systems

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### PART 1 - GENERAL

#### 1.01 WORK INCLUDED

- A. Furnish and install a complete system of electrical conduits and fittings.
- B. At the Contractor's option, metal clad (MC) cables may be utilized in indoor areas as defined in NEC 330, subject to acceptance by the State and Local Codes.
- C. Exposed conduit runs shall be on top of purlins or on top of the bottom cord of joists where possible. Exposed conduit shall be run parallel and perpendicular to the building. This shall be strictly enforced by the engineer/architect. Any conduit pathways not found parallel or perpendicular shall be re-run at contractor's expense. MC cable routed in open areas shall be supported every 36" in open ceiling areas to minimal slack.

#### 1.02 REFERENCE STANDARDS

- A. National Electrical Code.
- B. Local codes and ordinances.
- C. UL.

### PART 2 - PRODUCTS

#### 2.1 GENERAL

- A. The minimum conduit size shall be 1/2-inch unless indicated otherwise for low voltage systems.
- B. The minimum conduits for technology, voice, data, video, and multi-media outlet boxes shall be 3/4-inch conduit.
- C. Electrical nonmetallic tubing, BX cable, AC cable, flexible polyethylene or PVC tubing shall not be used on this project.

#### 2.02 ELECTRICAL METALLIC TUBING (EMT)

- A. UL labeled, standard weight.
  - 01. Cold rolled steel tubing.
  - 02. Zinc coated inside and out.
- B. Fittings shall meet the same requirements as EMT conduits.
  - 01. UL labeled
  - 02. Compression Fittings
  - 03. Insulated throat connectors

#### 2.03 FLEXIBLE CONDUIT

- A. Steel flexible metallic conduit.
  - 1. Zinc coated inside and out.
  - 2. 18-inches minimum length, 24-inches maximum length
- B. Liquid tight flexible steel conduit:
  - 1. Type L.A. - Grounded - UL Approved.
  - 2. 18-inches minimum length, 24-inches maximum length

#### 2.04 METAL CLAD (MC) CABLE

- A. Minimum conductor size shall be #12 AWG. All conductors shall be stranded copper.

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- B. All MC cable shall have an insulated ground conductor.
- C. Armor: A zinc coated galvanized steel armor shall be applied over the cabled wire assembly with an interlock in compliance with Section 13 of UL 1569.
- D. Fittings shall be UL listed and identified as MCI-A for such use with metal clad interlocking armor ground. Connectors shall be of steel or malleable iron and shall have saddle clamp to insure a tight termination of MC or MCI-A Cable to box.

### PART 3 - EXECUTION

#### 3.01 GENERAL INSTALLATION

- A. Install electrical conduits and fittings for all wiring of any type unless specifically specified or instructed to do otherwise. Install conduits and fittings in accordance with local codes and applicable sections of the NECA "Standard of Installation", concealed where possible.
  - 1. Fasten conduit supports to building structure and surfaces; do not support to roof deck.
  - 2. Arrange supports to prevent misalignment during wiring installation.
  - 3. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
  - 4. Do not attach conduit to ceiling support wires.
  - 5. Arrange conduit to maintain head room and present neat appearance.
  - 6. Maintain 12-inch clearance between conduit and surfaces with temperatures exceeding 104 degrees F.
  - 7. Cut conduit square using saw or pipe cutter; de-burr cut ends.
  - 8. Bring conduit to shoulder of fittings; fasten securely.
  - 9. Use conduit hubs to fasten conduit to sides and tops of electrical equipment, device, box, gutter, wireway, disconnect, etc. in damp and wet locations.
  - 10. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
  - 11. Ground and bond conduit as required.
  - 12. Identify conduit as required.
  - 13. Route all conduits above building slab perpendicular or parallel to building lines.
  - 14. Do not use no-thread couplings and connectors for galvanized steel or aluminum rigid conduit.
- B. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.
- C. Securely fasten conduits, supports and boxes, to ceiling, walls, with Rawl Plugs or approved equal anchors. Use lead cinch anchors or pressed anchors. Use only cadmium plated or galvanized bolts, screws. Plastic anchors and lead anchors shall not be used for overhead applications.
- D. Provide separate raceway systems for each different low voltage system (such as fire alarm, data, etc.), emergency circuits and different voltages
- E. Conduit terminations at locations including but not limited to switchgear, pull boxes, outlet boxes, stub-up, and stub-outs:
  - 1. Provide insulated throat connectors for EMT conduits.
  - 2. Provide insulated bushing on all rigid conduit terminations.
  - 3. Provide locknuts inside and outside of all boxes and enclosures.
  - 4. Provide threaded type plastic bushing at all boxes and enclosures
- F. Conceal conduit systems in finished areas. Conduit may be exposed in exposed mechanical and electrical rooms, and where otherwise shown or indicated only. Run the conduit parallel and perpendicular to the structural features of the building and support with malleable iron conduit clamps at intervals as required by NEC or on conduit racks, neatly racked and bent in a smooth radius at corners.
- G. "Daisy Chaining" light fixtures installed for lay-in ceiling areas is not allowed. Each light fixture shall have its own fixture whip from junction box. The only exception being light fixtures installed end to end using chase nipples between them, or light fixtures recessed in non-accessible ceilings.

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### 3.02 CONDUITS

- A. Conduit above grade indoors:
  - 1. Concealed Conduits: EMT or MC Cable
  - 2. Exposed conduits: EMT or MC Cable unless below applies
    - a. Below nine feet AFF where not directly attached and against building walls, ceiling, or structure: Rigid galvanized conduit.
    - b. Damp Locations: Aluminum rigid conduit
- E. Connections to transformers
  - 1. Liquid tight flexible metal conduit
  - 2. Liquid tight flexible metal conduit for 24-inch maximum length
- G. Light fixture whips:
  - 1. Light fixture whips shall not be supported from the ceiling suspension system. Provide support from structure with "Caddy" clips. Light fixture whips shall not rest on ceiling grid or tile.

### 3.03 MC CABLE INSTALLATION

- A. Pathways and Raceways are the support system for the infrastructure. All pathways shall be run perpendicular or parallel to the building structure. MC Cable bend radius shall not be less than 7 times the external diameter of the cable. All horizontal cable shall be properly supported every 72" in concealed areas and 36" in open ceiling area. Infrastructure Support Systems include, but may not be limited to the following:
  - 1. Properly supported Cable Trays
  - 2. Independent Cable Hangers spaced no more than 30" apart
  - 3. "Trapeze" style supports
- B. EACH BRANCH CIRCUIT SHALL HAVE ITS OWN NEUTRAL CONDUCTOR FROM THE BRANCH CIRCUIT LOAD BACK TO THE CIRCUIT BREAKER PANELBOARD. SHARED NEUTRAL CONDUCTORS SHALL NOT BE INSTALLED.
- C. All wiring shall be identified with permanent wire labels, using alphanumeric designations. Terminations and splices shall be identically labeled for the same wire (i.e. common conductors terminated in multiple locations).
- D. Identify conductors in outlets, pull boxes and similar locations where conductors are accessible with printed plastic adhesive tapes to show circuit numbers. Wrap tapes at least two turns around conductor. Mark panel identification number with felt tip pen on cloth or plastic tag and attach to entering conductors with nylon string.
- E. Splices at junction boxes shall be made with an approved, insulated, live spring type connector such as those manufactured by Scotchlock, 3M or Ideal.
- F. The cable end shall be cleanly cut with metal clad cable rotary cutting tool to ensure flush seating of the cable into the fitting. Fitting securement screws shall be properly torqued.
- G. Where metal clad cables are exposed, run parallel with walls or structural elements. Vertical runs shall be plumb; horizontal runs level and parallel with structure, as appropriate. Groups shall be racked together neatly with both straight runs and bends parallel and uniformly spaced.
- H. Metal clad cable installed parallel to framing members, such as studs, joist, or rafters, shall be supported so that the nearest outside surface of the cable is not less than 1-1/4 inches (31 mm) from the nearest edge of the framing member. Where this distance cannot be maintained, the cable shall be protected by a steel plate, sleeve, or equivalent that is at least 1/16-inch thick.
- I. Metal clad cable shall be supported immediately on each side of a bend and not more than 1 foot (300 mm) from an enclosure where a run of metal clad cable ends.



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### 3.04 CONDUIT PENETRATIONS, SLEEVES AND ESCUTCHEONS

- A. Furnish sleeves for placing in construction for all conduit passing through concrete or masonry walls and roofs. A conduit sleeve shall be one size larger than the size of conduit, which it serves except where larger sizes are required for manufactured water, fire, or smoke stop fittings.
- B. Sleeves in concrete or masonry walls shall be Schedule 40 galvanized steel. Sleeves shall be set flush with finished wall.
- C. Install manufactured UL listed water, fire, and smoke stop fittings, or caulk around conduit or cables in sleeves with sufficient UL listed fire safe insulation or foam to maintain wall or floor slab fire or smoke rating. Refer to Architecture drawings for locations of rated walls.
- D. Conduit passing through the housing on connected equipment shall pass through a cleanly cut hole protected with an approved grommet. Coordinate location with roofing installation as required.
- G. Conduit passing through fire rated wall shall be sealed with Fire Stop. Route conduit to preserve fire resistance rating of partitions and other elements, using materials and methods under the provisions of Division 7.

### 3.05 TECHNOLOGY/VOICE/DATA/VIDEO COMMUNICATIONS, SIGNAL, LOW VOLTAGE AND EMPTY CONDUIT SYSTEM RACEWAYS

- A. Conduit shall be installed in accordance with the specified requirements for conduit and with the additional requirements that no length of run shall exceed 100-feet for 1 inch or smaller trade sizes, and shall not contain more than two 90-degree bends or the equivalent. Pull or junction boxes shall be installed to comply with these requirements. Provide plastic bushings at all conduit terminations. Provide a grounding bushing on each data and voice conduit.
- B. Conduits shall be installed from outlet box to above an accessible ceiling. All cables routed through open spaces (no-ceiling below roof deck or above floor deck) shall be routed in conduit. Technology, telephone, communication systems, CATV, CCTV, fire alarm and BMCS cables can be installed above accessible ceilings without conduit. Cables installed above accessible ceiling shall be plenum rated. Conduit rough in of these cables shall include a 90-degree turn-out to an accessible location with insulated bushings on the end of the conduit.
  - 1. Provide conduit from each telephone / voice outlet box to accessible ceiling plenum.
  - 2. Provide conduit from each technology / data / communications outlet box to accessible ceiling plenum.
  - 3. Provide conduit from each cable TV / video / audio outlet box to accessible ceiling plenum.
  - 4. Provide conduit from each security / surveillance device outlet box to accessible ceiling plenum.
  - 5. Provide two conduits for each combination data/voice/video outlet box and each outlet box indicated to contain more than four data, voice, or video drops to accessible ceiling plenum.
- C. All conduit in which cable is to be installed by others shall have pull string installed. The nylon pull string shall have not less than 200 lb. tensile strength. Not less than 12-inches of slack shall be left at each end. Provide blank cover plate before substantial completion if box is for a future installation after substantial completion of the project. Conduit shall extend to a minimum six inches above nearest accessible ceiling, and be turned horizontally with plastic bushing at terminations.
- D. Conduits for Building Entrance Facilities:
  - 1. Install a pull box every 300-feet or after 180 degree turns. All turns should be large sweeps (not sharp 90s) with the radius of the sweep at least 10X the diameter of the conduit. Hence a 4-inch conduit requires a 40-inch radial sweep. If field conditions absolutely mandate a sharp 90 bend to be installed, then a pull box shall be installed at that location regardless of distance.
  - 2. Inside Plant: Install a pull box every 150-feet or after 180 degree turns. All turns shall be large sweeps, not sharp 90s, with the radius of the sweep at least 10X the diameter of the conduit. Hence, a 4-inch conduit requires a 40-inch radial sweep. If field conditions absolutely mandate a sharp 90 degree bend to be installed, then a pull box shall be

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- installed at that location regardless of distance.
3. Building entrance facilities shall not terminate in an IDF or any other space except the MDF.
  4. Provide 4-inch conduit unless indicated otherwise.

### 3.06 IDENTIFICATION

- A. Conduit Systems: Provide adequate marking of major conduit exposed or concealed in interior accessible spaces to distinguish each run as either a power or signal/communication conduit. Except as otherwise indicated, use orange banding with black lettering. Provide self-adhesive or snap-on type plastic markers. Locate markers at ends of conduit runs, near switches and other control devices, near items of equipment served by the conductors, at points where conduit passes through walls or floors or enters non-accessible construction, and at spacing of not more than 50-feet along each run of exposed conduit. Switch-leg conduit and short branches for power connections need not be marked, except where conduit is larger than 1-inch.

END OF SECTION

## Section 26 05 37 Electrical Boxes and Fittings

26 05 37-1

### PART 1 - GENERAL

#### 1.01 WORK INCLUDED

- A. Provide electrical box and fitting work as required, scheduled, indicated, and specified.

#### 1.02 QUALITY ASSURANCE

- A. UL Label: Electrical boxes and fittings shall be UL labeled.

### PART 2 - PRODUCTS

#### 2.01 FABRICATED MATERIALS

- A. Interior Outlet Boxes: Provide galvanized steel interior outlet wiring boxes, of the type, shape, and size, including depth of box, to suit respective locations and installation. Construct with stamped knockouts in back and sides. Provide gang boxes where devices are shown grouped. Single box design; sectional boxes are not acceptable, except for wall mounted electronic displays.
  - 1. Type of Various Locations:
    - a. Wall mounted video displays, televisions, electronic signage and similar installations; recessed wall mounted box for power and/or multi-media (low voltage) outlets: Arlington Industries #TVBS 613 or equal, 4-gang steel box with white trim plate.
    - b. Technology, data, voice, video and multi-media outlet boxes at locations other than wall mounted video displays, televisions, electronic signage and similar installations: minimum 4-inch square (2-gang), 3-inch deep interior outlet boxes.
    - c. Security, access control, and video surveillance outlet boxes: single gang, 3-inch deep outlet boxes mounted long axis vertically.
    - d. All other applications: minimum 4-inch square (2-gang) 2-1/8-inch deep boxes.
  - 2. Interior Outlet Box Accessories: Outlet box accessories required as for installation, including covers or wall device plates, mounting brackets, wallboard hangers, extension rings, plaster rings for boxes in plaster construction, fixture studs, cable clamps and metal straps for supporting outlet boxes. Accessories shall be compatible with outlet boxes used and meet requirements of individual wiring.
- B. Junction and Pull Boxes: Galvanized sheet steel junction and pull boxes, with screw-on covers, of type, shape, and size, to suit respective location and installation.
  - 1. Type for Various Locations:
    - a. Minimum Size: 4-inch square, 2-1/8-inches deep.
    - b. 150 Cubic Inches in Volume or Larger: Code gauge steel with sides formed and welded, screw covers unless shown or required to have hinged doors. All boxes mounted above ceiling shall have screw covers. Boxes in all other areas with covers larger than 12-inches shall have hinged with screw covers. Knockouts factory stamped or formed in field with a cutting tool to provide a clean symmetrically cut hole.
- C. Conduit Bodies: Provide galvanized cast-metal conduit bodies, of type, shape, and size, to suit location and installation. Construct with threaded conduit ends, removable cover, and corrosion-resistant screws.
- D. Bushings, Knockout Closures, and Locknuts: Provide corrosion-resistant punched-steel box knockout closures, conduit locknuts, and insulated conduit bushings of type and size to suit use and installation.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION OF BOXES AND FITTINGS

- A. Install electrical boxes and fittings as shown and as required, in compliance with NEC requirements, in accordance with the manufacturer's written instructions, in accordance with industry practices.

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26 05 37-2

- B. Junction and pull boxes, condulets, gutters, located above grid ceilings shall be mounted within 18-inches of ceiling grid. Junction and pull boxes above grid ceilings shall be mounted in the same room served. Junction boxes and pull boxes required for areas with inaccessible ceilings shall be located above the nearest accessible ceiling area. All junction box or pull box openings shall be side or bottom accessible. Removal of light fixtures, mechanical equipment or other devices shall not be required to access boxes.
- C. Determine from the drawings and by measurement the location of each outlet. Locate electrical boxes to accommodate millwork, fixtures, marker boards, and other room equipment at no additional cost to the Owner. The outlet locations shall be modified from those shown to accommodate changes in door swing or to clear interferences that arise from construction as well as modifying them to center in rooms. The modifications shall be made with no cost as part of coordination. Check the conditions throughout the job and notify the Architect of discrepancies. Verify modifications before proceeding with installation. Set wall boxes in advance of wall construction, blocked in place and secured. Set all wall boxes flush with the finish and install extension rings as required extending boxes to the finished surfaces of special furring or wall finishes. Provide wall box support legs attached to stud to prevent movement of box in wall.
- D. Unless noted or directed otherwise at installation, place outlet boxes as indicated on architectural elevations and as required by local codes.
- E. Outlets above counters, mount long axis horizontally. Refer to architectural elevations and coordinate to clear backsplash and millwork.
- F. Provide pull boxes and junction boxes where necessary for installation of electrical systems.
- G. Provide knockout closures to cap unused knockout holes in boxes.
- H. Locate boxes and conduit bodies to ensure access to electrical wiring. Provide minimum 12-inch clearance in front of box or conduit body access.
- I. Boxes for any conduit system shall not be secured to the ceiling system, HVAC ductwork or piping system.
- J. Provide junction and pull boxes for feeders and branch circuits where shown and where required by NEC, regardless of whether or not boxes are shown.
- K. Coordinate locations of boxes in fire rated partitions and slabs to not affect the fire rating of the partition or slab. Notify the Architect in writing where modification or construction is required to maintain the partition or slab fire rating.
- L. Identification: Paint the exterior and cover plates of building interior junction boxes and pull boxes to correspond to the following colors:
  - 1. Orange: - 480/277 VAC systems
  - 2. Blue: - 240 VAC three phase delta systems.
  - 3. Light Green - 120/208 VAC 3 phase and 120/240 VAC single-phase systems
- M. All box covers shall be labeled with Panel ID and circuit numbers of all circuits available in box using permanent black marker. Boxes containing main feeders are to list where fed from and load (example "MSB to Panel HA"). Information listed is to be legible, markovers are not acceptable. Multi-sectional panel numbers are not to be listed on covers (example "LA2" referring to Panel LA sec. 2 is to be listed as "LA"). Label covers for special applications explaining contents (example "Emerg. Gen. Annunciator controls", "IDF ground"). Do not attach box covers that have both sides painted or labeled differently. In public areas where boxes are painted same color as room per architect, label inside covers.
- N. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
- O. Use flush mounting outlet box in finished areas unless specifically indicated as being used with exposed conduit.

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**Electrical Boxes and Fittings**

26 05 37-3

- P. Locate flush-mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- Q. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches with stud separation. Provide minimum 24 inches with separation in acoustic rated walls.
- R. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness. Provide UL listed materials to support boxes in walls to prevent movement. Ensure box cannot be pushed inside wall.
- S. Use stamped steel bridges to fasten flush mounting outlet box between studs.
- T. Install flush mounting box without damaging vapor barriers, wall insulation or reducing its effectiveness.
- U. Use gang box with plaster ring for single device outlets.
- V. Support outlets flush with suspended ceilings to the building structure.

3.02 ADJUSTING

- A. Adjust flush-mounting outlets to make front flush with finished wall material.
- B. Install knockout closures in unused box openings.
- C. Box extenders or plaster rings shall not be used to increase the Code mandated cable capacity of a box.

END OF SECTION

## Section 26 09 23 Lighting Occupancy Sensors

26 09 23-1

### PART 1 - GENERAL

#### 1.01 WORK INCLUDED

- A. Provide occupancy sensing control devices so that lighting is turned off automatically in individual rooms or sections of rooms after a reasonable time delay when the last person leaves the room or area.
- B. Occupancy sensing controls shall accommodate for irregular use of rooms or areas, all individual work habits, and all occupancy habits or conditions of space utilization. Occupancy sensors must provide full volumetric coverage.

#### 1.03 QUALITY ASSURANCE

- A. Product manufacturer shall have a minimum of (5) years experience in the manufacturing of occupancy sensors.
- B. All components shall be UL listed, meet all state and local applicable code requirements.
- C. All components shall offer a five (5) year manufacturer's warranty.

### PART 2 - PRODUCTS

#### 2.01 ACCEPTABLE MANUFACTURERS

- A. Sensor Switch
- B. Greengate
- C. Watt Stopper
- D. My-Tech
- E. Hubbell
- F. Leviton
- G. Schneider Electric
- H. Cooper

#### 2.02 FEATURES AND PERFORMANCE PARAMETERS

- A. Line voltage wall switch sensor shall include zero crossing switching circuit. Sensor shall operate at 30-34 kHz.
- B. Line voltage wall switch sensors shall be ultrasonic and passive infrared and provide no-gap minor motion coverage of an area up to 300 square feet.
- C. Line voltage wall switch sensors shall operate on either 120V or 277V and control loads up to 800 watts at 120V and 1200 watts at 277V.
- D. Line voltage wall switch sensors shall be compatible with magnetic and electronic ballasts, shall be equipped with high capacity relay contacts with ratings that include tungsten loads.
- E. Wall switch sensors shall mount flush into a designer-style wall plate.
- F. Dual Technology sensors shall provide no-gap minor motion coverage throughout the entire controlled area. Ultrasonic sensor shall operate at 30-34 kHz.

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26 09 23-2

- G. All sensors shall have a manual override switch to allow the load to be turned on without the use of tools or pins in the event of sensor malfunction.
- H. Dual Technology Sensors shall have easily accessible, adjustable controls for time delay and sensitivity. Controls shall be recessed to limit tampering.
- I. All sensors shall be provided with an indicator light to verify that motion is being detected and that the unit is in operation.
- J. Dual Technology sensors shall self-adjust sensitivity to optimize performance.

### 2.03 SWITCHPACKS

- A. For ease of mounting, installation and future service, Switchpacks shall be able to externally mount through a 1/2" knock-out on a standard electrical enclosure and shall be an integrated, self contained unit consisting internally of a load switching relay and transformer to provide low voltage power. Switchpacks shall power up to five (5) sensors.
- B. Relay contacts shall be isolated and have ratings of:  
  
Heavy Duty:  
15 Amps: 120 VAC Tungsten  
20 Amps: 120/277 VAC Ballast  
1HP: 120 VAC  
2HP: 250 VAC  
  
BAS  
Isolated (Dry) 5 Amp Form C Contacts
- C. Control wiring between sensors and Switchpacks shall be Class 2, 18 AWG stranded UL classified, Teflon Jacketed cable suitable for use in plenum ceilings.
- D. Enclosures for Switchpacks shall be NEMA I Construction with mounting plates and barriers to provide separation between line and low voltage wiring or standard 4" deep junction box with Switchpack mounting through a 1/2" knockout.
- E. The Heavy Duty Switchpack shall have a heavy duty Form A relay and zero crossing circuitry that forces the relay contacts to engage and disengage at the zero crossing point of the AC voltage source, minimizing the magnitude of the inrush current and increasing the life of the Switchpack.

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. Provide the quantity of occupancy sensors required for complete and proper volumetric coverage to completely cover the controlled areas. Contractor shall verify room coverage and ceiling heights with manufacturer and provide the quantity of occupancy sensors as required. Rooms shall have one hundred (100) percent volumetric coverage of small motion detection to completely cover the controlled areas to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only rooms that are to be provided with sensors. Proper judgment must be exercised in executing the work so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural or architectural components. Provide sensors to provide complete and proper volumetric coverage.
- B. Exact locations of Switchpack boxes shall be based on observing good installation practice and shall be consistent throughout the project. Switchpacks shall be located in accessible ceiling spaces. Attention shall be paid to all aspects of installation to ensure that there is the minimum aesthetic impact of the hardware on the appearance of the affected rooms. All control unit hardware shall be completely contained within a suitable NEMA-type enclosure, with no exposed wire other than low voltage Class 2 wiring.

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26 09 23-3

- C. Control units used for the security or fire systems shall be powered from the emergency power source as indicated on the drawings. Other control units shall be powered from the lighting circuit, which they control.

### 3.02 INSTALLATION

- A. All occupancy sensors and switchpacks shall be of the same manufacturer throughout unless otherwise noted.
- B. Install occupancy sensors in areas shown, in accordance with manufacturer's written instructions, requirements of NEC, and in accordance with industry practices. Do not install devices until wall construction and wiring is completed.
- C. Install occupancy sensors and switches only in electrical boxes that are clean, free from excess building materials, debris, and similar matter.
- D. Install occupancy sensors plumb and aligned in the plane of the ceiling where they are installed.
- E. Refer to Architectural drawing, elevations, etc. for exact location of wall switches where indicated on the Architectural plans. Coordinate location of all wall switches with other specialty items and millwork and avoid conflicts. Coordinate with all trades to avoid conflicts during construction.
- F. Unless indicated otherwise, circuit switchpacks ahead of local control switches - source → switchpack → local toggle switch(s) → load.
- G. Low voltage cabling installed from switchpack to sensor(s) and from sensor to sensor shall be supported every 5 feet at a minimum height of 3 feet above grid/ceiling but no closer than six-inches below deck. Support system shall be ceiling wire attached to structure and clipped to ceiling support grid using Caddy drop wire securing clip #EC311. Cabling shall hang plumb to devices.

### 3.03 SENSOR TESTING AND ADJUSTMENT

- A. At the time of installation the contractor shall test and adjust each sensor for proper detection of motion appropriate to room usage. The contractor shall follow the testing and adjustment procedures as written in the manufacturer's installation instructions for each sensor model.
- B. Prior to testing and adjusting, verify with Owner/Architect the initial settings for each type of area based on its intended function and use.
- C. Verify with Owner all adjustable functions of each type of occupancy sensor prior to installation. Set all adjustable functions of each type of occupancy sensor as directed by Owner. Initial settings unless directed otherwise by Owner / Architect:  
Ceiling Sensors:
  - 1. Auto-On = On
  - 2. Lighting Sweep = Off
  - 3. Self-Adjust = On
  - 4. Energy Saver = Off or Normal
  - 5. Normal Sensitivity
  - 6. Manual Override = Off
  - 7. Maintain Lights On = Either Mode
  - 8. Frequency = 32 kHz
- D. Before energizing, check for continuity of circuits, short circuits, and grounding connections. After energizing, check devices to demonstrate proper operation.
- E. Operate each wall switch with circuit energized and verify proper operation.

END OF SECTION



**Section 26 24 16  
PANELBOARD AND ENCLOSURES**

26 24 16-1

**PART 1 – GENERAL**

1.01 WORK INCLUDED

- A. Panelboards and enclosures, including cabinet, as shown, scheduled, indicated, and specified.

1.02 QUALITY ASSURANCE

- A. UL Standards: Panelboards and enclosures shall confirm to all applicable UL standards and shall be UL labeled.

**PART 2 – PRODUCTS**

2.01 ACCEPTABLE MANUFACTURERS

- A. General Electric Co.
- B. Schneider Electric - Square D
- C. Siemens
- D. Eaton

2.02 MATERIALS AND COMPONENTS

- A. General: Panelboards shall be dead-front type equipped with fusible switches or circuit breakers as shown and scheduled.
- B. Busing Assembly: Panelboard phase, neutral, and equipment ground busing shall be copper. Bus structure and mains shall have ratings as shown and scheduled. Ratings shall be established by heat rise tests with maximum hot spot temperature on any connector or busbar not to exceed 65°C rise above 40°C ambient. Heat rise test shall be conducted in accordance with UL 67. The use of conductor dimensions is not accepted in lieu of actual heat tests. Furnish a bare uninsulated ground bus inside each panelboard enclosure. Two section panelboards shall be connected with copper cable, with an ampacity conforming to the upstream overcurrent device. Panelboards serving non-linear loads and fed with neutrals greater than 100% shall have 200% neutral bus.
- C. Circuit Breakers: Circuit breakers shall be molded case, thermal magnetic type equipped with individually insulated, braced, and protected connectors. The front faces of circuit breakers shall be flush with each other. Tripped indication shall be shown by the breaker handle taking a position between ON and OFF. Make prepared space provisions for additional breakers so that no additional connectors will be required to add breakers. Circuit breakers shall have bolt-in breakers. Two and three pole breakers shall have internal common trips. External handle ties will not be accepted for line to line connected loads. External handle ties are acceptable only for designated shared neutral loads. Circuit breakers for distribution panelboards rated 601 amps and above shall have plug-on circuit breakers.
  - 1. Provide lighting and appliance panelboard branch circuit breakers with interrupting capacity as shown, but in no case less than the following symmetrical amperes RMS:

Voltage (volts)	Interrupting Capacity
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120/208/240	10,000 AIC
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2. Circuit breakers for lighting circuits shall be UL listed switch duty (SWD).
3. Provide distribution panel circuit breakers with high interrupting capacity, or integral current limiters as shown. Circuit breakers shall have interrupting capacity not less than the following symmetrical amperes RMS:

CONVENTIONAL FRAME SIZE/ VOLTAGE	INTEGRAL INTERRUPTING CAPACITY
100A/240V	10,000 AIC

- D. Spaces: Where space for future breakers or switches is shown, panelboard enclosure shall include removable blank panels or knockouts to allow installation of future breakers or switches, prepared spaces, and panelboard busing shall be complete, including required connectors.
- E. Integrated Equipment Rating: Each panelboard, as a complete unit, shall have a short-circuit rating equal or greater than the available short circuit current. Rating shall have been established by tests on similar panelboards with the circuit breakers or fusible switches installed. Series rated panelboards and their protective upstream devices shall be labeled as required by the NEC.
- F. Panelboard Enclosures:
  1. Provide sheet steel enclosures, minimum 16-gauge nominal thickness, with multiple knockouts, unless shown otherwise. Provide all NEMA 1 panelboard fronts with spring-loaded door pulls, and flush lock and key, panelboard enclosures keyed alike to match the Owner's standard key system; coordinate with Owner.
  2. All NEMA 1 enclosure panelboards shall be hinged "door-in-door" type with interior hinged door with hand operated latch or latches, as required providing access only to circuit breaker or fusible switch operating handles, not to exposed energized parts. Outer hinged door shall be securely mounted to the panelboard box with factory bolts, screws, clips, or other fasteners, requiring a tool for entry. Hand operated latches are not acceptable. Push inner and outer doors shall open left to right.
  3. Equip with interior circuit directory frame, card, and clear plastic covering for panelboards.
  4. Provide gray powder coat finish over a rust inhibitor. Panelboards located in kitchen preparation or natatorium areas shall have Type 316 stainless steel door and trim (NEMA 1).
  5. Enclosures at exterior locations shall be NEMA 4X Type 316 stainless steel.
  6. Enclosure shall be for recessed or surface mounting as shown.
  7. Enclosures shall be fabricated by the same manufacturer as panelboards to be enclosed. Multi-section panelboards shall have same physical dimensions.

**PART 3 – EXECUTION**

**3.01 INSTALLATION OF PANELBOARDS AND ENCLOSURES**

- A. General: Install panelboards and enclosures, as shown, including electrical connections,

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in accordance with the manufacturer's written instructions, the requirements of NEC, NECA Standard of Installation, and industry practices. Circuit breakers shall be factory installed except for required field modifications due to actual site conditions.

- B. Coordination: Coordinate installation of panelboards and enclosures with conductor and raceways installation work.
- C. Anchoring: Anchor enclosures to walls and structural surfaces ensuring that they are permanently and mechanically secured.
- D. Directory Card: Provide a typed circuit directory card(s) upon completion of work. Directory card shall be of super heavy-weight index card stock, 110 lb, white. Directory shall include type of load (i.e.: receptacles, lighting, exhaust fan, etc.) and location (i.e.: Room 102, Office, etc.) Room number shall be identified as the actual graphics room number assigned to the space and not the room number identified on the Plans. Circuits with shunt trip shall be identified with the control circuit operating the shunt trip (i.e.: Kitchen Hood No. 2). Shunt trip breakers with common trip circuit shall be grouped in the panelboard (i.e.: circuits 1, 3, 5 and 7).
- E. Circuit Arrangement: Arrange branch circuit connections to 3-phase panelboards so that when two or three circuits are run with a common neutral, each circuit is connected to a different phase unless shown otherwise. Branch circuits shall be connected to the circuit breakers in the panelboard to provide the best possible phase balance, unless shown otherwise.
- F. Panelboards not intended to be used as service entrance (SE) rated shall have the factory installed neutral to ground bonding screws and straps removed.
- G. Spare Conduits: Provide (3) 1-inch and (3) ¾-inch spare conduits capped to 6-inches above accessible ceiling space and (3) 1-inch and (3) ¾-inch conduits capped down to ceiling space on floor below for all recessed lighting and appliance panelboards and all lighting and appliance panelboards located above ground floor.
- H. Conductors shall be bent neatly opposite the fuse or circuit breaker to which they are to be attached. Vertically installed conductors shall be neatly tie-wrapped. Conductors shall be connected in a neat and professional manner. Conductors brought in from the top or bottom of the cabinet shall be bent neatly opposite the fuse or circuit breaker to which they are to be attached. Each conductor shall be run along the full height of the panel and returned to the circuit breaker or fuse location to allow relocation of the conductor to any position along the bus. Panelboard shall be cleaned of all construction debris prior to substantial completion review. Neutral and grounding conductors shall be installed similar to the phase conductors.
- I. Install copper ground bus for copper ground conductors. Ground conductors size #1 and larger are to be landed to can with mechanical lugs and not to ground bus.
- J. Install panels so that breaker number 1 is the top left breaker. Panel interiors shall not be installed where breaker number 1 is the bottom right breaker.
- K. In panels that contain multi-layered neutral bus install neutrals beginning with the back neutral bus row and work forward. Do not make up neutrals on front neutral bus row unless all other rows are full.
- L. Label breaker mounting space with stick-on number labels.

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- M. Mount the fully aligned panelboard such that the maximum height of the top circuit breaker above the finished floor shall not exceed 78 inches. Mount panelboards that are too high such that the bottom of the cabinets will not be less than 6 inches above the finished floor.

3.02 TESTING

- A. Before energizing, energization, check for continuity of circuits and short circuits.

END OF SECTION

## Section 26 27 73 Wiring Devices

26 27 73-1

### PART 1 - GENERAL

#### 1.01 WORK INCLUDED

- A. Provide wiring device work as shown, scheduled, indicated, and specified.

#### 1.02 QUALITY ASSURANCE

- A. UL Label: Wiring devices shall be UL labeled.
- B. NEMA Standard WD1 and WD6
- C. Fed. Spec. WC596, W-S-896

### PART 2 - PRODUCTS

#### 2.01 ACCEPTABLE MANUFACTURERS

- A. Leviton, Mfg. Co., Inc.
- B. Pass and Seymour, Inc.
- C. Hubbell, Inc.
- D. Cooper – Arrow Hart
- E. Lutron, Inc. (Dimming)

#### 2.02 WIRING DEVICE COLOR

- A. Device color shall be white except 20A, 125V receptacles and toggle wall switches which are directly supplied from an emergency source shall be red. Verify with Architect prior to submitting for approval.

#### 2.03 RECEPTACLES

- A. Commercial grade receptacles, NEMA configuration indicated.
  - 1. 20A, 125V grounded duplex NEMA #5-20R: Leviton #16352 or equal
  - 2. 20A, 125V ground fault circuit interruption (GFCI) NEMA #5-20R: Leviton #7898 or equal
  - 4. Provide weather resistant (WR) receptacles at all exterior locations

#### 2.04 WALL SWITCHES

- A. Toggle: Commercial grade flush toggle switches, with mounting yoke insulated from mechanism, equipped with plaster ears, switch handle, back and side-wired screw terminals.
  - 1. Single-pole, 120/277V, 20A switch: Leviton #54521 or equal
  - 2. Double Pole 120/277V, 20A switch: Leviton #54522 or equal
  - 3. Three-way, 120/277V, 20A switch: Leviton #54523 or qual
  - 4. Four-way, 120/277V, 20A switch: Leviton #54524 or qual
- B. Local relay switch for remote control low voltage switching systems:
  - 01. Single-pole, double throw, center off, 120/277V, 15A momentary switch: Hubbell #HBL-1556 or equal

#### 2.05 GFCI – GROUND FAULT CIRCUIT INTERRUPTER, BLANK FACE

- A. 20A, 125V, GFCI, switch rated, blank face feed through, Hubbell #GFBF20GYL, gray finish, stainless steel cover plate engraved with device protected, (example: DRINKING FOUNTAIN GFCI).

#### 2.06 INTERIOR WALL COVER PLATES

- A. Smooth finish, molded of high impact nylon.

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26 27 73-2

1. Plate color shall match device and/or toggle color.
2. Fastening screws shall match plate color.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

- A. All wiring devices for receptacles and wall switches shall be of the same manufacturer throughout unless otherwise noted. .
- B. Install wiring devices where shown, in accordance with manufacturer's written instructions, requirements of NEC, and in accordance with industry practices. Do not install devices until wall construction and wiring is completed.
- C. Install receptacles and switches only in electrical boxes that are clean, free from excess building materials, debris, and similar matter.
- D. Install wiring devices plumb and aligned in the plane of the wall, floor, or ceiling in where they are installed.
- E. Install switches in boxes on the strike side of doors as hung. Verify door swing of all doors prior to rough-in. Install a uniform position so the same direction will open and close the circuit throughout the project. Where more than one switch is in the same location, install switches in a multi-gang box with a single cover plate.
- F. Provide a plate for every receptacle, switch, telephone outlet and other wiring devices
- G. Mounting heights of all wiring devices shall comply with current Accessibility Standards and local codes, except where wiring devices are indicated for special purpose and access is only required by maintenance or service personnel.
- H. Refer to Architectural drawing, elevations, etc. for exact location of wiring devices where indicated on the Architectural plans. Coordinate location of all wiring devices with other specialty items and millwork and avoid conflicts. Coordinate with all trades to avoid conflicts during construction.
- J. Locate receptacles for electric drinking fountains so that the receptacle is accessible and concealed as much as practical from public view. Provide GFCI blank face up-stream to provide GFCI protection for the drinking fountain. Locate blank face in an accessible location as indicated or as directed by Architect / Owner. At all electric drinking fountain locations provide GFCI blank face with test/reset in an easily accessible location in corridor adjacent to drinking fountain. From this GFCI receptacle, circuit non-GFCI type receptacle(s) located at and for the drinking fountain, but protected downstream by GFCI type receptacle in corridor. Locate receptacle for drinking fountain so that it is hidden from public view, concealed by drinking fountain cowling.
- K. Provide GFCI, 20A, 125V duplex receptacles at all receptacle locations in custodial rooms, electric drinking fountains, vending machines, kitchen and food preparation areas, and all locations where receptacles indicated are within six feet of water sources, sinks, lavatories, faucets, and mop sinks. Where outlet is indicated behind vending machines or drinking fountain cowling, or other equipment, provide remote GFCI blank face in readily accessible location with standard receptacle outlet behind equipment.
- L. Install wall box dimmers to achieve full rating specified and indicated after de-rating for ganging as instructed by manufacturer.
- M. Install receptacles with grounding pole down, or as directed by Owner. If installed horizontally, install with neutral on top.
- N. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.
- O. Connect wiring devices by wrapping ground conductor around screw terminal or inserting into mechanical lug. Provide pigtail to each receptacle and each switch. Neutral and phase conductors shall be installed using side or rear entry lugs only. Do not wrap neutral and phase conductors around screw terminals. Tighten all screws and lugs as recommended by manufacturer.

## Section 26 27 73 Wiring Devices

26 27 73-3

- P. Provide nameplate engraving for emergency outlets at locations indicating panelboard and circuit number.

### 3.02 TESTING

- A. Before energizing, check for continuity of circuits, short circuits, and grounding connections. After energizing, check wiring devices to demonstrate proper operation and receptacles for correct polarization. Test GFCI receptacle operation with simulated ground fault tester.
- B. Operate each wall switch with circuit energized and verify proper operation.
- C. Verify that each receptacle device is energized.
- D. Test each receptacle device for proper polarity.
- E. Test each GFCI receptacle device for proper operation.

END OF SECTION

## Section 26 51 13 Lighting Fixtures and Lamping

26 51 13-1

### PART 1 - GENERAL

#### 1.01 WORK INCLUDED

- A. Work Included: Lighting fixture work is as shown, scheduled and specified.

### PART 2 - PRODUCTS

#### 2.01 MATERIALS AND COMPONENTS

- A. General: Provide lighting fixtures of the size, type, and rating indicated, complete with, but not limited to, lamps, lamp holders, reflectors, ballasts, starters, and wiring.
- B. Fixture Types:
1. Fluorescent Fixtures: Provide fluorescent fixtures complete with lamps and ballasts.
    - a. Fluorescent fixtures in continuous rows shall be supplied with fixture couplings, chase nipples, and accessories recommended by the manufacturer for continuous row installation.
  2. Downlight Fixtures: Provide recessed downlight fixtures with trim rings compatible with the ceiling material where fixture is to be installed. Downlight fixtures shall have a minimum efficiency of 65-percent and exhibit "lamp before lamp image" 45-degree cutoff for ceiling up to 10 feet.
  3. LED Exit Signs: The exit lighting fixtures shall meet the requirements of Federal, State, and Local Codes.
- C. Electronic Ballast - Fluorescent:
1. Provide programmed start T8 and T5, multi-volt (120-277V), high power factor, normal light output, Class P, thermally protected, electronic ballasts for fluorescent lighting fixtures. Programmed Start T8 ballast shall have parallel circuiting so that if any one lamp fails or is removed the others remain illuminated.
- D. Lamps:
1. Provide lamps of the wattage, type, color, and reflector lamps with type of beams indicated, as shown, scheduled, and complying with the light fixture's recommendations. Any deviation between the lamps specified and those recommended by the light fixture manufacturer shall be brought to the attention of the Architect/Engineer prior to submission of shop drawings.
  2. Similar wattage and type fluorescent lamps shall be from the same manufacturer and production run.
- E. Emergency Fluorescent Battery Ballasts - Fluorescent: Full light output 90-minute minimum operation. Nominal 1250-1400 lumen battery ballasts for emergency linear fluorescent or long compact fluorescent lighting fixtures. Provide minimum 3400 lumen battery ballasts for emergency fluorescent lighting fixtures in areas where the ceiling height is 14' or greater. Where pendant mounted direct / indirect fixtures are mounted above 14-feet, provide two 1400 lumen emergency battery packs for each 4-foot emergency lighting segment indicated. Locate each 1400 lumen battery pack in two separate 4-foot segments, as required. Provide minimum 700-lumen emergency battery ballast for small compact fluorescent lighting fixtures 3-year replacement warranty.
- I. Emergency fluorescent battery ballasts shall illuminate two lamps for fixtures with two or more lamps.
- J. Emergency Battery Packs – Exit Signs: Nickel Cadmium battery with self- diagnostics; Minimum 3-year non-prorated replacement warranty.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

- A. Attachment: Fasten fixtures to the indicated structural support members of the building. Provide two separate wire supports for recessed ceiling mounted lighting fixtures, at opposite corners of fixture. Check to ensure that solid pendant fixtures are plumb.



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26 51 13-2

- B. Coordination: Field coordinate and locate lighting fixtures in open ceiling areas including mechanical and electrical rooms so that light is not obstructed by piping, ductwork, etc. Locate light fixtures in front of electrical and mechanical equipment to provide adequate illumination for testing and maintenance.
- C. Install suspended luminaries using pendants supported from swivel hangers. Provide pendant length required to suspend luminary at indicated height.
- D. Locate recessed ceiling luminaries as indicated on the Architectural reflected ceiling plan.
- E. Install surface mounted luminaries plumb and adjust to align with building lines and with each other. Secure to prohibit movement.
- F. Install recessed luminaries using accessories and fire stopping materials to meet regulatory requirements for fire rating.
- G. Provide emergency powered light fixture in front of all electrical switchgear, including but not limited to panelboards, low voltage control panels, transfer switches, and disconnect switches.
- H. Contactors shall not be installed above ceiling and shall be readily accessible.
- I. Lighting Fixture Supports: provide support for all of the fixtures. Supports may be anchored to channels of the ceiling construction to the structural slab or to structural members within a partition, or above a suspended ceiling.

### 3.02 TESTING

- A. General: Upon installation of lighting fixtures, and after building circuits are energized, apply electrical energy to demonstrate proper operations of lighting fixtures, emergency lighting, and controls. When possible, correct malfunctioning units at the site, then retest to demonstrate proper operation; otherwise, remove and replace with new units, and proceed with retesting.
- B. Lamps: Install new incandescent lamps before final inspection. Fluorescent and HID lamps may be used to finish the building. Replace gaseous discharge lamps that are defective, show discolorations, or have exceeded more than 1/3 of their rated life, in accordance with construction inspector's records, with new lamps for final inspection.
- C. Pre-Inspection Tasks: Immediately before final inspection, clean fixtures inside and out, including plastics and glassware, adjust trim to fit adjacent surfaces, replace broken or damaged parts, and lamp and test fixtures for electrical and mechanical operation. Any fixtures, or parts of fixtures that show signs of rust or corrosion at the time of completion, shall be removed, and replaced with protected metal parts.
- D. Final aiming and Adjustment: Aim and adjust aimable and adjustable lighting fixtures for their intended purpose. Re-aim and re-adjust as required to the satisfaction of the Architect / Owner, including nighttime adjustment of exterior lighting in the presence of the Architect / Owner.

END OF SECTION

## Section 28 31 00 Fire Alarm and Smoke Detection Systems

28 31 00-1

### PART 1 - GENERAL

#### 1.01 SECTION INCLUDES

- A. Provide all detailed engineering, documentation, materials and devices, installation, calibration, software programming and check-out necessary for a complete and fully operational fire detection and alarm system in accordance with the full intent and meaning of the drawings and specifications including, but not limited to, the following:
1. Supply, install and connect all hardware necessary to provide a complete and operational fire detection and alarm system.
  2. Supply, install and wire all field hardware, fire alarm control panel, power supplies, power circuits, alarm initiating devices, audible and visual alarm devices, auxiliary control relays, signal initiating and signaling devices, conduits, wires, fittings and all accessories required for the system to perform as specified as required.
  3. Supply, install, debug and test all software required to provide all software functions described in accordance with the full intent and meaning of the drawings and specifications.
  4. Coordinate the work specified under this Section with other trades and contractors to assure a complete and fully operational system.
- B. The intent of fire detection and alarm system work is specified in this section and indicated on the drawings. The installing contractor shall design and provide a complete system. The Contractor shall provide all fire alarm and initiation devices required for a complete system acceptable to all governing authorities. Provide proper spacing and coverage of all devices.

#### 1.02 CODES / STANDARDS / REFERENCES (LATEST EDITIONS)

- A. National Fire Protection Association (NFPA):
1. NFPA 13 Systems, Installation
  2. NFPA 70 National Electrical Code
  3. NFPA 72 National Fire Alarm Code.
  4. NFPA 101 Life Safety code.
- Q. Local & State Building Codes
- R. In addition the above requirements, comply with all local codes. Where discrepancies exist between codes, drawings or specifications, the more stringent requirement shall prevail. Installation shall be subject to approval, inspection and test of applicable regulatory agencies.

#### 1.03 PLANNER AND INSTALLER QUALIFICATIONS

- A. The installing contractor shall have been actively engaged in the business of designing, selling, installing, and servicing fire alarm systems for at least five (5) years.
- B. The entire Fire Detection and Alarm System shall be installed by an authorized representative of the Fire Alarm Manufacturer and certified by the manufacturer to distribute, sell, and install the specified fire alarm and smoke detection system. Include all components, elements, and testing and acceptance procedures.
- C. The installing contractor shall be licensed by the State Fire Marshall to design, sell, install, and service fire alarm systems as required by the State Insurance Code.
- D. The installing contractor shall have on his staff a Fire Alarm Planning Superintendent (APS) licensed by the State Fire Marshall's office for such purpose and under whose supervision installation, final connections, and check out will take place as required by the State Insurance Code.
- E. The APS shall be a certified NICET Level III state licensed fire alarm planner under whose supervision system design shall take place
- F. The installing contractor shall provide 24-hour, 365 days per year emergency service with factory trained, state licensed service technicians.