	Title: YALE OFFICE OF FACILITIES PROCEDURE MANUAL Chapter: 01 - Yale Design Standard Division: Electrical Standards	Section: 26 27 26 Wiring Devices
		Date: 6/15/16
		Author: Office of Facilities
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Change History


Date	Description of Change	Pages / Sections Modified	Change Approver Initials
6/15/16	Updated division section from 16140 to 26 27 26, removed references to other section numbers	-	mgl44
3/26/13	Amend text for cover plates on emergency power systems.	34 – 16140 G. #9 (Wiring Devices; Installation Guidelines)	SO
3/26/13	Add next item addressing separation of alternate and emergency power runs from normal power runs/	34 – 16140 G. #10 (Wiring Devices; Installation Guidelines)	SO

A. Summary

This section contains design criteria for receptacles, wall switches, and cover plates; as well as miscellaneous items, such as dimmers, small fan speed controls, interval timers, time switches, occupancy sensors, photocontrols, and call-for-aid devices.

B. System Design and Performance Requirements

1. Confirm all receptacle configurations with the equipment plug to be connected. Use only standard NEMA configurations.
2. All receptacles must be grounding-type, including locking types, three-phase, and special configurations. Where areas of renovation projects contain ungrounded receptacles, remove and replace them with grounding-types receptacles. Replace the plugs and cords on associated equipment, and add grounding conductors to branch circuits to provide a continuous grounding path.
3. Use ground-fault receptacles in preference to ground-fault breakers located in panelboards.
4. Where subject to abnormal conditions, specify receptacles that will withstand the anticipated conditions.
 - a. Specify hospital-grade devices where receptacles are subject to physical abuse.
 - b. Specify pediatric safety-type devices where receptacles are subject to tampering.
 - c. Specify corrosion-resistant devices where receptacles are subject to water spray, high humidity, acid fumes, or other similar conditions.
5. Specify occupancy sensors with off delay for the control of exhaust fans in toilet rooms.

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6. Use time switches only for mechanical loads. Use occupancy sensors and photocontrols for automatic control of lighting loads.
7. Locate occupancy sensors on walls. Where necessary, provide ceiling sensors to supplement wall sensors.
8. Locate photocontrols in areas where their operation will not be affected by lighting from buildings, vehicles, or other artificial sources.
9. It is the engineer's responsibility to provide and tag life safety dedicated circuits, such as the circuits for the fire alarm and direct digital controller. Incorporate locking devices for circuit breakers providing power to these circuits.

C. Submittals

Furnish occupancy sensors with a minimum three-year manufacturer's warranty.

D. Product Standards


Ensure that products conform to the following standards:

- NEMA WD1, General-Purpose Wiring Devices
- NEMA WD2, Semiconductor Dimmers for Incandescent Lamps
- NEMA WD5, Specific-Purpose Wiring Devices
- UL 20, General-Use Snap Switches
- UL 498, Electrical Attachment Plugs and Receptacles
- UL 508, Electric Industrial Control Equipment
- UL 773A, Non-Industrial Photoelectric Switches for Lighting Control
- UL 943, Ground-Fault Circuit Interrupters
- UL 1449, Transient Voltage Surge Suppressors

E. Manufacturers

Subject to compliance with the design requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

1. **Wiring Devices, Fan Speed Controls, and Dimmers**
 - Bryant
 - General Electric

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- Hubbell
- Leviton
- Lutron (dimmers only)
- Pass & Seymour

2. Occupancy Sensors

- Leviton
- Hubbell
- Sensor Switch –Preferred
- Switchomatic

3. Interval timers, Time Switches, and Photocontrols


- Paragon
- Intermatic
- Tork
- Zenith

4. Call-for-Aid Devices


- DuKane
- Edwards
- Florence

F. Materials


1. Use specification-grade, side-wired receptacles only, with nylon or thermoplastic faces, and colored ivory in finished areas, unless other colors are more appropriate for adjacent wall finishes. Receptacles must be rated for a minimum of 20 amperes, except where 15-ampere locking receptacles are required to suit particular equipment.
 - a. Use duplex receptacles that feature break-off tabs for split wiring.
 - b. Use feed-through type ground-fault receptacles for downstream fault protection. For ground-fault protection for personnel, use Class A-rated ground-fault circuit interrupters with test and reset buttons unless in wet or steam areas where GFCI breaker shall be used.
 - c. Use isolated ground receptacles that feature an orange face or marking on the front to indicate an isolated grounding system.

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- d. Use feed-through type surge suppression receptacles for downstream protection that contain visual and audible means to indicate when the device no longer provides specified protection. Surge suppressors must protect against normal- and common-mode surges, with a clamping level maximum of 500 volts upon a 120 volts basis per UL permanently-wired test, a minimum peak energy rating of 140 joules, and a response time of five nanoseconds or less.
 - e. Specify receptacles connected to circuits with a distinctive face color to distinguish alternate circuits from normal circuits. In existing buildings, color codes must match existing systems. Color codes in new buildings are red or marked on front to indicate emergency circuit.
2. Use only specification-grade, side-wired switches, with grounding terminals where available and ivory toggles in finished areas, unless other colors are more appropriate for adjacent wall finishes.
 - a. Use full-capacity, 20 ampere-rated snap switches with resistive, tungsten, fluorescent, and high intensity discharge lighting sources. Use 80 percent capacity snap switches with motor loads.
 - b. Use long-life, LED-type pilot light switches with an illuminating toggle when the load is energized. Toggles must be red.
 - c. Use illuminated, long-life, neon-type switches with illuminating toggles when the load is de-energized. Toggles must be clear.
 - d. Use ivory, slide-type dimming switches with a positive off position and separate rocker switch to allow on-off switching without disturbing the preset light level. Use solid-state dimmers with circuitry to filter radio-frequency interference.
 - (1) Use incandescent dimmers rated for a minimum of 1000 watts.
 - (2) Use fluorescent dimmers that are suitable for use with 28 watt, T8 rapid-start lamps (minimum 6 lamps, maximum 30) and are listed for use with electronic ballasts. Thyristor-type dimmers are not acceptable.
 - e. Use single pole, double throw (center return), momentary contact switches.
 - f. Use ivory, slide-type fan speed control switches for fractional horsepower motors with a positive off position and a separate rocker switch to allow on-off switching without disturbing preset speed levels. The control switches must be single-pole with a minimum 10-ampere rating. Use solid-state speed controls suitable for use with split-capacitor or shaded-pole motors with circuitry to filter radio-frequency interference.

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- g. Use spring-wound, rotary electronic-type interval timer switches with a 30 minute range. The interval timer switches must be single-pole, single-throw, with a minimum 15-ampere rating at 120 volts.
- h. Use digital controller time switches with a capacitor backup requiring no battery. If the required configuration is not available with a capacitor backup, an alkaline battery backup may be specified. Time switches must be suitable for 120 volt control with minimum single-pole, double-throw dry contacts rated at 20 amperes inductive at 120/240 volts. Time switches must also contain an LCD display and must be capable of seven-day scheduling with automatic daylight savings time and leap year adjustments that include a minimum of 16 set points at one minute resolution and manual override capability to next scheduled event.
- i. Use passive, infrared-type occupancy sensing switches for lighting control. Sensing switches must be rated at a minimum of 600 watts and equipped with an Off-Automatic selector switch with manual override by special key only. The time delay must be field-adjustable from 1 to 20 minutes. Sensitivity must also be field-adjustable. The LED must indicate when motion is sensed. Sensor failure must result in a continuously-energized load. After a power failure, the sensor must energize the load instantly upon restoration of power. Sensors must be RFI resistant and compatible with electronic ballasts.
 - (1) The minimum sensing pattern of wall-mounted sensors must be 160° in the horizontal plane and 40° in the vertical plane, except in cases where a narrower pattern is required to eliminate detection of unrelated motion.
 - (2) The minimum sensing pattern of ceiling-mounted sensors must be 360° around the vertical axis, except in cases where a narrower pattern is required to eliminate detection of unrelated motion.
 - (3) Sensors must be capable of sensing, at a distance of 20 feet, the motion of a 12-inch long object rotating around the central axis of the sensor (with one end of the object fixed on the central axis) at a rate of 90° per second through a 90° arc in a plane perpendicular to the central axis of the sensor.
- j. Use single-pole, single-throw type photocontrol switches rated at a minimum of 2000 watts for tungsten loads and 1900 volt-amperes for ballast loads. The photocontrol must energize the load when the ambient illumination falls below 1.5 footcandles and de-energize the load when the ambient illumination rises above 4.5 footcandles. A minimum 15-second delay is required to avoid nuisance switching. Failure of photocontrol shall result in a continuously- energized load.

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3. Use ASTM type 430, stainless steel cover plates for recessed boxes in finished areas and for boxes on surface metal raceway systems. Use nylon plates where colored cover plates are required. Use galvanized steel cover plates for surface boxes on exposed conduit systems.
 - a. Covers for cast boxes must be cast of the same metal as the box and equipped with a gasket.
 - b. Covers for weatherproof receptacles in damp locations must be cast aluminum for horizontal mounting, with an individual, spring-loaded, gasketed cover for each boss of a duplex receptacle.
 - c. Covers for weatherproof receptacles in wet locations must be polycarbonate for horizontal mounting, with a hinged cover enclosing sufficient space for attachment plugs and cords to be connected with the cover closed.
4. Call-for-aid devices located in single-occupancy handicapped toilets must be equipped with an actuating pull cord station that energizes a corridor lamp and buzzer until reset.
 - a. The pull cord station must be of a single pole, double-throw, toggle switch type bearing the legend "PULL FOR HELP" on a stainless steel cover plate.
 - b. The corridor light and buzzer must consist of a white plastic dome mounted on a stainless steel cover plate, with a 120-volt lamp and buzzer.

G. Installation Guidelines

1. The following list identifies the standard mounting heights of receptacles and switches from a finished floor to the center of the device:
 - Receptacles (except as noted below): 18 inches.
 - Receptacles above counters: 12 inches above the counter surface to the center of the device.
 - Switches: 48 inches.
2. Install receptacles in the vertical position with the grounding pole at the top of the receptacle face. Receptacles installed in two-piece surface metal raceway systems, or with weatherproof covers, may be installed horizontally. Install switches on the strike side of a door, approximately four inches from the trim, in a vertical position with the load de-energized when the toggle is down. Arrange three-way switches such that the load is de-energized when both toggles are in the same position.

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- a. Switches should generally be located within sight of the controlled load. Where switches are within sight of the controlled load, pilot light toggles should be specified.
 - b. In dark rooms, install a switch for the control of safe light on strike side of the door and a switch for general room light on the hinge side of door to prevent accidental energizing of room light when the dark room is in use.
 - c. Whenever possible, install receptacles with protective functions, such as feed-through protection in ground-fault and surge suppressor receptacles, in locations where the protective function is evident from the location of the protected device.
 - d. All receptacles shall be marked with adhesive markers identifying the panel and circuit number.
3. Wrap conductors a 3/4 turn around screw terminals. Back wiring screwed terminations are allowed.
 4. Install dedicated neutral conductors on the load side of dimmers and fan speed controls.
 5. Use bonding jumpers to connect branch circuit equipment grounding conductors to devices and boxes.
 6. Where switches are ganged on 277-volt systems, provide a barrier between each switch.
 7. Where a controlled load is not within sight of the switch location, use pilot light switches, and specify an engraved cover plate describing the purpose of the switch.
 8. In laboratories and health care facilities, install receptacle cover plates with adhesive markers identifying the circuit number.
 9. Where receptacles are connected to emergency circuits, install red cover plates, "EMERGENCY" unless the receptacle face is color-coded in accordance with the standard in use throughout the building. Where receptacles are connected to alternate system circuits, install red cover plates engraved with the legend, "ALT. SYSTEM".
 10. All emergency and alternate wiring and raceways shall be isolated from the normal system.

H. Quality Control

Use a plug-in receptacle tester to verify proper receptacle wiring. Use an external, calibrated ground-fault simulator to test all receptacles protected by ground-fault circuit interrupters for proper operation.

End of Section