

SECTION 16145

WIRING AND CONTROL DEVICES

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. This section specifies providing switches, cover plates, limit switches, occupancy sensors, receptacles, plugs, magnetic contactors, automatic transfer switches, photoelectric controls and time switches.
- B. Related Work Specified Elsewhere:
 - 1. Ornamental metal: Section 05700.
 - 2. Wire connection accessories: Section 16125.
 - 3. Grounding and bonding: Section 16060.
 - 4. Raceways, boxes and cabinets: Section 16130.

1.02 QUALITY ASSURANCE:

- A. Codes, Regulations, Reference Standards and Specifications:
 - 1. Comply with codes and regulations of the jurisdictional authorities.
 - 2. National Electrical Code (NEC).
 - 3. National Electrical Manufacturers Association (NEMA):WD1, General Color Requirements for Wiring Devices; KS1, Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum); ICS 2, Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC; ICS 12, Profiles of Networked Industrial Devices--Part 1: General Rules; NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 4. American National Standards Institute (ANSI): Z55.1, Gray Finishes for Industrial Apparatus and Equipment.
 - 5. UL: 98, Enclosed and Dead-Front Switches; 198D, Class K Fuses; 198E, Class R Fuses; 508, Industrial Control Equipment; 773, Plug-In Locking-Type Photocontrols for Use With Area Lighting; 1008, Transfer Switch Equipment.
 - 6. American Standards of Testing and Materials (ASTM): A47/A47M-99, Standard Specification for Ferritic Malleable Iron Castings; A276-00a, Standard Specification for Stainless Steel Bars and Shapes; and A507-00, Standard Specification for Drawing Alloy Steel, Sheet and Strip, Hot-Rolled and Cold-Rolled.
 - 7. ITS: Directory of ITS Listed Products
- B. Source Quality Control:
 - 1. Following items listed per referenced UL or ITS directory:
 - a. Snap switches.
 - b. Disconnect switches.
 - c. Receptacles and plugs.
 - d. Automatic transfer switch.
 - e. Lighting contactor.
 - f. Photoelectric control.
 - g. Time switch.
 - h. Occupancy sensor.
- C. Qualifications: Select a manufacturer who is regularly engaged in the production of automatic transfer switches.

1.03 SUBMITTALS:

- A. Submit the following for approval in accordance with the General Requirements and with the additional requirements as specified for each:
 - 1. Shop Drawings.
 - 2. Certification:
 - a. Certified test reports of factory tests performed on each automatic transfer-switch unit in accordance with reference standards.
 - b. Furnish certificate from manufacturer verifying that automatic transfer switches conform to specified requirements. Include certificate with submittal of shop drawings.
 - 3. Documentation for Automatic Transfer Switch:
 - a. Submit field test plan within 60 days after award with accompanying documentation in the form of test data recording sheets and list of proposed test equipment for approval prior to testing.
 - b. Submit certified copies of test data, dated and clearly identified within two weeks after completion of testing.
 - 4. Operation and Maintenance Manuals for Automatic Transfer Switch.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Mark each item in accordance with applicable reference standard.
- B. Ship each unit securely packaged and labeled for safe handling and to avoid damage
- C. Store products in secure and dry storage facility.

PART 2 - PRODUCTS

2.01 PRODUCTS AND MATERIALS:

- A. Snap Switches:
 - 1. NEMA WD1, specification grade.
 - 2. Rating:
 - a. Twenty amperes at 120-277 volts ac.
 - b. Horsepower-rated when used as disconnecting device for motor circuit.
 - 3. Body and base: Fully enclosed, brown, fire-resistant, non-absorptive thermosetting urea or nylon.
 - 4. Contacts: Silver alloy.
 - 5. Mounting yoke: Corrosion-resistant metal with plaster ears.
 - 6. Poles: Single-pole, double-pole, three-way or four-way as shown.
- B. Disconnect (Safety) Switches:
 - 1. UL 98, NEMA KS1, heavy-duty, fusible or non-fusible as shown.
 - 2. Voltage rating: 240 volts ac, 480 volts ac or 250 volts dc as shown and as necessary.
 - 3. Number of poles and current rating: As shown and as necessary.
 - 4. Fuses:
 - a. UL 198D.
 - b. For fused disconnect switch associated with motor load: UL Class RK5 with time delay or as shown.
 - c. For fused disconnect switch associated with other loads: UL Class RK1 or as shown.
 - d. Current rating: As shown.
 - 5. Enclosure: (NEMA 250)

- a. Type:
 - 1) For aboveground indoor locations and electrical rooms: Type 1.
 - 2) For tunnel and underground locations, except electrical rooms: Type 4.
 - 3) For outdoor locations: Type 3R.
 - b. Materials:
 - 1) Steel sheet: ASTM A507-00.
 - 2) Malleable iron: ASTM A47/A47M-99.
 - c. Finish: Metallic surface cleaned, degreased, primed with zinc primer and finished with light-gray enamel, ANSI Z55.1, Color 61; minimum dry-film thickness, two mils.
6. Quick-make/quick-break switching mechanism with operating handle external to enclosure with positions labeled ON/OFF and capable of being padlocked in OFF position, defeatable interlock to prevent opening of enclosure door when switch is closed.

C. Receptacles and Plugs:

- 1. NEMA WD1, specification grade.
- 2. Rating: 20 amperes at 125 or 250 volts as shown.
- 3. Base and body: Brown, fire-resistant, non-absorptive thermosetting urea or nylon.
- 4. Receptacles:
 - a. Outlet: Single or duplex as shown.
 - b. Mounting yoke: Corrosion-resistant metal with plaster ears.
 - c. Configuration:

Rating	NEMA Configuration
Two-pole, three-wire, 20 amps, 125 volts	5-20 R
Two-pole, three-wire, 20 amps, 250 volts	6-20 R

- d. For use in restroom; water service room; locker room; wash rooms; elevator machine room, pit and hoistway; and outdoor locations: Equipped with solid-state ground-fault circuit interrupter with five-milliampere trip level.
5. Plugs:
- a. Configuration and design: As follows unless otherwise shown:

Rating		NEMA Configuration
Two-pole, three-wire, 20 amps, 125 volts	Urea or neoprene with cord grip	5-20 P
Two-pole, three-wire, 20 amps, 250 volts	Armored cap with cord grip	6-20 P

D. Cover Plates:

- 1. Wall plates:
 - a. NEMA WD1, suitable for specified receptacles and switches, size suitable for recess-mounted or surface-mounted associated outlet box, stainless steel, ASTM A276-00a, Type 304, or approved equal.

- b. For use in indoor public areas: Bronze, with M32 medium satin finish as specified in Section 05700.
 - c. For above ground indoor service areas and electrical rooms: Steel, stainless steel or aluminum plate, as standard with the manufacturer.
 - d. For receptacles in outdoor and underground locations, except electrical rooms: Stainless steel, ASTM A276-00a, Type 304, wall plate with gasketed spring-loaded hinged cover.
2. Floor plates: Section 16130.
- E. Automatic transfer switch: UL-1008, electromechanical, in surface-mounted enclosure as shown, with the following additional requirements:
- 1. Operating and electrical characteristics:
 - a. Capable of transferring load automatically from normal source to alternate source when the voltage drops to 85 percent of rated voltage on any phase for set time. Operating point adjustable over range of 80 to 90 percent of rated voltage and time-delay adjustable over range from zero to five minutes in increments of at least eight steps.
 - b. Capable of transferring load automatically from alternate source to normal source when normal source returns to 90 percent of rated voltage for set time. Operating point adjustable over range of 85 to 100 percent of rated voltage and time-delay adjustable over range from zero to five minutes in increments of at least eight steps.
 - c. Capable of transferring load automatically from normal source to alternate source when normal source failure is simulated by integral test switch.
 - d. Rating:
 - 1) Number of poles: Three or four as shown.
 - 2) Voltage rating: 480-volt, three-phase, three-wire or 480Y/277-volt, three-phase, four-wire, 60 Hertz system as shown.
 - 3) Current rating: As shown and rated 100 percent.
 - 4) Transfer time: Ten cycles maximum on 60-Hertz base after initiation signal.
 - 5) Short-circuit current rating, rms symmetrical amperes: 14,000; 22,000; 25,000; 30,000; 35,000; or 50,000 as required and shown.
 - 6) Capacity to close into available short-circuit current or let-through current of fuses without functional degrading.
 - e. Solid-state control panel for sensing and control logic with accuracy of plus-or-minus two percent on voltage and frequency settings over a temperature range of minus 20 degrees to plus 70 degrees.
 - 2. Design and construction features:
 - a. Mechanically held, electrically operated, double-throw switch.
 - b. Electrical and mechanical interlock to prevent maintained neutral position.
 - c. Designed to break-before-make on transfer and retransfer.
 - d. Equipped with renewable silver-alloy contact.
 - e. Neutral bus or terminal provided on 480Y/277-volt, three-phase, four-wire unit to allow interconnection of neutral conductors.
 - f. Pilot lights on door to indicate switch position as follows:
 - 1) On normal source: Green light.
 - 2) On alternate source: Red light.
 - g. Pilot lights on door to indicate:
 - 1) Normal source available: Green or white light.
 - 2) Alternate source available: Red or white light.
 - h. Contacts opened by single solenoid, motor operator or stored energy mechanism.
 - i. Handle provided to permit manual operation of automatic transfer switch for maintenance purposes.
 - j. Power conductors made of silver-plated copper bus.

- k. Equipment ground lug provided.
 - 3. Enclosure:
 - a. Type:
 - 1) For aboveground indoor locations and electrical rooms: NEMA Type 1.
 - 2) For tunnel and underground locations, except electrical rooms: NEMA Type 12.
 - b. Door: Hinged with handle and latch.
 - c. Material: Steel.
 - d. Finish: Metallic surface thoroughly cleaned, degreased, primed with zinc primer and finished with gray enamel, ANSI Z55.1, Color No. 61; two mils minimum DFT.
- F. Lighting Contactors:
 - 1. NEMA ICS 2, UL 508, electrically held, equipped with silver-alloy contacts, designed to control incandescent, tungsten, halogen, fluorescent, high-intensity discharge lamp load.
 - 2. Number of poles: As shown.
 - 3. Continuous current rating: As shown.
 - 4. Line and load voltage: 480-volt or 208-volt three-phase or 277-volt or 120-volt single-phase as shown.
 - 5. Control coil rated 120 volts.
 - 6. 480-volt or 277-volt to 120-volt control transformer fused on secondary and primary as required.
 - 7. Control:
 - a. Heavy-duty, three-position selector switch with positions labeled HAND/OFF/AUTO for lights controlled by photo-electric cell.
 - b. ON-OFF push button for indoor lights.
 - 8. Enclosure: NEMA 250, Type 1; fabricated from steel, cleaned, degreased, primed with zinc primer and finished with light-gray enamel, ANSI Z55.1, Color 61; minimum dry-film thickness, two mils.
- G. Photoelectric Control:
 - 1. UL 773, designed to respond to natural daylight with 15-second inherent delay to prevent functioning due to sudden bright light such as vehicle lights or lightning and to operate in ambient temperature from minus 50C to plus 60C.
 - 2. Adjust to turn lights ON at two plus-or-minus one foot-candles, unless otherwise specified. ON to OFF ratio: One to three.
 - 3. Rating: 1,800VA at 120 volts or 277 volts, 60 Hertz, as shown.
 - 4. Contacts:
 - a. For control of outdoor lights: SPST, NC contact.
 - b. For control of tunnel lights at portals: SPST, NO contact
 - 5. Cells: Hermetically sealed.
 - 6. Enclosure: Weatherproof and tamper proof aluminum or non-metallic enclosure equipped with locking receptacles when mounted on fixture or designed for mounting on outlet box as shown and as necessary.
 - 7. At tunnel portal, set photoelectric control to turn on selected lights at dawn and turn off lights at dusk, as shown.
- H. Limit Switches:
 - 1. NEMA ICS 2, industrial-control.
 - 2. Suitable for mounting in folding-gate cabinet. Switch contacts closed when cabinet door is fully closed and latched. Switch contacts opened when respective cabinet door is not fully closed.
 - 3. Voltage rating: 120 volts ac.
 - 4. Current rating: 10-amperes continuous.

5. Enclosure: NEMA 250, Type 13.
 6. Actuator: Lever-operated and adjustable, with spring return.
 7. Mounting: Plug-in type with receptacle tapped for conduit size as shown.
 8. Contacts: Single-pole double-throw; one NO, one NC; snap action.
- I. Time Switch:
1. Seven-day and 24-hour calibration for each day time switch, listed per referenced UL or ITS directory, heavy-duty type suitable for controlling type of lighting fixtures shown.
 2. Type: As shown, with contacts capable of switching continuous load of 20 or 40 amperes per pole at 277 volts as necessary.
 3. Seven-day, 24-hour dial with day and night zones and 24-hour calibration for each hour clearly marked.
 4. Providing up to four automatic ON/OFF operations each day.
 5. Removable ON/OFF trippers designed for minimum ON period of one hour and minimum two-hour period between one OFF operation and next ON operation.
 6. Provision for manual ON and OFF operation of switch by hand without disturbing weekly preset schedule.
 7. Provision for omitting operation of switch on selected days.
 8. Spring-driven reserve power suitable for operation of switch for 16 hours minimum after failure of power. On restoration of power, switch transfers to synchronous motor drive and automatically rewinds spring.
 9. Terminals designed to accommodate up to 8AWG conductor cable.
 10. Operation at 480/277Y or 208Y/120 volts, 60 Hertz as shown and within temperature range of zero degree F to plus 140F.
 11. Enclosure:
 - a. NEMA 250, Type 1, steel, surface-mounted.
 - b. Hinged flush front door with catches and spring-loaded door pull.
 - c. Finish: Metallic surfaces cleaned and degreased, primed with zinc primer and finished with one coat of light-gray enamel, ANSI Z55.1, Color 61; minimum dry-film thickness, two mils.
- J. Occupancy Sensor:
1. UL 508, passive infra-red motion detector designed for wall mounting over single-gang outlet box, minimum radio frequency interference and use with incandescent and fluorescent lighting fixtures and electronic ballasts.
 2. Voltage rating: 120-277 volts ac.
 3. Switching capacity:
 - a. 120-volt operation: 800 watts minimum.
 - b. 277-volt operation: 1,500 watts minimum.
 4. Coverage area: 1,000 square feet.
 5. Detection zone:
 - a. Horizontal: 180 degrees.
 - b. Vertical: 5 degrees.
 6. Ambient light sensing: Photocell for preventing operation of lights at ambient light levels above an adjustable setting.
 7. Adjustments: Adjustable settings for time delay, sensitivity and light level concealed by tamper proof cover. Time delay adjustable from 10 seconds to 15 minutes after motion stops.
 8. Operating mode: OFF/AUTO.
 9. Detection indicator: LED.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Install switches, limit switches, occupancy sensors, receptacles, automatic transfer switches, lighting contactor, photoelectric controls and time switches as shown and in accordance with referenced codes and standards in Article 1.2, and manufacturer's instructions.
- B. Install cover plate on switch and receptacle.
- C. Install cover plate with gasketed spring-loaded cover, on each receptacle in outdoor and underground locations except electrical rooms.
- D. Ground disconnect switch, time switches, automatic transfer switches, receptacles, snap switches, photoelectric controls and lighting-contactor enclosures in accordance with Section 16060.
- E. Make power cable connections to snap switches, plugs, time switches, occupancy sensors, photoelectric controls, receptacles, automatic transfer switches and lighting contactors by means of integral mechanical connectors. If such items are not furnished with integral mechanical connectors, make connections using compression connectors in accordance with Section 16125.
- F. Make power cable connections to snap switches and receptacles using their side screw wiring connection terminals.
- G. Apply matching touch-up paint as necessary.

3.02 FIELD QUALITY CONTROL:

- A. Furnish necessary test equipment and perform the following in the presence of the Engineer, in accordance with approved procedures:
 - 1. Test time switches, receptacles and contactors for connection in accordance with wiring diagram.
 - 2. Test equipment enclosure for continuity to grounding system.
 - 3. Check tightness of cable connections of snap switches, receptacles, time switches, occupancy sensors, disconnect switches, automatic transfer switches, lighting contactors, photoelectric controls and limit switches.
 - 4. Test operations of circuits and controls of switches, occupancy sensors, receptacles and contactors.
 - 5. Automatic transfer switches:
 - a. Test switches for connection in accordance with wiring diagrams.
 - b. Calibrate and set voltage-sensing device for each source and time delay for transfer and retransfer as follows and as approved:
 - 1) Automatic transfer switches for fan shafts and drainage pumping stations: Time delay setting for transfer equal to total of 30 seconds for each connected motor or additional time as required.
 - 2) Time delay setting for retransfer equal to or greater than time delay setting for transfer.
 - c. Perform automatic transfer of load in accordance with the following requirements:
 - 1) With power available on both the normal and alternate sources, initiate automatic transfer from the normal source to the alternate source by opening the disconnect switch or circuit breaker on the line side of the automatic transfer switch for the normal source. Check that the switch position changes to the alternate source and remains connected to the alternate source.
 - 2) With power available on the alternate source and the switch connected to the alternate source, initiate automatic transfer to the normal source by closing the disconnect switch or circuit breaker on the line side of the automatic transfer switch for the normal source.

Check that the switch position changes to the normal source and remains connected to the normal source.

- 3) If testing indicates failure to comply with specified requirements, modify settings for the automatic transfer switch so that the specified requirements are met. Conduct additional tests witnessed by the Engineer to prove compliance with specified requirements.

- B. Submit certified test reports for compliance with field quality control requirements.

END OF SECTION