

Lighting and Occupancy Sensors

The scope of this project consists of:

- Replacing all of the existing light fixtures and installing occupancy sensors in all of the classrooms and office areas
 - o The replacement of the existing light fixtures shall be done on a one-for-one basis.
 - o Selection of the type of occupancy sensor shall be based on either using ceiling and or wall/corner sensors that work best in the room. **Note: Do not use in-wall sensor + switch because line of site is required to work properly.**
- Additionally all of the habitable rooms (offices+ program spaces [Library, Cafeteria, Gymnasium and Boiler/Mechanical Rooms]) in the school shall have Occupancy Sensors installed in them as well as Rooms which do not receive occupancy sensors are Toilet Rooms, Storage Rooms, Corridors, and Custodial rooms.

In rooms, where the fixture is a T12 only or the fixture has both T12 and T8 lamps Replace entire fixture with T8 type (25 W) Lamp and Electronic-programmed start ballast that is compatible with the proposed Occupancy Sensors

It is the contractor's responsibility to verify the installation of all occupancy sensors and fixtures. They should be installed:

1. Sensors - Maximum effective height,
2. Sensors - In line of site of the main occupant and student/staff. (Note: sensors must work if the teacher is in the room alone or with a class.
3. Sensors - The power pack is installed after the light switch to guarantee the occupancy sensor can be disabled when lights are required to be off.

Occupancy Sensors and the light fixtures are retrofitted accordingly and in all other habitable rooms.

The contractor is responsible for the demolition and disposal of all replaced and/or repaired items associated with this project including clean-up.

Specifications for the lighting and the control devices are attached.

SECTION- LIGHTING CONTROL DEVICES

PART 1- GENERAL

1.1 SUMMARY

Section Includes:
Indoor Occupancy Sensors

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Field quality-control reports

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of lighting control device to **include in emergency, operation, and maintenance.**

MRT 2- PRODUCTS

2.1 INDOOR OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Bryant Electric, a Hubbell Company
 - 2. Cooper Industry, Inc.
 - 3. Hubbell Building Automation, Inc.
 - 4. Leviton Mfg. Company, Inc.
 - 5. Lutron Electronics Co., Inc. (preferred)
 - 6. Watt Stopper
- B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack. **Do not use in-wall sensor + switch occupancy sensors.**
 - 1. Listed and labeled as defined in NFPA 70, by qualified testing agency, and marked for intended location and application.
 - 2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied and turn them off when unoccupied; with a time delay for turning lights off, is 30 minutes and sensitivity is set high (picture at desk)
 - 3. Sensor Output: Contacts rated to operate the connected relay, complying with UL773A. Sensor is powered from the power pack.

4. Power Pack: Dry contacts rated for 20A ballast load at 120- and 277-V ac, for 13-tungsten at 120-V ac and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, and Class 2 power source, as defined by NFPA 70
 5. Mounting:
 - a) Sensor: Suitable for mounting in any position on a standard outlet box
 - b) Relay: externally mounted through a 1/2-inch knockout in a standard electrical enclosure
 - c) Time-delay and Sensitivity Adjustments: Recessed and concealed behind hinged door
 1. Indicator: Digital display, to show when motion is detected during and normal operation of sensor.
 2. Bypass Switch: Override the "on" function in case of sensor failure
 3. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.
- C. Dual-Technology type: Ceiling mounted; detect occupant in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect Occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of manner at an approximate speed of 12 inches/s.
 3. Detection Coverage (Standard Room): Detect Occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.

2.2 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Bryant Electric, a Hubbell Company
 2. Cooper Industries, Inc.
 3. Hubbell Building Automation, Inc.
 4. Leviton Manufacturing Company, Inc.
 5. Lutron Electronics Co., Inc. (preferred)
 6. Watt Stopper
- B. General Requirements: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switch box.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
 3. Switch Rating: Not less than 800-VA fluorescent at 120V, 1200-VA fluorescent at 277 V, and 800-W incandescent.

2.3 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Note smaller than No. 12 AWG. Comply with requirements in "Low-Voltage Electrical Power Conductors and Cables."

PART 3- EXECUTION

3.1 SENSOR INSTALLATION

- A. Require a License Electrician to oversee all work. All wiring work and programming of the sensors is only done by certified electricians. An apprentice can only assist in the install of sensors to the wall or ceiling.
- B. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- C. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions

3.2 WIRING INSTALLATION

- A. Wiring Method: Comply with "Low-Voltage Electrical Power Conductors and Cables".
- B. Wiring with enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacture written instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminals strips junction, pull, and outlet boxes; terminal cabinets; and equipment enclosure

E. Label time switches and contactors with a unique designation.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

A. Lighting control devices will be considered defective if they do not pass tests and inspections. B.

Prepare test and inspection reports.

3.4 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operation.

END OF LIGHTING CONTROL DEVICES SPECIFICATIONS

SECTION - INTERIOR LIGHTING PART

1- GENERAL

1-1 SUMMARY

- A. Section Includes:
 - 1. Interior lighting fixtures, lamps, and ballasts
 - 2. Emergency lighting units
 - 3. Exit signs
 - 4. Lighting fixture supports

1.2 DEFINITIONS

- A. BF: Ballast Factor.
- B. CCT: Correlated color temperature.
- C. LER: Luminaire efficacy rating.
- D. Lumens: Measured output of lamp and luminaire, or both.
- E. Luminaire: Complete lighting fixture, including ballast housing if provided.

1-3 ACTION SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and following:
 - 1. Physical description of lighting fixture including dimensions
 - 2. Emergency lighting units including battery and charger
 - 3. Ballast, including BF.

1-4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Lighting fixtures.
 - 2. Suspended ceiling components
 - 3. Partitions and millwork that penetrate the ceiling or extends to within 12 inches of the plane of the luminaire.
 - 4. Ceiling-mounted projectors
 - 5. Structural members to which suspension systems for lighting fixtures will be attached.
 - 6. Other items in finished ceiling including the following:

- a. Air outlets and inlets
- b. Speakers
- c. Sprinklers
- d. Smoke and Fire detectors
- e. Occupancy sensors
- f. Access panels

7. Perimeter moldings

- B. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.
- C. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from **manufacturer.**
- D. Field quality-control Reports
- E. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operational and Maintenance Data: For lighting equipment and fixtures to include in **emergency/ operation, and maintenance manuals.**
 - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps: Ten percent of each type and rating installed. Furnish at least one of each type.
 - 2. Plastic Diffusers and Lenses: Ten percent of each type and rating installed. Furnish at least one of each type.
 - 3. Ballasts: Ten percent of each type and rating installed. Furnish at least one of each type.
 - 4. Globes and Guards: Ten percent of each type and rating installed. Furnish at least one of each type.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

1.8 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire suppression system, and partition assemblies.

PART 2- PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work included, but are not limited to, product(s) indicated.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixture.
- B. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE SA as applicable.
- C. Metal Parts: Free of burrs and sharp corners and edges
- D. Sheet metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Doors, Frames, and other internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames lenses, diffusers and other components from falling accidentally during relamping and when secured in operating position.
- F. Diffusers and Globes:
 - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
 - b. UV stabilized.
- G. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following lamp and ballast characteristics:
 - a. "USE Only" and include specific lamp type.

- b. Lamp diameter code (T-4, t-5, T-8, T-12, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
- c. Star type (preheat, rapid start, instant start, etc.) for fluorescent and compact fluorescent luminaires.
- d. ANSI ballast type (M98, M57, etc.) for HID luminaires. e.

CCT and CRI for all luminaires

- H. Electromagnetic-Interference Filters: Factory installed to suppress conducted electromagnetic interference as required by MIL-STD-461E. Fabricate lighting fixtures with one filter on each ballast indicated to require a filter.

2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

A. General Requirements for Electronic Ballasts:

- 1. Comply with UL 935 and with ANSI C82.11.
- 2. Designed for type and quantity of lamps served
- 3. Ballasts shall be designed for full light output unless another BF, Dimmer, or bi-level control is indicated.
- 4. Sound rating: Class A.
- 5. Total Harmonic Distortion Rating: Less than 10 percent.
- 6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or Better.
- 7. Operating Frequency: 42 kHz or higher.
- 8. Lamp Current Crest Factor: 1.7 or less.
- 9. BF: 0.98 or higher
- 10. Power Factor: 0.98 or higher
- 11. Parallel Lamp Circuits: Multiple lamp ballast shall comply with ANSI C82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.

- A. Ballasts for Low Electromagnetic-Interference Environments: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for consumer equipment.

2.4 BALLASTS FOR COMPACT FLUORESCENT LAMPS

- A. Description: Electronic-programmed rapid-start type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless or bi-level control is indicated:

1. Lamp end-of-life detection and shutdown circuit
2. Automatic lamp starting and shutdown circuit
3. Sound rating: Class A.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or Better.
6. Operating Frequency: 20 kHz or higher.
7. Lamp Current Crest Factor: 1.7 or less.
8. BF: 0.98 or higher
9. Interference:
10. Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.

2.5 FLUORESCENT LAMPS

- A. T8 - 32 W maximum, nominal length of 48 inches, 2800 initial lumens (minimum), CRI82 (minimum)
- B. T8- 25 W lamp, rapid start programmable ballast, nominal length of 48 inches, 2500 initial lumens (minimum), CRI82 (minimum), color temperature 4100 K, and average rated life 84,000 hours unless otherwise indicated
- B. T8 rapid-start lamps, rated 17 W maximum, nominal length of 24 inches, 1300 initial lumens (minimum), CRI82 (minimum), color temperature 4100 K and average rated life 20,000 hours unless otherwise indicated.
- C. Compact Fluorescent Lamps: Replace Compact/Incandescent lamps with equivalent LED lamps where possible.

2.6 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with "Hangers and Supports for Electrical Systems" for Channel and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: Y,-inch steel tubing with swivel ball fittings and ceiling canopy. Finish **same as fixture.**

- C. Twin-Stem Hangers: Two, Y,-in steel tube with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM a 641/A 641M, Class 3, soft temper, zinc-coated steel 12 gage
- E. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- F. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord and locking-type plug.

PART 3-EXECUTION

3.1 INSTALLATION

- A. lighting fixtures:
 - 1. Set level, plumb, and square with ceilings and walls unless otherwise indicated
 - 2. Install lamps in each luminaire
- B. Temporary lighting: If it is necessary, and approved by Owner, to use permanent luminaire for temporary lighting, install and energize the minimum number of luminaire necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall
- C. Lay-in Ceiling lighting Fixtures Supports: Use grid as a support element.
 - 1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches from lighting fixture corners.
 - 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are **Unlisted** for the application.
 - 3. Fixtures of Sizes less than ceiling Grid: Install as shown on site or center in acoustical panel, and support fixtures independently with at least two 1/2-in metal channels spanning and secured to ceiling tees
 - 4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength or the weight of fixture at a safety factor of 3.
- D. Suspended light Fixture Support
 - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 - 3. Continuous Row: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
 - 4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.
- E. Connect wiring according to "Low-Voltage Electrical Power Conductors and Cables."

3.2 IDENTIFICATION

- A. Install Labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification for Electrical Systems

3.3 FIELD QUALITY CONTROL

- A. Prepare a written report of tests, inspection, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF INTERIOR LIGHTING SPECIFICATIONS