

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following lighting control devices:
 - 1. Indoor occupancy sensors
 - 2. Indoor photo sensors
- B. This Section includes the following daylighting control devices:
 - 1. Dimmed control of electronic dimming ballasts with photo sensor, occupancy sensor and wall box dimmer.
- C. Related Sections include the following:
 - 1. Section 26 05 19 Copper Conductors and Cables
 - 2. Section 26 27 26 Wiring Devices for light switches and wall-box dimmers
 - 3. Section 26 51 00 Lighting and 26 50 01 Lighting Fixture Schedule for light fixture ballasts.
 - 4. Section 26 09 43 Network Lighting Controls

1.2 DEFINITIONS

- A. LED: Light-Emitting Diode.
- B. PIR: Passive Infrared.
- C. PDT: Passive Dual Technology.

1.3 SUBMITTALS

- A. Make submittals in accordance with Section 26 05 00 - Common Work Results For Electrical.
- B. Product Data: Provide clearly marked and legible data sheets for each item of equipment being installed on the project. This shall include each major replaceable component that is part of a larger assembly. Data sheets should clearly indicate:
 - 1. Equipment manufacturer, make, model number, size, nameplate data, etc.
 - 2. Dimensional and performance data for specific unit provided as appropriate
 - 3. Required environmental operating parameters
 - 4. UL, FM and ETL listing and category
 - 5. Manufacturer contact information including address, telephone number, facsimile number, email address, web site address and contact person or persons.
 - 6. Local manufacturer's representative contact information including address, telephone number, facsimile number, email address, web site address and contact person or persons.
- C. Shop Drawings: Show installation details for occupancy and light-level sensors.
 - 1. Lighting plan showing location, orientation, and coverage area of each sensor. This plan shall take into consideration the size and use of each space as well as the specific capabilities of submitted manufacturer's equipment to provide proper coverage to the areas of control.
 - 2. Interconnection diagrams showing field-installed wiring.

- D. Label List: Submit list of proposed text for all labels prior to manufacturing for review and approval by Owner's representative.
- E. Warranty: Submit a copy of product warranty that complies with contract document requirements. Where these requirements exceed manufacturer's standard warranty include cost of extended warranty in contract price.
- F. Maintenance Requirements: Submit maintenance requirements manual or guidelines. This document should detail the requirements necessary to comply with the warranty. This is required for the submittal process and is in addition to the O&M requirements.
- G. Samples: Provide sample devices and finishes plus other samples when requested, as part of the submittal process
- H. Commissioning Checklist: Submit a copy of the proposed commissioning checklist to be utilized for this project.
- I. Commissioning Results: Submit a copy of the completed commissioning documents.

1.4 COORDINATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.
- B. Coordinate with system manufacturer to provide equipment which will most effectively control lighting within designated spaces. Contractor and equipment manufacturer are responsible for providing equipment which takes into consideration the size and occupant use of the space, and any other limiting factors in the field to properly control these areas.

1.5 QUALITY ASSURANCE

- A. Qualifications
 - 1. Manufacturer shall have been in the business of manufacturing and providing service for lighting control equipment for similar capabilities and size, under the same name and ownership, for a minimum of three years preceding bid date of the project
 - 2. All components and assemblies shall be factory pre-tested prior to installation.
 - 3. Factory trained technicians shall be on site for start-up, commissioning and training
 - 4. Factory trained technicians shall be available for telephone support twenty four (24) hours a day, seven (7) days a week
- B. Regulatory Requirements
 - 1. Underwriters Laboratories: Provide U.L. listed lighting control equipment.
 - 2. Code of Federal Regulations: 47 CFR - FCC All assemblies are to be in compliance with FCC emissions standards specified in Part 15 for Class A application.

1.6 WARRANTY

- A. Manufacturer's Warranty: The manufacturer shall provide a written warranty agreeing to provide parts to replace any portion of the lighting control system equipment that fails due to material or workmanship for a period of twelve months from warranty commencement.

- B. **Warranty Commencement:** Warranty shall begin at the point of substantial completion of the system installation, which is defined as the date when commissioning and owner training has been completed and the owner obtains beneficial use of the system.
- C. **Warranty Replacement Parts:** The manufacturer shall be able to ship replacement parts within 24 hours for any component that that fails due to material or workmanship during the warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the contract documents, provide products from one of the following manufacturers:
 - 1. Hubbell
 - 2. Leviton
 - 3. Lithonia Lighting
 - 4. Pass & Seymour/ Legrand
 - 5. SensorSwitch
 - 6. Watt Stopper (The)

2.2 INDOOR OCCUPANCY SENSORS

- A. **General Operation**
 - 1. The Occupancy Sensor system shall sense the presence of human activity within the desired space and fully control the on/off function of the loads automatically, set to MANUAL ON, AUTO OFF for vacancy sensing. Sensors shall turn on the load within 2 feet of entrance and shall not initiate "on" outside of entrance.
 - 2. Sensing technologies shall be completely passive in nature, in that the occupancy sensor system shall not emit or interfere with any other electronic device, or human characteristic. Acceptable known technologies are Passive Infrared (PIR), or Micro phonic.
 - 3. Upon detection of human activity by the detector, a Time Delay shall be initiated to maintain the light on for a field adjustable pre-set period.
 - 4. **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.
 - 5. **Automatic Photo Sensor:** Adjustable from 2 to 200 footcandles to turn lighting off when selected light level is present.
 - 6. **Line Voltage Sensors**
 - a. Sensor shall be a self-contained dual voltage device capable of directly switching loads upon detection of human activity.
 - b. Sensor must be rated for 800 watts at 120 VAC, suitable for incandescent light fixtures, fluorescent light fixtures with magnetic or electronic ballasts, or 1/6 hp motors or rated for 1000 watts at 277 VAC, suitable for fluorescent light fixtures

with magnetic or electronic ballasts, or 1/3 hp motors minimum. Sensor shall be capable of parallel wiring for 3-way switching applications.

- c. Sensor Time Delay shall be factory set for typical applications, and field adjustable from 30 seconds to 20 minutes. Sensor must provide a green LED motion indicator.
7. Low Voltage Sensor
 - a. Sensors must be designed to work in conjunction with remote power packs, relays, or other control systems. Sensors must operate with a Class 2, low voltage wiring strategy. Sensors must be capable of being parallel wired for multi-sensor applications.
 - b. Sensor must provide a transistor output, returning the voltage input rectified to DC, to control remote power packs, relays, or other control systems. Sensor must have optional single pole, double throw signal relay capable of being wired open on occupancy, or closed on occupancy. Sensor Time Delay shall be factory set for typical applications, and field adjusted during commissioning.
 8. System components shall be selected to provide full coverage of the intended area in the manner intended. This design should use any variety of sensors to accomplish this task, and shall be designed based on field conditions present at the time of installation.

B. Switch-Box Occupancy Sensors

1. General
 - a. Photo sensor override shall be factory set in the off mode, but be field adjustable. All adjustments shall be concealed once installed.
 - b. Sensor must not protrude out from the cover plate more than 0.37 inches, and recess into the switch box more than 1 inch. Sensor must surface mount to single gang switch box, and accept accessory plates for multi-gang installations. Sensor must provide a vertical sliding Off/Auto override switch, (2 switches if 2-pole device).
 - c. Optional 2-Pole units shall be available. Additional photo sensor override of either pole shall also be available. Power switching shall be performed with a mechanical relay in parallel with an AC Semiconductor to allow relay contacts to switch under a no load condition.
 - d. Where conditions exceed maximum allowable distances, areas, or other field conditions require additional control in the space, such control will be designed and installed as needed.
2. Passive Infrared (PIR) Technology
 - a. PIR sensing, incorporating a combination of heat and movement sensing to detect occupancy in the area of coverage.
3. Passive Dual Technology (PDT)
 - a. Sensing must incorporate PIR with Micro phonics, which utilizes a passive microphone with automatic gain control (AGC) to sense both occupants moving and sounds. The PIR must be used to initiate an ON condition; once ON the PIR or Micro phonics shall keep the load on. After the time delay expires and the load goes off, the Micro phonics shall remain active up to 10 seconds as a back-up grace period.
 - b. PDT sensors shall be provided unless specific site conditions prohibit the use of any devices utilizing Micro phonics which could interfere with equipment in the space.
4. Small Area Wall Switch Sensors

- a. Small Area Wall Switch Sensors must be provided for small spaces where the occupant's work area is within 20 feet of sensor and the space is no larger than 300 square feet.
- b. PIR sensing, incorporating a nominal one half inch focal length Fresnel lens, designed to view at least 9 inches above and 9 inches below the horizontal plane when measured 10 feet from the sensor. The PIR beam pattern must be at least 170 degrees with 20 separate beams evenly spaced.

C. Ceiling Occupancy Sensors

1. General

- a. Sensor shall be circular ceiling mounted device, mounted to a single gang enclosure.
- b. Time delay shall be set during commissioning and field adjustable.
- c. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
- d. Bypass Switch: Override the "on" function in case of sensor failure.
- e. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s). Detection Coverage
 - 1) Small Room: Detect occupancy anywhere within a circular area of 600 sq. ft. (56 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
 - 2) Standard Room: Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
 - 3) Large Room: Detect occupancy anywhere within a circular area of 2000 sq. ft. (186 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
 - 4) Corridor: Detect occupancy anywhere within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling in a corridor not wider than 14 feet (4.3 m).

2. Passive Infrared (PIR) Technology

- a. PIR sensing, incorporating a combination of heat and movement sensing to detect occupancy in the area of coverage.
- b. PIR sensing must utilize a high density Fresnel domed lens, providing a circular view pattern of 360 degrees.
- c. Sensitivity: Detect occurrences of 6-inch minimum movement of any portion of a human body that presents a target of at least 36 sq. in.

3. Dual Technology (DT)

- a. Sensing must incorporate PIR with Ultrasonic. Both PIR and Ultrasonic motion sensing shall initiate an ON condition and either technology sending motion shall keep the ON state.

D. Wall Mount Occupancy Sensors (low voltage)

1. General

- a. Sensor shall be designed for large spaces where the occupants work area is up to 40 feet from the sensor. Sensor shall be mounted 8 to 10 feet above the floor, out of occupants reach. Sensor shall be mounted either flat against the wall or in a corner. For pendant mount fixture applications, sensor shall be mounted below the level of the fixture.

- b. Sensor time delay shall be set during commissioning and shall be capable of being field modified if necessary.
- c. Sensors shall be capable of parallel wiring for multi-sensor applications.

2.3 POWER PACKS AND SLAVE PACKS

- A. Power Packs and Slave Packs must be designed to power and accept signals from remote Low Voltage Sensors, or other control devices, and directly switch the line voltage of the desired load controlled.
- B. Power Packs shall accept 120, 240, or 277 VAC utilizing a dual tap transformer.
- C. Power Pack and Slave Pack relay switching shall not require more than 3 milliamps of current at 15 to 30 VDC.
- D. Power Pack and Slave Pack relay switching shall be performed with a mechanical relay in parallel with an AC Semiconductor to allow relay contacts to switch under a no load condition. Switching capacity shall be 20 amps of all types of loads: Incandescent, Electronic Ballast, Magnetic, or Motor.
- E. Power Packs shall be available in combination 2-Pole units capable of switching two independent loads, 20 amps each.

2.4 DAYLIGHT HARVESTING DIMMING CONTROLS

- A. System Description: Sensing daylight and electrical lighting levels, the system shall adjust the indoor electrical lighting levels. As daylight increases, the lights shall be dimmed.
 - 1. Lighting control set point is based on two lighting conditions:
 - a. When no daylight is present (target level).
 - b. When significant daylight is present.
 - 2. Provide system programming with two hand-held, remote-control tools.
 - a. Initial setup tool.
 - b. Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.
- B. Photo sensors shall provide an ON set point and a separate OFF set point, thereby creating a dead band to prevent unnecessary cycling of the artificial lights. Set point setting shall be verified with a digital volt meter connected to test leads provided by the sensor. Sensor shall send an electronic, low voltage signal to a remote power pack or other control device which is directly connected to the load. Footcandle level shall be set 50 fc (300 lux) or as directed by the Owner.
- C. Dimming sensors shall interface with the lighting fixture(s) in one of the following ways:
 - 1. The photo sensor shall interface with a 0 to 10 VDC controllable electronic dimming ballast. Dimming sensor shall connect directly to the ballast with 2 low voltage wires. Photo sensing element shall be a photoelectric sensor. Sensors shall be closed loop for single zone control or open loop for multi-zone control.
 - 2. The photo sensor shall interface with a control module that operates one or more 0 to 10 VDC controllable electronic dimming ballasts. Dimming sensor shall connect directly to

the control module with 2 low voltage wires. Photo sensing element shall be a photoelectric sensor. Sensors shall be closed loop for single zone control or open loop for multi-zone control

2.5 PHOTO SENSORS

- A. The photo sensor shall interface with multi-input digital addressable dimming ballasts. Dimming sensor shall connect directly to the ballast or module with 4 low voltage wires. Photo sensing element shall be a photoelectric sensor. Sensors shall be closed loop for single zone control or open loop for multi-zone control.

2.6 DAYLIGHT ZONE DIMMING CONTROL WITH LOCAL DIMMING

- A. The lighting fixtures in this room configuration shall be controlled by manual wall dimmers, occupancy sensors and photo sensors. The wall dimmers and occupancy sensor together shall control all normal power lighting circuits in the room. The light photo sensor shall automatically dim the lamps located in the daylight zone (as indicated on the contract drawings) in response to available daylight.
- B. Wall dimmers:
 - 1. As specified in section 26 27 26 Wiring Devices.
- C. Dimming Ballast:
 - 1. Standard 4-wire, 0-10 VDC dimming ballast as specified in Section 26 50 00 - Lighting, quantity as required to control each fixture in the daylight zone as specified in Section 26 50 01 Lighting Fixture Schedule.
- D. Occupancy sensor:
 - 1. Occupancy sensor shall be a ceiling-mounted device, powered by the DC voltage supplied by a remote power pack or other control device which is directly connected to the load.
 - 2. Provide quantity of power pack and slave packs with control relays as required to control all designated circuits in the daylighting area.
- E. Photo Sensor:
 - 1. Photo sensor shall be a low voltage device, directly connected to the 0-10V control loop of the dimming ballast.

2.7 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG, complying with Section 26 05 19 – Copper Conductors and Cables.
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded copper conductors not smaller than No. 22 AWG, complying with Section 26 05 19 - Copper Conductors and Cables.
- C. Class 1 Control Cable: Multiconductor cable with stranded copper conductors not smaller than No. 18 AWG, complying with Section 26 05 19 - Copper Conductors and Cables.

- D. Install unshielded, twisted-pair cable for control and signal transmission conductors, complying with Section 26 05 19 - Copper Conductors and Cables.

Cabling which is not installed in conduit or raceway shall be plenum rated.

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

- A. 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.
- B. Install and aim sensors in locations to achieve at least 90 percent coverage of areas indicated. Install sensors in accordance with manufacturer's instructions. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 WIRING INSTALLATION

- A. Wiring Method: Comply with Section 26 05 19 - Copper Conductors and Cables.
- B. Wiring within 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 manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 26 05 53 - Identification For Electrical Systems.
- B. Label time switches and contactors with a unique designation.

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
 - 2. Operational Test: Verify actuation of each sensor and adjust time delays.
- B. Remove and replace lighting control devices where test results indicate that they do not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 SYSTEM STARTUP AND COMMISSIONING

- A. Commissioning shall take place prior to demonstration of system to Owner. After the system has been installed the Contractor shall provide manufacturer's recommended commissioning with factory trained and authorized technicians on-site, to:
1. Verify that the contractor has properly installed and interconnected all necessary components.
 2. Verify correct operation of all system components.
 3. Verify that all switch and contact inputs are in compliance with contract requirements.
 4. Occupancy sensors and photo-sensors: Ensure that each sensor is correctly placed and oriented to provide the intended function. Adjust sensor location if unanticipated obstructions are present that impede the proper operation of the device.
 5. Occupancy Sensors: Adjust sensitivity and time delay of the occupancy sensor and test to ensure it provides appropriate response. Set initial time delay for 15 minutes. Set to MANUAL ON, AUTO OFF for vacancy sensing.
 6. Dual Technology Type Occupancy Sensors: If interferences occur, disable either PIR or ultrasonic technology as appropriate for application.
 7. Daylight harvesting: Calibrate sensors after all furnishings and interior finishes are installed. Adjust photo-sensor to determine the threshold for switching based upon the detected light level. Calibrate sensor under normal daylight levels and dusk light levels.
 8. Daylight dimming controls: Confirm that lamps are pre-seasoned by manufacture or season lamps as recommended by manufacture prior to dimming.
 9. Submit completed verification checklist.

3.6 OWNER'S INSTRUCTIONS AND SYSTEM DEMONSTRATION

- A. System Demonstration
1. Schedule demonstration a minimum of two-weeks prior to system turn over and substantial completion. Schedule with owner's representative and electrical engineer.
 2. Demonstrate complete system operation and contract compliance to designated owner's representative and engineer to prove system is functional and ready for comprehensive training.
- B. System Instruction
1. The Contractor shall after one week (minimum) written notification to Architect conduct an instruction session during which all maintenance and operational aspects of the system will be described and demonstrated to personnel selected by the Owner. The session shall be conducted by a Contractor's representative thoroughly familiar with the characteristics of the system. O & M manual information regarding the system shall be turned over to the Architect prior to scheduling the instruction session.
 2. Training shall utilize the following draft documents:
 - a. Draft O&M Manual
 - b. Contractor's record drawings
 3. The training effort shall validate the O&M Manual and record drawing documentation.

END OF SECTION