

**City of Fort Collins
SPECIFICATION**

**DIVISION 16
Electrical**

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SECTION 16 01 00 – GENERAL REQUIREMENTS

Part 1: General

1.01 Summary

- A. Electrical design and installation shall, as a minimum, use the most recent applicable versions or regulatory requirements of the following:
 - 1. Federal and State regulations.
 - 2. OSHA
 - 3. NEC as adopted by the City
 - 4. ANSI/ NFPA 70 (National Electrical Code)
 - 5. NEMA
 - 6. IEEE
 - 7. ANSI
 - 8. ANSI/ IEEE C2 – National Electrical Safety Code (NESC)
 - 9. Local Protective Signaling Systems
 - 10. NFPA 72A
 - 11. Fire Detection in Mechanical Systems
 - 12. NFPA – 90A
 - 13. NFPA – 101A
 - 14. Life Safety Code

1.02 INTENT

- A. These technical specifications are for guidance only. These guidelines are founded on considerable design and maintenance experience with the intent of reducing future maintenance problems and extending the trouble-free life of expensive equipment. With these overall goals in mind, the consulting engineers should apply these design priorities consistent with budget constraints:
 - 1. Occupant safety
 - 2. Low life cycle cost of equipment including maintenance and energy
 - 3. Low first cost

1.03 MATERIALS

- A. All materials shall be brand new and current production runs. No close-out items are allowed.

1.04 WARRANTY

1.05 FUTURE TEMPORARY BUILDING – Not currently applicable

1.06 AS-BUILT DRAWINGS

- A. Use the red-lined drawings maintained by the Contractor during construction.
 - 1. One-line diagram(s) with revised load calculation.
 - 2. Accurate routing of wiring.
 - 3. Locations of panels and loads.
 - 4. Point-to-point connection diagrams.
 - 5. Accurately locate buried conduit.
 - 6. Accurate circuit connection designations.

1.07 SCHEMATIC DIAGRAMS

- A. Include schematic diagrams and point-to-point wiring diagrams for the following systems.
 - 1. Clock systems.
 - 2. Electrical systems control.
 - 3. Fire detection/ alarm systems.
 - 4. Lighting/ dimming control systems.
 - 5. Medium voltage equipment.

6. Motor control systems.
7. Kitchen hood fire control panel.
8. Communication system (rough-in)
9. Security systems (rough-in)
10. Stage lighting systems.
11. Sound systems.

Part 2: GENERAL DESIGN GUIDELINES

2.01 General

- A. Provide receptacle outlets in the following areas. Small Rooms: One duplex receptacle at door 48" AFF, Custodian Closet, Mechanical Rooms, Storage Areas. Large Mechanical Rooms: One duplex on all walls 48" AFF.
- B. New branch circuits needing a neutral, installed from the panelboard shall have an individual neutral wire installed for the circuit. Sharing a neutral in multi-wire branch circuits is not permitted.

Part 3: INSTALLATION

3.01 General

- A. Include in the O&M manual certifications received with any electrical equipment and data for any equipment tests performed.
- B. Label main electrical gear with the name, voltage, phase, amp rating, source, and destination of power.
- C. Remove construction debris and leave areas broom clean after construction. In electrical rooms, the MDC shall be vacuumed and contacts dusted.
- D. Label all spare conduits on the ends as to where it originates and terminates. Install pull string in each empty conduit. (Exception: it is not necessary to label spare conduits directly above an electrical panel.)

END OF SECTION 16 01 00

SECTION 16 01 26 – MAINTENANCE TESTING OF ELECTRICAL SYSTEMS

Part 1: General

Part 2: Products

Part 3: Execution

3.01 Preparation

- A. Specified tests shall be performed and witnessed by a City Electrical Department Representative as a requirement for final payment. Explain the functions and demonstrate the operation of major equipment. Tests to be run on the following systems (minimum 1 hour per system):
 1. Fire alarm.
 2. Clock system.
 3. Emergency generator system
 4. Exterior lighting controls

- 5. Other special systems.
 - 6. Special lighting system
- 3.02 Installation

END OF SECTION 16 01 26

SECTION 16 05 00 – COMMON WORK RESULTS OF ELECTRICAL

Part 1: General

Part 2: Products

Part 3: Execution

3.01 Preparation

3.02 Installation

A. Anchors:

1. Only anchors that use removable bolts or screws are allowed. Screw type anchors approved for the application will be the only type of fastener accepted. Anchors shall be used and approved for use per manufacturer instructions. Examples listed.
 - i. **Drywall:** Molly, E-Z (screw in type), toggle bolt and other.
 - ii. **Masonry, block, concrete:** Plastic, lead w/ machine screw bolt, drop-in and other.
 - iii. Nail in or Pin type anchors **shall not** be used to mount fixtures, straps, boxes, or any device associated with the electrical system.

B. Boxes:

1. J-boxes in boiler rooms, mech./elect. rooms, storage rooms or above ceilings shall be a minimum of 2 1/8" deep 4" sq. boxes w/ combo 1/2" & 3/4" concentric KO's.
2. Any boxes in public areas shall be cast weather-proof type or wire mold (mid-depth i.e. 5748)
3. One extension box is permitted on remodel work to extend existing installations. Where more than one box is needed to flush out installation, provide a larger (i.e. 6" x 6" minimum) box to flush out the existing box and nipple over to a new box.
4. Floor boxes for cast-in-place concrete floors:
 - i. Prohibited without written approval from the City.
 - ii. Must be fully adjustable, cast iron or formed galvanized steel.
 - iii. Front face shall be perpendicular to the floor to prevent entrance of liquids and debris.

C. Conduit:

D. Cover Plates:

E. Emergency Power Systems:

F. Fixtures: (luminaires)

1. Wall-pack fixtures shall be hung with metal or lead type expanding anchors with a minimum of 1/4" machine screw to fasten on masonry walls; *plastic or drive-in 'button head' nail type wedge anchors are not to be used.
2. Fixtures mounted on drywall should use toggle bolts or screwed into wall stud or other framing member. **Do Not** use screw in type anchors. (i.e.: E-Z anchor)

G. Flex:

H. Labeling/ Identification:

1. All electrical panels and equipment shall be labeled. All labels shall be engraved plastic, white letters on black background. Labels shall be attached with screws or rivets. No pressure-sensitive adhesives will be allowed.
 2. The following equipment shall have a plastic nameplate with a minimum letter height of 1/4":
 - i. Main Service Feeder Switch or Circuit Breaker.
 - ii. Sub-distribution Equipment.
 - iii. Main Switchboard and Panel.
 - iv. All Subdistribution Panelboards and Special Equipment and Boxes.
 3. The following equipment shall have a plastic nameplate with a minimum letter height of 3/16":
 - i. Each separately mounted disconnect and starter for a motor or fixed appliance. Nameplate shall also provide the motor designation, voltage, and phase. (Panel and circuit #)
 4. The following equipment shall have a plastic nameplate with a minimum letter height of 1/4":
 - i. All branch circuit panelboards, complete with voltage and phase.
 - ii. All branch circuit panelboards shall have their directories neatly typed.
 5. All switches that control mechanical equipment, pumps, fans, boilers, etc., shall have plastic nameplates with a minimum letter height of 1/8".
 6. Device covers (receptacles, switches) shall be labeled neatly with a permanent marker or label maker with panel & circuit number. (ex. L1A-10)
 7. On the cover of each junction box and pull box: the circuit number(s) of the enclosed conductors are to be legibly written with a black permanent ink broad tip marking pen and the system identification.
 8. All disconnects & motor starters shall be labeled with panel and circuit number.
 9. Panelboard directories shall be labeled with the actual **finished** building room numbers for circuit identification and not the room numbers from the construction plans. (Unless they are the same)
- I. Motors:
1. No contactors, transformers, or control devices to be located above ceilings. Unless approved by City Electrical Department.
 2. Phase Protection: All motors using 3-phase power and 3-phase air conditioning units shall have protection for phase reversal, loss of phase, or phase unbalance of 10% voltage drop or greater on any one phase.
 3. Provide proper rotation of all motors.
- J. Receptacles:
1. Receptacles shall be 20A commercial grade. Duplex receptacles shall be extra heavy-duty type with nylon fronts and backs.
 2. Devices must be pigtailed from branch circuit for ease of device removal or replacement.
 3. All unused screws on the receptacles or switches shall be in the tightened position.
- K. Switches:
1. Switches shall be extra heavy-duty type with nylon fronts and backs.
 2. Keyed switches shall be P&S 20AC1-L Series. No exceptions.
 3. Devices must be pigtailed from branch circuit for ease of device removal or replacement.
 4. Switches for life safety circuits shall be red.
- L. Tying into Circuits:
1. Leave splices long enough to tap for future use. If new wires are being run through a box, leave a loop big enough to splice into at a later date.
- M. Wire:

1. Minimum wire size:
2. Conductor type:
 - i. Conductors #10 AWG and larger, stranded copper.
 - ii. Conductors #12 AWG can be solid or stranded copper.
 - iii. Conductors #14 AWG can be solid or (stranded copper, depending on application.)
 - iv. Conductors smaller than #14, solid copper or stranded.
3. Wire sizing:
4. Purple or pink wire is the preferred color for the load side of switches. (Switch leg)
5. Standard electrical system phase colors:
 - i. Color code wires for building voltage classes as follows:
 - ii. 120/ 208V - 3 \emptyset :
 - a. \emptyset A – Black
 - b. \emptyset B – Red
 - c. \emptyset C – Blue
 - d. Neutral – White
 - e. Ground – Green
 - iii. 277/ 480V - 3 \emptyset :
 - a. \emptyset A – Brown
 - b. \emptyset B – Orange
 - c. \emptyset C – Yellow
 - d. Neutral – Gray
 - e. Ground – Green

N. Wiremold:

3.03 Cleaning and Protection

END OF SECTION 16 05 00

SECTION 16 05 26 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

Part 1: General

- 1.01 Summary
- 1.02 Related Sections
- 1.03 Definitions
- 1.04 Submittals
- 1.05 Quality Assurance
- 1.06 Scheduling
- 1.07 Delivery, Storage, and Handling
- 1.08 Regulatory Requirements

Part 2: Products

- 2.01 Manufactures
- 2.02 Products
 - A. Grounding System:
 - 1. Provide separate grounding conductor in all raceways.
 - 2. Provide separate grounding jumpers from grounding screw of all receptacle devices to metallic box in which it is mounted. Jumpers may be attached to the box with a separate grounding screw. No ground clip devices are allowed.
 - 3. Provide separate bonding conductor in all runs to exterior lighting standards; i.e. post lights, signs, etc.
 - 4. All conductors used for grounding and bonding purpose shall be copper bare or insulated green only.
 - 5. Provide a separate grounding jumper for all dielectric unions in a fresh water system of the same size as main service ground.
 - 6. Neutral/ground bonding point shall be done within transformers for secondary distribution systems.

Part 3: Execution

- 3.01 Preparation
- 3.02 Installation
- 3.03 Cleaning and Protection

END OF SECTION 16 05 26

SECTION 16 12 00 – MEDIUM VOLTAGE TRANSFORMERS

Part 1: General

- 1.01 Summary
- 1.02 Related Sections
- 1.03 Definitions
- 1.04 Submittals
- 1.05 Quality Assurance
- 1.06 Scheduling
- 1.07 Delivery, Storage, and Handling
- 1.08 Regulatory Requirements
 - A. Comply with US Department of Energy's Candidate Standard Level three (CSL-3).

- B. Comply with IEEE-519.
- C. Exceed National Electric Code related requirements.
- D. Exceed NEMA TP-1.

Part 2: Products

- 2.01 Manufactures
- 2.02 Products

Part 3: Execution

- 3.01 Preparation
- 3.02 Installation
 - A. Provide built-in surge suppression and enhanced energy efficient harmonic cancellation.
 - B. Provide 25 year warranty.
- 3.03 Cleaning and Protection

END OF SECTION 16 12 00

SECTION 16 24 00 – PANELBOARDS

Part 1: General

Part 2: Products

Part 3: Execution

- 3.01 Preparation
- 3.02 Installation
 - A. General
 - B. Main Distribution Center shall be installed on a 4" housekeeping curb, wall mounted, with a maximum height of 90" to the top of the equipment from finished floor, level and plumb.
 - C. Install nameplates identifying main distribution center, AIC rating, voltage, amps, phase, all branch loads and main devices.
 - D. Provide locks with two keys furnished per lock. All panels keyed alike.
 - E. Door-in-door type front panel construction with nameplate mounted on front of panel.
 - F. Install nameplates identifying main distribution center, AIC rating, voltage, amps, phase, all branch loads and main devices.
 - G. Furnish typewritten directory boards to identify each circuit. Note spare circuits on directory cards in pencil.
 - H. Label each breaker within a panel as to type of circuit and area served with room numbers.
 - I. Locate in a dedicated lockable room.
 - J. Main Distribution Switchboard/Panelboards: Copper or tin-plated aluminum bus bars. Prefer Square D or approved equal by City Electrical Department.
 - K. Safety Switches: Heavy-duty type fusible or nonfusible, NEMA rating for environment installed. Prefer Square D or approved equal.
 - L. Transformers shall be high efficiency type. (PowerSmith to be approved) Sound levels shall not exceed level listed by ANSI-C89. Transformers to be mounted with additional isolation pads and electrical connections made with flexible conduit.

- M. Electrical services to include 25% spare capacity for future.
- N. Provide 25% spare capacity and space in all branch circuit panels.
- O. Label all spare conduits on each end as to where it originates and terminates. Install pull string in each empty conduit.

3.03 Cleaning and Protection

END OF SECTION 16 24 00

SECTION 16 32 00 – PACKAGED GENERATOR ASSEMBLIES

END OF SECTION 16 32 00

SECTION 16 50 00 – LIGHTING

Part 1: General

1.01 Regulatory Requirements

A. Indoor lighting

1. Incandescent lamps shall not be used.
2. Exit lighting as required by IBC and NFPA.
3. Luminaire Schedule: Provide a luminaire schedule on the design documents to give the following information.
 - i. Luminaire identification.
 - ii. Description (including ballast type).
 - iii. Manufacturer and catalog number.
 - iv. Voltage.
 - v. Lamps (catalog number and type).
 - vi. Mounting with required recess depth.
 - vii. Input Watts per fixture.
4. Stairs: Mount fixtures on walls at landings 8'-0" above finished landing. No fixtures allowed above stairs.
5. Consideration of fixtures should include the following.
 - i. Durability – Choose fixtures that will last for many years, and take the abuse of people.
 - ii. Practical – Choose fixtures that can be maintained easily and parts available for years. Choose fixtures that will be easy to clean and will keep bugs, paper, pencils, etc... out.
 - iii. Standardize – Choose fixtures with standard lamps and try to reduce the amount of different lamps the City has to stock.
 - iv. Fixtures that require a T5 bulb are not allowed
6. LAMPS AND BALLASTS
 - i. Incandescent lights shall not be used. All lamps shall be 28w, 4100k T8 and low-mercury type.
 - ii. T5 bulbs shall not be used.
 - iii. All fluorescent fixtures shall have instant start electronic ballasts. (Sylvania Quicktronic: QHEx32T/ UNV ISL-SC-B)

- iv. Metal halide lamps shall not be used in any areas unless approved by the City Electrical Department.
- v. All ballasts shall be high efficiency per applicable rebate requirements.

Part 2: Products

- 2.01 Manufactures
- 2.02 Products

Part 3: Execution

- 3.01 Preparation
- 3.02 Installation
- 3.03 Cleaning and Protection

END OF SECTION 16 50 00

SECTION 16 56 29 – SITE LIGHTING

Part 1: General

- 1.01 Summary
- 1.02 Related Sections
- 1.03 Definitions
- 1.04 Submittals
- 1.05 Quality Assurance
- 1.06 Scheduling
- 1.07 Delivery, Storage, and Handling
- 1.08 Regulatory Requirements
 - A. AREA LIGHT CONTROL
 - 1. Provide manual override in a convenient location for checking of exterior fixtures by City Electrician during daytime. (Location to be approved by City Electrical Department.)
 - B. EXTERIOR LIGHTING
 - 1. Building and parking lighting shall be pole mounted. 30' maximum, 12'-0" minimum pole height from finished grade. Install light poles on minimum 24" high concrete pedestals in landscaped areas, and 36" concrete pedestal in parking lots.
 - 2. All fixtures shall use tamper proof screws
 - 3. Minimum Lighting Levels in Foot Candles
 - i. Building Exterior:
 - ii. Entrance Areas:
 - iii. Egress Emergency Lighting:
 - iv. Parking Lots:
 - v. Average exterior lighting level shall be 1 foot candle, and no areas shall be less than 0.5 foot candles.
 - 4. Exterior Lamps and Ballasts
 - i. All complete building replacement of exterior fixtures shall be High Pressure Sodium or LED or induction type approved by City Electrical Department.
 - ii. Remodel projects shall try to match existing exterior LED or High Pressure Sodium fixtures if possible or City Electrical Department approved.

Part 2: Products

- 2.01 Manufactures
- 2.02 Products

Part 3: Execution

- 3.01 Preparation
- 3.02 Installation
- 3.03 Cleaning and Protection

END OF SECTION 16 56 29

SECTION 16 57 00 – PROGRAMMABLE LIGHTING CONTROL SYSTEM

Part 1: General

1.01 Summary

- A. In general the system shall control all building lighting.
- B. Lighting control system shall utilize networking technology to be integrated with the Building Automation System. (BAS)
- C. Lighting control system shall have programmable override switches. (The number and location of override switches to be determined in the design process) The override switches shall be capable of turning lights on/off that are turned on/off by a photocell and/ by the BAS timeclock. (Previous Lighting Control System specs/systems used in the City are available).

1.02 Related Sections

1.03 Definitions

1.04 Submittals Required

1.05 Quality Assurance

- A. Source Limitations:
 - 1. Obtain lighting control devices from a single source.
- B. Manufacturers:
 - 1. Firms regularly engaged in manufacture of lighting control equipment whose products have been in satisfactory use in similar service for not less than five years.
- C. System Support:
 - 1. Factory-authorized technician or factory-authorized service representative shall be available for onsite training as well as telephone support.

1.06 Scheduling

1.07 Delivery, Storage, and Handling

1.08 Regulatory Requirements

Part 2: Products

2.01 Manufacturers

- A. Acceptable Manufacturer: L C & D, Lutron, Lithonia, Wattstopper or approved equal.

2.02 Products

- A. Submit shop drawings on programmable lighting controller & components for approval.

Part 3: Execution

3.01 Preparation

3.02 Installation

- A. Provide all necessary software to integrate the lighting control system with the building automation system. (BAS)
- B. Program timeclock functions according to Owner representative(s) desired settings.
- C. Demonstration
 - 1. Provide a factory-authorized technician or factory-authorized service representative to train CITY Electrical Department personnel as specified below.
 - (a) Troubleshooting, servicing, adjusting, and preventive maintenance.
 - (b) Programming of the lighting control system.
 - (c) Provide a minimum of three hours training.

3.03 Cleaning and Protection

END OF SECTION 16 57 00