

UL 231

ISBN 0-7629-0281-7

Power Outlets

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UL Standard for Safety for Power Outlets, UL 231

Eighth Edition, Dated June 22, 1998

Revisions: This Standard contains revisions through and including April 6, 2007.

SUMMARY OF TOPICS

Revisions to Table 8.1 to better indicate the situations that require ground-fault protection; addition of Exception 2 to 8.5.2 and revision to 35.74 to explain ground-fault protection marking, and; addition of new 35.76 to clarify the marking for power outlets not provided with ground-fault protection with the new Exception 2 to 8.5.2.

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Text that has been changed in any manner is marked with a vertical line in the margin. Changes in requirements are marked with a vertical line in the margin and are followed by an effective date note indicating the date of publication or the date on which the changed requirement becomes effective.

The following table lists the future effective dates with the corresponding reference.

Future Effective Date	References
August 15, 2007	Paragraphs 2.1.8, 8.5.1, 8.5.2, 18.1, 18.2, 18.3, 18.4, 18.5, 26.1.1, 26.1.2, 26.1.3, 26.2.1, 26.2.2, 26.3.1, 26.3.2, 26.3.3, 26.4.1, 32.1, 33.2, 33.3, 35.17.1, 35.19, 35.58, 35.74, 35.76, and 38.1 Figures 8.2, 8.3, and 18.1 Tables 2.1, 8.1, and 33.1

The revisions dated April 6, 2007 include a reprinted title page (page1) for this Standard.

The new and/or revised requirements are substantially in accordance with UL's Proposal(s) on this subject dated August 16, 2006 and January 18, 2007.

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22-23	August 15, 2005
24-24A	April 6, 2007
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A1	July 20, 2006
A2	August 15, 2005
SR1	August 15, 2005
SR2-SR2B	April 6, 2007
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UL 231

Standard for Power Outlets

First Edition – February, 1967

Second Edition – June, 1970

Third Edition – November, 1972

Fourth Edition – May, 1977

Fifth Edition – September, 1982

Sixth Edition – September, 1988

Seventh Edition – May, 1994

Eighth Edition

June 22, 1998

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc.

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INTRODUCTION

1 Scope

1.1 These requirements cover power outlets, with or without integral mounting posts or pedestals, and power outlet fittings for use in accordance with the National Electrical Code, NFPA 70.

1.2 A power outlet covered by these requirements, although not restricted to such use, is intended for use:

- a) At outdoor locations such as on farms, at building sites, and the like, where power is required to operate portable, mobile, or temporarily installed equipment,
- b) To supply power to a mobile home or a recreational vehicle, and
- c) To supply shore power to boats.

1.3 A power outlet may contain:

- a) Attachment plug receptacles,
- b) Circuit breakers,
- c) Fuseholders,
- d) Fused switches and facilities for watt-hour meters, and
- e) Provisions for field installed circuit breakers or switches and fuses.

1.4 Power outlet fittings covered by these requirements are intended for factory or field assembly into or in conjunction with power outlets designed for such assembly. Fittings may be panels or combination units incorporating receptacles, disconnecting means, overcurrent protection or other devices that have been determined to be equivalent. A separable mounting post or pedestal to which power outlets are to be mounted is also a fitting.

1.5 In addition to or instead of mounting to a post or pedestal fitting as mentioned in 1.4, a power outlet may be constructed for mounting on and connection to a mounting post or pedestal also designed to be used with other types of distribution equipment.

1.6 Some power outlets may have special features and markings to indicate their acceptability for use as service equipment.

1.7 A power outlet with a mounting post is intended for mounting in concrete. A power outlet with a mounting pedestal is intended for mounting on a concrete slab. Unless marked otherwise, a mounting post or pedestal fitting is not intended to serve as the sole support of a mast for overhead wiring.

1.8 A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this Standard, and that involves a risk of fire, electric shock, or injury to persons shall be evaluated using the appropriate additional component and end-product requirements to determine that the level of safety as originally anticipated by the intent of this Standard is maintained. A product whose features, characteristics, components, materials, or systems conflict

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with specific requirements or provisions of this Standard shall not be judged to comply with this Standard. Where appropriate, revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this Standard.

1.8 revised March 12, 1999

2 General

2.1 Components

2.1.1 Except as indicated in 2.1.2, a component of a product covered by this standard shall comply with the requirements for that component. See Appendix A for a list of standards covering components generally used in the products covered by this standard.

2.1.2 A component is not required to comply with a specific requirement that:

- a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard, or
- b) Is superseded by a requirement in this standard.

2.1.3 A component shall be used in accordance with its rating established for the intended conditions of use.

2.1.4 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

2.1.5 A component not marked with a short-circuit current rating is considered rated for use in a circuit having a maximum available fault current as shown in Table 2.1.

2.1.6 The short-circuit current available in the secondary circuit of a transformer rated 10 kVA or less is considered to be 5000 amperes or less.

2.1.7 The short-circuit current available on the load side of a 15 ampere current-limiting circuit breaker or Class CC, G, J, RK1, RK5, or T fuse is considered to be 5000 amperes. In a single phase 120-volt circuit, the short-circuit current available on the load side of a 20 ampere circuit breaker or Class CC, G, J, RK1, RK5, or T fuse is considered to be 10,000 amperes or less.

2.1.8 For a power outlet having a short circuit rating exceeding 5000 amperes rms symmetrical, a luminaire as covered in item 4 of Table 2.1 shall be located in the secondary circuit of a maximum 10 kVA transformer as specified in 2.1.6 or on the load side of a 15 ampere current-limiting circuit breaker or fuse as specified in 2.1.7 that is provided in the power outlet or power outlet fitting.

Exception: The transformer, circuit breaker, or fuse may be remotely located if the power outlet or power outlet fitting is marked as specified in 35.73.

Revised 2.1.8 effective August 15, 2007

2.2 Units of measurement

2.2.1 If a value for measurement is followed by a value in other units in parentheses, the second value may be only approximate. The first stated value is the requirement.

Table 2.1
Assumed maximum short-circuit current rating for unmarked components

Revised Table 2.1 effective August 15, 2007

Component	Short-circuit current rating, kA
1. Circuit breaker (including GFCI type)	5
2. Clock-operated switch	5
3. Fuseholder	10
4. Lighting fixture (circuit) internal	5
5. Miniature fuse	10 ^a
6. Plug fuse	10
7. Industrial control equipment:	
a. Auxiliary device	5
b. Motor controllers or switches (other than mercury tube type)	5
c. Mercury tube switches:	
Rated over 60 amperes or over 250 volts	5
Rated 250 volts or less, 60 amperes or less, and over 2 kVA	3.5 ^b
Rated 250 volts or less and 2 kVA or less	1 ^b
8. Meter socket base	10
9. Photoelectric switches	5
10. Receptacle (GFCI type)	2 ^c
11. Receptacle (other than GFCI type)	10
12. Snap switch	5
13. Terminal block	10
14. Thermostat	5
^a The use of these fuses is limited to 125-volt circuits as specified in the Exception to 14.5. ^b This rating is below the minimum specified in Table 33.1 and the component shall either: 1) Be investigated for the minimum short-circuit current rating specified in Table 33.1 or 2) Be located on the load-side of a suitable current-limiting overcurrent protective device. ^c A GFCI type receptacle is restricted for use in power outlets rated no more than 20 amperes (See 32.1(d)) unless: 1) The power outlet and GFCI type receptacle comply with the short-circuit current test specified in the Short-Circuit Current Test, Section 26 or 2) The receptacle is located in the 120-volt secondary circuit of a transformer rated 5 kVA or less (a circuit considered to have a short-circuit current available of 2 kA or less) and is provided with suitable overcurrent protection.	

2.2.2 Unless otherwise indicated, all voltage and current values mentioned in this standard are root-mean-square (rms).

2.3 Undated references

2.3.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

3 Glossary

3.1 For the purposes of these requirements, the following definitions shall apply.

3.2 COVER – An unhinged, removable covering part.

3.3 DOOR – A hinged, sliding, or similarly attached covering part that can be removed only by the use of a tool.

3.4 FILLED OPENING – An opening that has been closed with a filler plate.

3.5 FILLER PLATE – A part intended for closing an opening that would otherwise be closed by subsequent installation of a circuit breaker or other device.

3.6 KNOCKOUT – A factory closed opening with a nonreplaceable closure provided for subsequent installation of a:

- a) Conduit,
- b) Circuit breaker,
- c) Other device, or
- d) Wiring system.

3.7 RESTRICTING BARRIER – A barrier used to prevent the entry of rain or direct access to a live part through a ventilation opening in the enclosure.

CONSTRUCTION

4 General

4.1 A power outlet shall not have provision for the mounting of additional receptacles unless the receptacles are part of a power outlet fitting.

4.2 A knockout or filled opening may be provided in a power outlet only if intended to accommodate:

- a) A circuit breaker or fused switch;
- b) A combination unit as described in 4.6; or
- c) Specific additional equipment that has been determined to be equivalent.

4.3 A knockout or filled opening that is intended to accommodate a receptacle shall not be used in a power outlet or power outlet fitting.

4.4 A panel (power outlet fitting) shall not require the use of a tool or the provision of wiring for connecting the supply or ground. The grounding connection shall comply with 17.8.1.

Exception: A metal dead front or cover that does not include a receptacle may be grounded by the mounting screws.

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4.5 A mounting means shall be provided for connecting:

- a) A panel to a power outlet and
- b) A power outlet to a mounting post or pedestal.

Such means shall be determined for equivalence in security to that provided by four machine screws.

Exception: A panel that is not more than 6 inches (152 mm) in width or length may be secured with two machine screws.

4.6 A combination unit (power outlet fitting) consisting of a receptacle and overcurrent protection and intended to be field or factory installed in a power outlet shall not require the use of a tool or the provision of wiring for effecting supply and grounding connections and shall be provided with a mounting means at the receptacle that does not depend solely upon the plug-in connection. The grounding connection shall comply with 17.8.1.

Exception: A metal cover that is not part of the grounding path for a receptacle may be grounded by the mounting screws.

4.7 Field installation of an individual circuit breaker or fused switch in a power outlet shall not require the use of a tool or the provision of wiring in making supply connections directly to the circuit breaker or switch and shall be intended only for field connection to a permanently wired load circuit.

4.8 A circuit breaker or fused switch intended for field connection to a permanently wired load circuit shall be mounted to the panel dead front only if all electrical connections to the panel are made by stabs and jaws.

4.9 A power outlet or panel (power outlet fitting) with provision for the field installation of additional circuit breakers or fused switches shall contain a dead front with filled openings or knockouts for the circuit breaker handles or fused switches that will cover all wiring and live parts.

4.10 A power outlet marked for use with a power outlet fitting described in 4.4, 4.6, and 4.9 shall be shipped:

- a) With a power outlet fitting installed;
- b) With a dead front having knockouts or filled openings for the field installation of additional circuit breakers or fused switches; or
- c) With a blank dead front without knockouts or openings for circuit breakers or fused switches that will cover all wiring and live parts and prevent the entrance of rain above live parts.

4.11 A filler plate shall be judged according to the Standard for Panelboards, UL 67. Marking requirements for dead fronts using filler plates are contained in 35.31.

4.12 A power outlet intended for mounting to a separable field-installed mounting post or pedestal may be provided with an opening for the mounting post or pedestal. If the power outlet can be mounted so that field-installed conduit could interfere with access to field-wiring terminals, the mounting post shall be marked in accordance with 35.29.

5 Enclosure

5.1 General

5.1.1 Unless specified otherwise in this standard, a metallic enclosure shall comply with the Standard for Enclosures for Electrical Equipment, UL 50. A non-metallic enclosure shall comply with 5.5.1 and 5.5.2. Provisions for a conduit hub need not be provided if the enclosure is marked in accordance with 35.52.

5.1.2 An external operating mechanism, such as for a disconnect, mounted on or through the enclosure shall withstand the environmental tests specified in the Standard for Enclosures for Electrical Equipment, UL 50, for the enclosure type marked in accordance with 35.2.

5.1.3 A power outlet marked in accordance with 35.2 with a Type 3S enclosure designation and provided with an external operating mechanism shall be capable of supporting the weight of any ice build-up, being operated as intended, and withstanding removal of the ice by a tool or auxiliary means to gain access to the interior of the enclosure. Determination of these characteristics is to be made in accordance with 21.1 for each maintained position of the external operating mechanism.

5.1.4 Internal wiring and live parts, other than those associated with exposed parts of fuseholders and receptacles, shall not be exposed during fuse replacement or insertion or removal of attachment plugs as specified in 14.11.

5.1.5 The enclosure shall be constructed to withstand beating rain and splashing water as determined by application of the requirements specified in the Rain and Splash Test, Section 22 and, when marked for marine use, as specified in the Spray Test, Section 23. If there is an opening for a ringless type meter without a viewing pane in front of the meter, the enclosure shall be provided with a permanent structural system to channel any accumulation of water to the outside of the enclosure. During the tests specified in the Rain and Splash Test, Section 22, and the Spray Test, Section 23, a meter having the dimensions specified in Figure 5.1 shall be installed in place.

5.1.6 A receptacle or circuit breaker, including a handle opening, that is located in the bottom end wall of the enclosure shall be shielded by an extension of each side of the enclosure. The shielding shall extend a minimum of 1/2 inch (12.7 mm) below the face of any receptacle or circuit breaker (excluding the handle).

Exception: A minimum of 1/8 inch (3.2 mm) extension of any side of the enclosure may be provided if no part of a receptacle or circuit breaker face is closer than 1 inch (25.4 mm) to that vertical side of the enclosure.

5.1.7 The various parts of a power outlet as covered in these requirements are illustrated in Figure 5.2.

5.1.8 Means for mounting shall be external to the enclosure.

Exception No. 1: A metal enclosure designated as Type 3R may be provided with internal means for mounting consisting of no more than two openings above the level of any live part or any terminal for a neutral or grounding conductor. More openings may be provided if all such openings:

- a) Are closed at the factory; and*
- b) While in the as-received condition, exclude water when subjected to the test described in the Rain and Splash Test, Section 22.*

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Exception No. 2: Internal mounting means may be provided in a nonmetallic enclosure if the construction is in accordance with Exception No. 1 and if means to reduce the risk of contact between internal conductors and the mounting means is provided in accordance with 5.1.9.

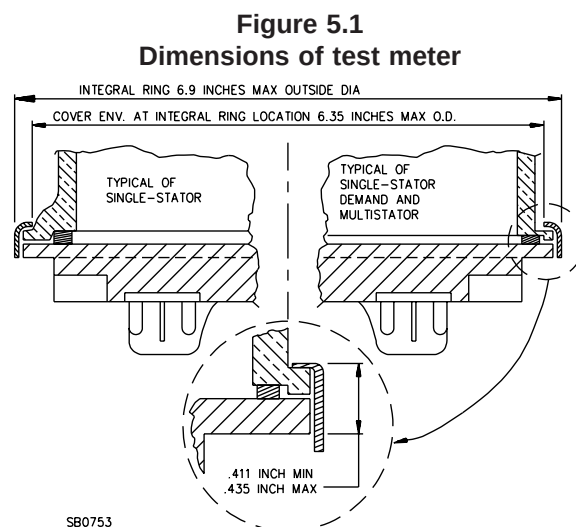
5.1.9 To reduce the risk of contact between a supporting screw and conductors within an enclosure as required in Exception No. 2 to 5.1.8, a hole in an enclosure for a screw shall be located in a recess constructed so that there will be a spacing of not less than 1/32 inch (0.8 mm) between the plane of the top of the recess and the head of the largest screw that is provided with the enclosure. If a screw is not provided with the enclosure, this spacing shall be measured using the largest round-head screw, as specified in Table 5.1, that can be inserted in a hole that is not chamfered; or the largest flat-head screw that can be inserted in a hole that is chamfered.

5.1.10 In a power outlet marked for marina and boatyard use, internal mounting holes located above live parts shall be gasketed.

5.1.11 There shall be provision for drainage of the enclosure. In a mounting post the drain hole shall be located directly above the moisture seal and shall drain to the outside.

5.1.12 An edge, projection, or corner of an enclosure, opening, frame, guard, knob, handle, or the like of a power outlet shall not be sufficiently sharp to constitute a risk of injury to persons during intended use or user maintenance.

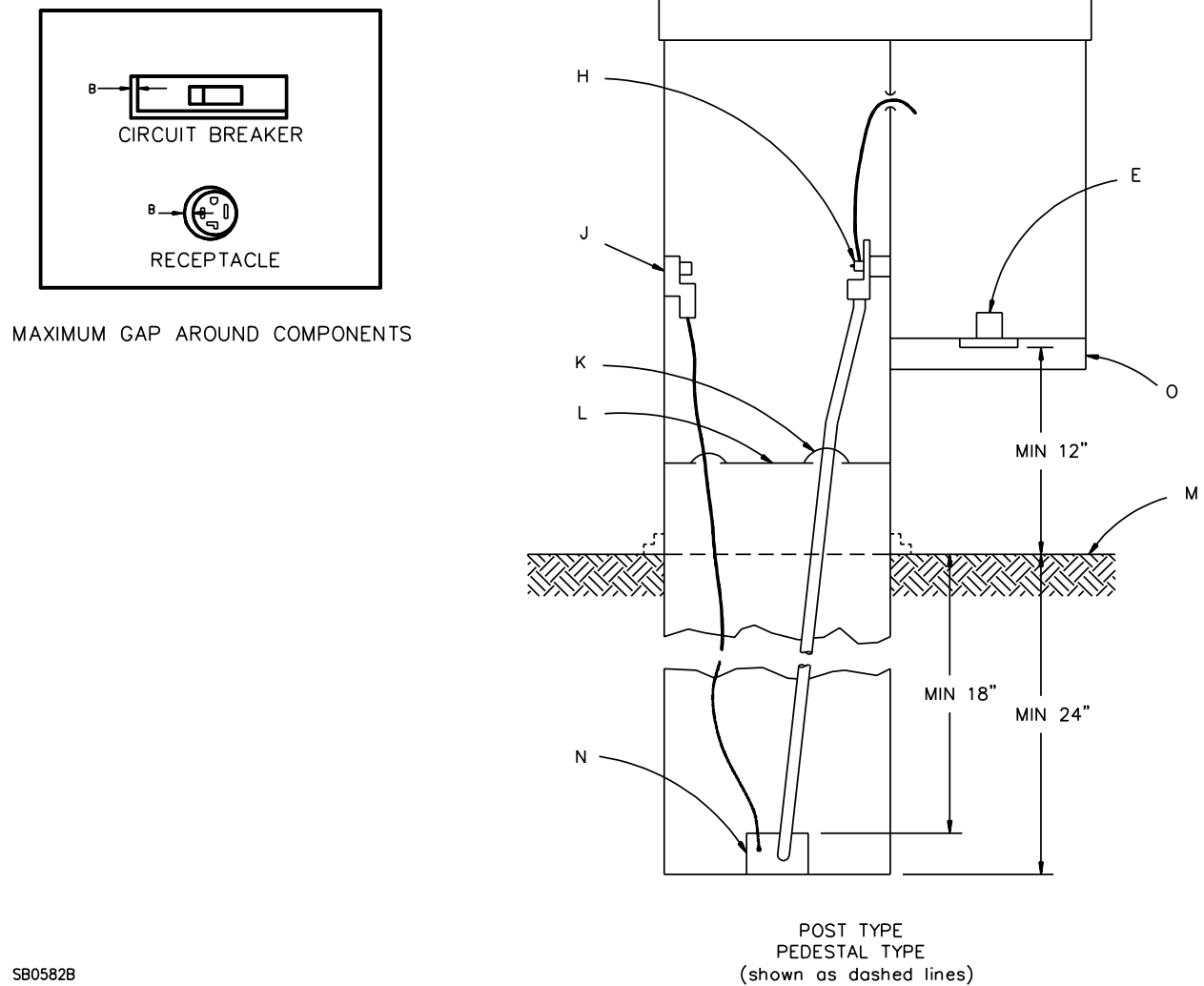
5.1.13 Metals shall not be used in such combination as to cause galvanic action that will affect adversely any part of the device.



inches	(mm)
6.9	175
6.35	161
0.411	10.4
0.435	11.0

Figure 5.2
Typical power outlet construction features

Figure 5.2 revised August 15, 2005



SB0582B

Figure 5.2 continued on next page

- A – Maximum 1/8-inch (3.2-mm) gap, top of dead front to edge of open door (see 5.6.7).
- B – Maximum gap 3/32 inch (2.4 mm) each side (maximum 1/8 inch total) between component and edge of opening in dead front, or between dead front and wall of enclosure (see 5.6.3 and 5.6.8).
- C – Fuseholder in compartment (see 5.3.2).
- D – Barrier (see 5.3.3).
- E – Receptacle.
- F – 1- by 1-inch (25.4- by 25.4-mm) end wall extension (see 5.6.5).
- G – 1/2-inch (12.7-mm) wall extension (see 5.6.5).
- H – Line terminals (see 7.3.1 and 10.2.1).
- J – Enclosure grounding terminal (see 7.3.1).
- K – Sealing material, applied during installation (Optional).
- L – Sealing provision (Optional).
- M – Marked grade level (see 35.13).
- N – Conductor entrance (see 7.4.1).
- O – Receptacle or circuit breaker rain shield extension (see 5.1.6).
- P – Distance between a receptacle or a live part and grade level (see 7.3.1 and 12.6).

Table 5.1
Supporting screw hole dimensions

Nominal screw size	Diameter of hole,		Minimum dimensions of recess			
			Diameter,		Depth,	
	inch	(mm)	inch	(mm)	inch	(mm)
6	0.138	3.51	1/4	6.4	4/32	3.2
8	0.164	4.17	19/64	7.5	9/64	3.6
10	0.190	4.83	11/32	8.7	5/32	4.0
12	0.216	5.49	25/64	9.9	11/64	4.4
1/4	0.250	6.35	29/64	11.5	13/64	5.2
5/16	0.313	7.95	9/16	14.2	15/64	6.0

5.2 Enclosure of switches and circuit breakers

5.2.1 A switch or circuit breaker shall be operable from outside the enclosure.

Exception: A switch or circuit breaker may be located behind a door if live parts or wiring are not exposed during operation.

5.2.2 An enclosure involving a pull-out switch member shall completely enclose any part that may be live when a hinged pull-out switch member is in the closed position or when the door over a detachable pull-out member is closed. A pull-out switch member shall be designed so that no live part will be exposed to unintentional contact with the operator when the pull-out switch member is in any position.

5.2.3 The accessibility of a live part with respect to unintentional contact as mentioned in 5.2.2 is evaluated with reference to any actual operating condition and with the pull-out member tilted at any angle at which it can be inserted. If the protection of a live part against unintentional contact is accomplished by means of a shield, barrier, or the like, that may be moved or deflected under pressure so as to affect either the width of the opening or the recessing of the live part, the dimensions specified are to be investigated with pressure applied.

5.2.4 A live part is not considered to be exposed to unintentional contact if it is recessed or set back 1/8 inch (3.2 mm) or more from the plane of an opening having at least one dimension not greater than 3/8 inch (9.6 mm), as shown in Figure 5.3. If the recessing or set-back is more than 1/8 inch, a larger opening may be used if the construction provides protection against unintentional contact with the live part and has been determined to be at least equivalent to that just described.

5.2.5 With respect to Figure 5.4, the dimensions specified in 5.2.4 apply also to live parts on a pull-out switch member.

Exception: The blades or other current-carrying parts may be recessed or set back less than 1/8 inch (3.2 mm) if their exposure while live is not more than 1/8 inch.

5.2.6 The enclosure of a power outlet not employing a pull-out switch member shall completely enclose all parts that may be live regardless of any switch position.

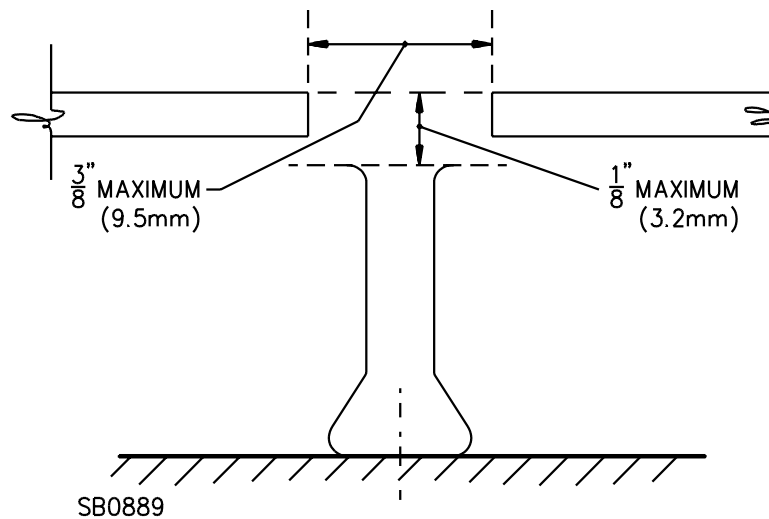
5.2.7 The enclosure described in 5.2.6 shall not have any open hole or slot to provide for movement of an operating handle.

Exception: An opening may be provided for a closely fitting operating handle if the opening is closed when the handle is in the operating position, and the clearance between the edge of the hole and the handle does not exceed 3/32 inch (2.4 mm) on either side (one side only) and 1/8 inch (3.2 mm) total (both sides). The clearances are measured with the handle in the on and off positions, but with the handle and its supporting member assembled in any position that results from ordinary factory assembly.

5.2.8 A power outlet shall be designed so that during the installation of circuit breakers or fused switches and panels as mentioned in 4.4 and 4.7, the exposure of live parts shall not be greater than necessary to permit the installation of the number of circuit breaker or fused switch poles for which the assembly is intended.

5.2.9 No live parts other than load and neutral terminals shall be exposed to unintentional contact by the installer during the wiring of permanently installed load circuits.

Figure 5.3
Recessing of live parts



inch	(mm)
3/8	9.5
1/8	3.2

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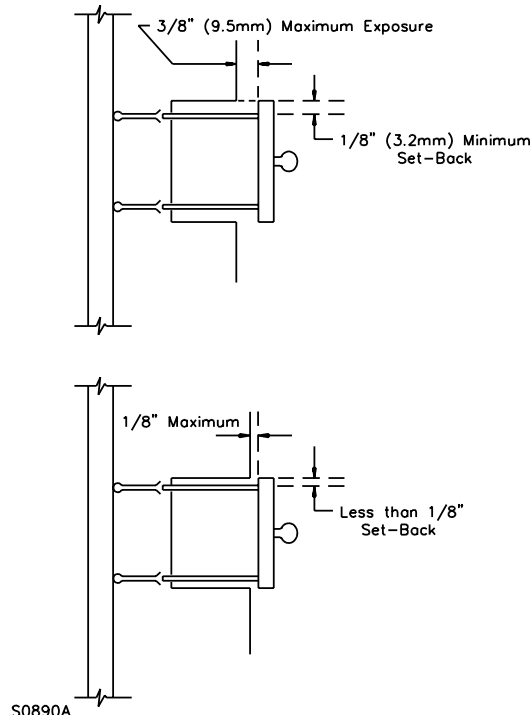
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Figure 5.4
Recessing of pull-out switch



5.3 Enclosure of fuses

5.3.1 A fuse, fuseholder, or fusible switch shall be located inside an enclosure but shall be accessible for fuse replacement.

5.3.2 The portion of the enclosure containing any component described in 5.3.1 shall be closed off by a barrier of at least 0.053-inch (1.35-mm) thick sheet steel, or that which has been determined to be equivalent for polymeric materials, from that space behind a door containing any opening such as for cord passage.

5.3.3 With respect to 5.3.2, a joint between the barrier and the adjacent dead front, enclosure door, and sides need not be flanged, but shall have as close a fit as practicable. With the door fully closed a maximum 1/16-inch (1.6-mm) gap may exist between adjacent flat surfaces, or a maximum 3/32-inch (2.4-mm) gap between adjacent curved surfaces.

5.4 Opening for cord

5.4.1 A power outlet that will require the passage of flexible cord from an interior receptacle to supply an external load shall be provided with one or more smooth openings in the bottom of the enclosure or the door. The door shall close completely with all cords and plugs in place.

5.5 Nonmetallic enclosures

5.5.1 A nonmetallic enclosure shall comply with the requirements for outdoor nonmetallic enclosures for fixed equipment specified in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. However, with regard to the reference to Table 8.1 in 6.1 of UL 746C, the electrical properties shall be those applicable to indirect support material as specified in 9.1 and Tables 9.1 and 9.2. The relative thermal index shall be equal to or greater than the sum of 40°C (72°F) and the temperature rise on the enclosure during a temperature test; or, if a temperature test is not conducted, the relative thermal index shall be at least 80°C (176°F). The oven temperature for the mold stress test shall be equal the maximum use temperature [40°C (104°F) plus the temperature rise] plus 10°C (50°F) but not less than 70°C (158°F); or, if a temperature test is not conducted, the oven temperature shall be 90°C (194°F).

Exception: Compliance with the requirements in Enclosure Flammability – Large Mass Considerations, Section 21, of UL 746C is not required.

5.5.2 A nonmetallic enclosure intended for connection to a rigid conduit system shall be subjected to the tests described in the Conduit Connection Tests, Section 27.

5.6 Dead front

5.6.1 A dead front supporting no components shall have a thickness not less than:

- a) 0.032 inch (0.81 mm) if of uncoated steel or
- b) Not less than 0.034 inch (0.86 mm) if of coated steel.

5.6.2 A dead front supporting components shall comply with the general enclosure requirements specified in 5.1.1 – 5.1.13.

5.6.3 A dead front with or without a 1/2-inch (12.7-mm) integral flange shall form a close fit with the walls (sides and bottom) of the enclosure [within 3/32 inch (2.4 mm) on bottom or either side (one side only) and 1/8 inch (3.2 mm) total on sides (both sides) with the dead front assembled in any intended position] or shall overlap a flange, projection, or that which has been determined to be equivalent, on the enclosure walls so that no direct opening into the area behind the dead front will result.

5.6.4 A dead front is a panel used behind a door (that may have openings for the passage of cords) to cover wiring and uninsulated live parts that would otherwise be exposed. Portions of a component involving mechanical operation (handles of circuit breakers or switches, fuseholders, and receptacle faces) may project through the dead front.

5.6.5 If a door has an opening for cord passage, and the dead front is not constructed with the 1/2-inch (12.7-mm) flange and does not overlap a flange on the enclosure walls as specified in 5.6.3, the bottom end wall of the enclosure shall extend horizontally forward from the dead front. The extension shall be at least 1/2 inch at all points, but at the bottom end of each side wall the extension shall be at least 1 inch (25.4 mm) for a distance of 1 inch from each side wall.

5.6.6 The 1/2-inch (12.7-mm) horizontal dimension referred to in 5.6.5 may be reduced to a value of 3/8 inch (9.6 mm) at a cord opening if the edge of such an opening is turned up a minimum of 1/8 inch (3.2 mm).

5.6.7 A dead front shall form a close fit that is within 1/8 inch (3.2 mm) from the top surface of the door when the door is in the open position.

5.6.8 A gap may exist between the body of a component (such as a circuit breaker or a receptacle) that projects through an opening in the dead front and the metal of the dead front, but such a gap shall not exceed 3/32 inch (2.4 mm) on either side (one side only) and 1/8 inch (3.2 mm) total (both sides) with the dead front panel and the component assembled in any position that will result from ordinary assembly.

5.7 Doors and covers

5.7.1 An opening in an enclosure giving access to a live part or wiring shall be closed by a door or cover. An opening giving access to a fuse or pull-out fuseholder shall be closed by a door.

5.7.2 A door or cover over an opening in the enclosure as well as a door or cover provided to keep rain from a receptacle or a switch and circuit breaker handle shall comply with the requirements for doors and covers.

5.7.3 A door or cover shall have flanges for the full length of all edges. The flanges shall:

- a) Not be less than 1/2 inch (12.7 mm) deep;
- b) Make a close telescoping fit with the outside walls of the enclosure; and
- c) Overlap the enclosure edges not less than 7/16 inch (11.1 mm).

Exception No. 1: Openings for the cord may be used under the provisions of 5.4.1 and 5.6.5.

Exception No. 2: The flange on the bottom edge of the door or cover may be omitted or reduced in depth if the test described in 5.7.5 is successfully completed, and if:

- a) All sides of the dead front are flanged at least 1/2 inch (12.7 mm) and, with the dead front in any position that might result from assembly, no single gap between any side of the front and the adjacent enclosure wall exceeds 3/32 inch (2.4 mm), and the total of the gaps between two opposite dead-front sides and their adjacent walls do not exceed 1/8 inch (3.2 mm);*
- b) The enclosure walls have flanges, projections, or that which has been determined to be equivalent, to provide minimum 1/2 inch overlaps with the dead front; or*
- c) The construction uses combinations of such flanges and overlaps (such as two walls with flanges and two with overlaps).*

Exception No. 3: The flange on the upper edge of a door or cover may be reduced in depth or may be omitted if the door or cover in combination with the top wall of the enclosure and a flange formed from the top wall overlaps the door or cover at least 1/2 inch in accordance with either of the following conditions:

- a) If the width of the door or cover is 10 inches (254 mm) or less.*
- b) If the width of the door or cover is at least 10 inches but no more than 18 inches (457 mm) and complies with the tests specified in 5.7.6.*

Exception No. 4: A door is not required to comply with these requirements if the door serves only as a rain shield for a receptacle or for a switch or circuit-breaker handle.

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5.7.4 To determine if a flanged door or cover complies with the requirement in 5.7.3 regarding depth of flange, the distance between the flat portion of the door or cover (clear of forming radii, beads, draws, or the like) and a straight-edge placed across any two flanges at any point is to be measured.

5.7.5 If the flange is omitted in accordance with Exception No. 2 to 5.7.3, the construction shall comply with 5.7.6 except the deflection under the load may exceed 1/8 inch (3.2 mm). However, there shall not be permanent deflection greater than 1/8 inch in the door or cover or in its supporting structure after the test load is removed.

5.7.6 A door or cover as described in Exception No. 3(b) to 5.7.3, or a cover or cap as described in the Exception to 7.2.1, may be used if it is not deflected more than 1/8 inch (3.2 mm) when subjected to a force created by placing a 30-pound (13.6-kg) weight at any point 1 inch (25.4 mm) from the edge. The test is to be conducted with the cover mounted on the enclosure in the intended manner. The force is to be applied through the end of a steel probe having a square face 1/2 by 1/2 inch (12.7 by 12.7 mm). The box is to be on its back on a horizontal surface that is smooth and firm.

5.7.7 If the top of the door or cover has an inward flange and the front of the top end wall has an overlapping downward flange of not less than 1/4 inch (6.4 mm), the 1/2-inch (12.7-mm) overlap may consist of the sum of the overlaps of the two adjacent flanges if the cover flange is within 1/8 inch (3.2 mm) of the top wall with the door or cover closed.

5.8 Meter socket base

5.8.1 Any live part within a 3-inch (76.2-mm) radius of the center of a meter socket base shall be recessed not less than 1/2 inch (12.7 mm) behind the front plane of:

- a) The meter mounting rim of a ring-type meter socket as shown in Figure 5.5 or
- b) The meter support of a ringless-type meter socket.

5.8.2 A meter-socket base shall be mounted independently of the cover unless it is intended to be used with a current transformer.

5.8.3 If a meter socket base is secured independent of the cover, the construction of a ring-type meter socket shall be such that removal of the cover necessitates a procedure tending to guide the cover clear of any uninsulated part.

Exception: The guiding means is not required if the jaws or other live part of the meter socket are recessed at least 1/16 inch (1.6 mm) behind the front plane of the meter socket cover.

5.9 Ventilation openings

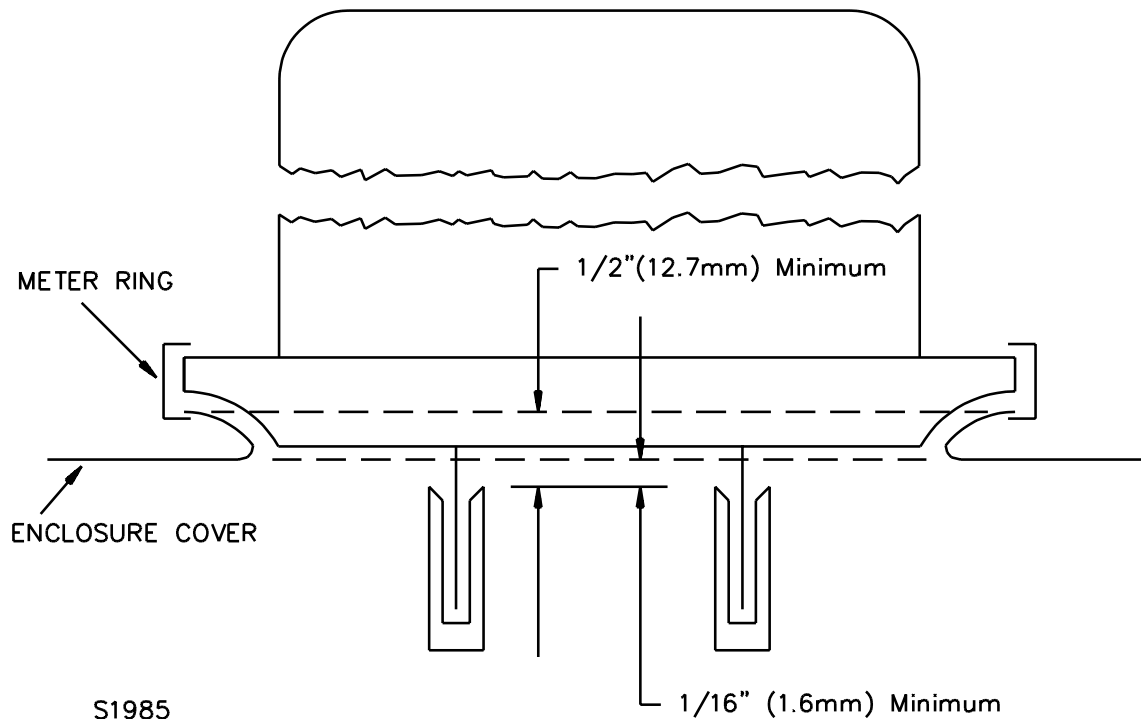
5.9.1 If ventilation openings are provided, they shall comply with 5.9.2 – 5.9.4.

5.9.2 Ventilation openings shall be guarded so that there is no direct access to a live part as covered in 5.9.3 and 5.9.4.

5.9.3 Ventilation openings shall be:

- a) Screened or louvered openings with internal barriers or
- b) Hoods or stacks with labyrinth air passages.

Figure 5.5
Ring-type meter socket



5.9.4 A barrier shall be of such dimensions and located so that a straight line drawn from any live part past the edge of the barrier will intersect the enclosure minimum 1/4 inch (6.4 mm) from the edge of an opening.

5.9.5 A ventilation opening – slot, louver, or the like – shall be protected by:

- a) One or more baffles;
- b) Barriers; or
- c) Other obstructions

of such dimensions and locations that any access path to a live part requires at least two changes of direction, one of which involves an angle of 90 degrees or more from a straight line, as shown in Figure 5.6. In addition, if the minor dimension of a ventilation opening is larger than 1/4 inch (6.4 mm), it shall be protected by a screen having a minor dimension no larger than 1/4 inch.

5.9.6 The size, shape, and location of a screened opening shall not weaken the overall enclosure.

5.9.7 The wires of a screen required to protect a ventilation opening shall be no smaller than No. 16 AWG (1.3 mm²) and the openings in the screen shall not exceed 1/4 inch (6.4 mm) in any dimension.

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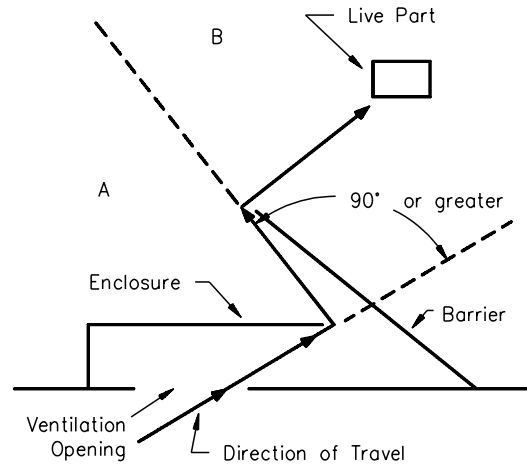
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Figure 5.6
Angle of change of direction



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A – No live parts permitted in this area.

B – Live parts may be present in this side of barrier.

5.9.8 Perforated sheet steel or expanded-steel mesh shall not be less than 0.042 inch (1.07 mm) thick if uncoated or 0.045 inch (1.14 mm) thick if zinc-coated, if the mesh openings or perforations are 1/2 square inch (3.23 cm²) or less in area. For larger openings, the steel or mesh shall be no less than 0.080 inch (2.03 mm) thick if uncoated or 0.084 inch (2.13 mm) thick if zinc-coated.

Exception: If deflection of the expanded-steel mesh will not alter the clearance between uninsulated live parts and grounded metal so as to reduce the spacings to values below the minimum values specified in Table 15.1, expanded-steel mesh may be made of minimum 0.024-inch (0.61-mm) thick sheet steel if uncoated or 0.028-inch (0.71-mm) thick sheet steel if zinc-coated.

5.9.9 A grille construction complying with the intent of the requirements in the Exception to 5.9.8 may be used for a particular application.

5.9.10 The width of ventilation louvers in an enclosure shall be such that at least 1/6 of the enclosure material will remain at each end of the louver.

5.9.11 A separate louvered panel that is riveted or welded in place over a ventilation opening in the enclosure shall not be less than 0.032-inch (0.81-mm) thick sheet steel.

5.9.12 A louver in the enclosure for ventilation shall be located and arranged so that the entrance of water will be controlled in accordance with the requirements in Exception No. 1 to 22.1.1 and the accessibility of live parts will be in accordance with the requirements in 5.2.2.

6 Connections for Wiring Systems

6.1 Facilities shall be provided for accommodating permanently connected line or load conductors of the required ampacity by means of one of the wiring systems rated for the application.

6.2 If provided, a knockout shall be located so that the installation of a bushing for conduit of the size required to accommodate conductors having the ampacities necessary for line or load connections will result in spacings complying with the requirements in this standard.

6.3 If provided, a hole for conduit shall be threaded unless it is located where not exposed to rain or spray or is wholly located below the lowest terminal lug or other live part within the enclosure and shall be provided with a conduit end stop unless the thread is tapered.

6.4 Removal of a cover for making or inspecting line and load connections shall not require removal or disturbing of a permanently connected wiring system.

6.5 A conduit hub in an enclosure shall be threaded and shall have a wall thickness before threading no less than that of the corresponding trade size of conduit. A conduit hub shall not depend upon friction alone to prevent its turning, and shall be capable of withstanding the torque specified in Table 6.1 applied to a short length of rigid conduit threaded into the hub in the intended manner, without turning in the enclosure and without stripping of any threads. The enclosure shall be securely (rigidly) mounted or supported.

Table 6.1
Applied torque for conduit threaded into hub

Conduit trade size, inch	Torque,	
	lb-inch	(N·m)
3/4 and smaller	800	90
1, 1-1/4, or 1-1/2	1000	113
2 and larger	1600	181

6.6 If threads for the connection of conduit are tapped all the way through a hole in an enclosure, or if a construction that has been determined to be equivalent is used, there shall not be less than 3-1/2 threads in the metal, and the construction shall be such that a conduit bushing can be attached as intended. If threads for the connection of conduit are not tapped all the way through a hole in an enclosure wall, conduit hub, or the like, there shall be no less than five full threads in the metal and there shall be a smooth, well-rounded inlet hole for the conductors which shall afford protection to the conductors that has been determined to be equivalent to that provided by a standard conduit bushing, and which shall have an internal diameter approximately the same as that of the corresponding trade size of rigid conduit.

6.7 Separable conduit hubs and closure fittings shall be designed so that the combination will comply with the requirements in 6.3, 6.5 and 6.6.

6.8 An opening in metal for the passage of conductors (internal or field-installed) shall be such as to minimize inductive heating.

7 Mounting Posts and Pedestals

7.1 General

7.1.1 A metallic mounting post or pedestal shall not be less than 12 square inches (77 cm²) in cross section and 2-1/2 inches (63.5 mm) deep, and at least three sides shall be fabricated of galvanized steel no less than 0.070 inch (1.8 mm) thick.

Exception: The enclosure may be less than 2-1/2 inches deep, less than 12 square inches in cross-sectional area, or less than 0.070 inch thick steel, if the mounting post or pedestal is tested in accordance with 29.1 – 29.3 and 30.1 – 30.3, and if it is fabricated of galvanized steel not less than 0.056 inch (1.42 mm) thick or of a non-metallic material.

7.1.2 A non-metallic mounting post or pedestal shall be subjected to the torque deformation and beam loading deflection tests specified in 29.1 – 29.3 and 30.1 – 30.3.

7.1.3 That portion of a steel post located below grade level and up to 12 inches (305 mm) above grade level shall be painted on both the inside and outside surfaces in addition to being galvanized— Designation G90 or equivalent as covered in the Standard for Enclosures for Electrical Equipment, UL 50.

7.2 Cover

7.2.1 A cover or cap for a mounting post or pedestal shall be of metal not thinner than as required in 5.1.1 or other material rated for the purpose. A cover or cap fabricated from 0.056-inch (1.4-mm) thick steel may be any length if its width does not exceed 10 inches (254 mm).

Exception: A cover or cap provided on a mounting post or pedestal to close unused openings intended to accommodate a field-installed separable power outlet may be thinner than specified herein if the construction complies with the test described in 5.7.6.

7.3 Electrical connections

7.3 revised August 15, 2005

7.3.1 The distance between the marked final grade level of a mounting post as covered in 35.13 or the bottom of the base of a mounting pedestal and the lowest uninsulated live part, receptacle face, or splicing area shall not be less than 1 foot (305 mm) nor less than specified in 12.6 if applicable.

7.3.1 revised August 15, 2005

7.4 Wire opening

7.4.1 The opening provided in the base of a mounting post for the entrance of underground wiring shall be rolled, flanged, or equipped with a bushing so that there will be a smoothly rounded surface against which the cables can bear. The opening shall be at least 18 inches (457 mm) below the marked final grade level.

7.5 Bonding

7.5.1 Means shall be provided for bonding a metal raceway to a post or pedestal, and there shall be grounding continuity from the post to the power outlet.

7.6 Overlap

7.6.1 A power outlet intended for mounting on a separable mounting post or pedestal shall be provided with an opening having side extensions that will overlap the metal of the post or pedestal not less than 1 inch (25.4 mm). The two enclosures shall be secured at the overlap by not less than two screws on each side exceeding 4 inches (102 mm) in width and by not less than one screw on each side 4 inches or less in width.

7.7 Instructions

7.7.1 With respect to 1.7, a power outlet provided with a mounting post or pedestal shall be provided with instructions indicating the correct mounting procedure. A mounting post shall be provided with installation instructions in accordance with Mounting in Concrete, Section 37.

7.7.1 revised August 15, 2005

7.8 Pedestal

7.8.1 A mounting pedestal shall have mounting holes or similar provision in the base for securing the pedestal to a concrete slab. Aluminum in a pedestal enclosure shall not be in contact with the concrete mounting pad. A metallic or nonmetallic coating used to separate aluminum from a concrete pad shall be tested to demonstrate resistance to corrosion that has been determined to be equivalent to that of galvanized (G90 zinc coating) steel 0.061 inch (1.55 mm) thick.

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8 Wiring Devices

8.1 General

8.1.1 Not more than six No. 10 AWG (5.3 mm²) or smaller, four No. 6 AWG (13.3 mm²), or No. 8 AWG (8.4 mm²) insulated, stranded conductors shall be used to supply or ground components (switches, receptacles, circuit breakers, or the like) mounted on a panel that must be or is likely to be moved during installation or for making field connections. Only pressure wire-connector terminals or wire-binding screw terminals shall be used on components so mounted.

Exception: More than six but not more than ten No. 10 AWG or smaller conductors may be used to supply or ground components mounted on a panel or a hinged top of a pedestal if the conductors are bound together or otherwise caused to retract into the enclosure in an orderly fashion when the dead front is mounted in place or the top is closed.

8.2 Receptacles

8.2.1 A receptacle in a power outlet shall be a grounding type having a voltage rating appropriate for the voltage rating of the power outlet.

8.2.2 A grounding-type receptacle has:

- a) The grounding contact terminal identified by a green color and
- b) A single ampere and a single voltage rating.

8.2.3 A power outlet shall be limited in number and type of receptacles only as indicated in 8.2.4, Table 8.1, and Figure 8.1. References in the table and figure are to the Standard for Wiring Devices – Dimensional Requirements, ANSI/NEMA WD-6-1988.

Table 8.1
Required receptacle patterns

Revised Table 8.1 effective April 6, 2007 for the change to allow the use of Type TT-30R receptacles rated 30 A, 125 V for temporary site service equipment and mobile home service equipment, and the removal of footnote c for GFCI protection from Type TT-30R receptacles rated 30 A, 125 V and Type 14-50 receptacles rated 50 A, 125 - 250 V for recreational vehicle site supply equipment. The remainder of revised Table 8.1 effective August 15, 2007.

Power outlet or power outlet fitting marking ^a	Common general-purpose non-locking grounding type receptacle configurations (see Figure 8.1)					Common specific-purpose locking grounding type receptacle configurations (see Figure 8.2)			Common pin-and-sleeve type configurations (see Figure 8.3)
	5-15R ^b 15 A, 125 V	5-20R ^b 20 A, 125 V	TT-30R ^b 30 A, 125 V	14-50R ^b 50 A, 125 - 250 V	Other types	30 A, 125 V	50 A, 125 - 250 V	Other ratings	60 - 100 A, 125 - 250 V
No marking for service equipment	A	A	A	A	A	A	A	A	A
Temporary site service equipment	A ^c	A ^c	A	A ^c	A ^c	A ^c	A ^c	A ^c	A ^c
Mobile home service equipment	A ^c	A ^c	A	A ^e	A ^{c, e}	A ^e	A ^e	A ^{c, e}	A ^e

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Table 8.1 Continued on Next Page



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Table 8.1 Continued

Power outlet or power outlet fitting marking ^a	Common general-purpose non-locking grounding type receptacle configurations (see Figure 8.1)					Common specific-purpose locking grounding type receptacle configurations (see Figure 8.2)			Common pin-and-sleeve type configurations (see Figure 8.3)
	5-15R ^b 15 A, 125 V	5-20R ^b 20 A, 125 V	TT-30R ^b 30 A, 125 V	14-50R ^b 50 A, 125 – 250 V	Other types	30 A, 125 V	50 A, 125 – 250 V	Other ratings	60 – 100 A, 125 – 250 V
Recreational vehicle site supply equipment	A ^c	R ^{c, f}	R ^f	R ^{e, f}	A ^{c, e}	A	A ^e	A ^{c, e}	A ^e
Marina and boatyard service equipment; marina type equipment	A ^{c, g}	A ^{c, g}	N ^{d, g}	N ^{d, g}	A ^{c, g}	R ^h	R ^h	N	R ^h
Service equipment	N ⁱ	N ⁱ	N ⁱ	N ⁱ	N ⁱ	N ⁱ	N ⁱ	N ⁱ	N ⁱ

NOTE— The letter coding used in this table is defined as follows:

A – May be used; N – Shall not be used; R – Required to be used

^a When marked for any combination of services, the receptacles provided shall include those required for each use.

^b Receptacle pattern as specified in the Standard for Wiring Devices – Dimensional Specifications, ANSI/NEMA WD 6.

^c Ground-fault circuit protection for personnel shall be provided as specified in Ground-fault circuit protection for personnel, Section 8.5.

^d The receptacle patterns may be used if the power outlet is not restricted to use only as temporary site, mobile home, or marina and boatyard service equipment.

^e 125/240 volt receptacles are to be marked in accordance with 35.17.1.

^f A receptacle to supply electric power to a recreational vehicle shall be one of the three configurations noted with the letter code "R."

^g These receptacles shall be marked as described in 35.58 as not to be used to supply power to boats.

^h A receptacle to supply shore power to boats shall be rated not less than 30 A or more than 50 A and be of the locking and grounding type. Receptacles rated for 60 A or 100 A shall be of the pin and sleeve type.

ⁱ In accordance with 8.2.4, receptacles shall not be provided.

8.2.4 A power outlet marked "Suitable for use as service equipment" or "Suitable only for use as service equipment" but not marked for a specific type of service, such as mobile home, temporary site, or the like, shall not be provided with receptacles.

8.2.5 The ampere rating of a receptacle shall be no less than that of the overcurrent protection provided in the circuit in which it is used.

Exception: Two or more 15-ampere receptacles may be used on a 20-ampere circuit.

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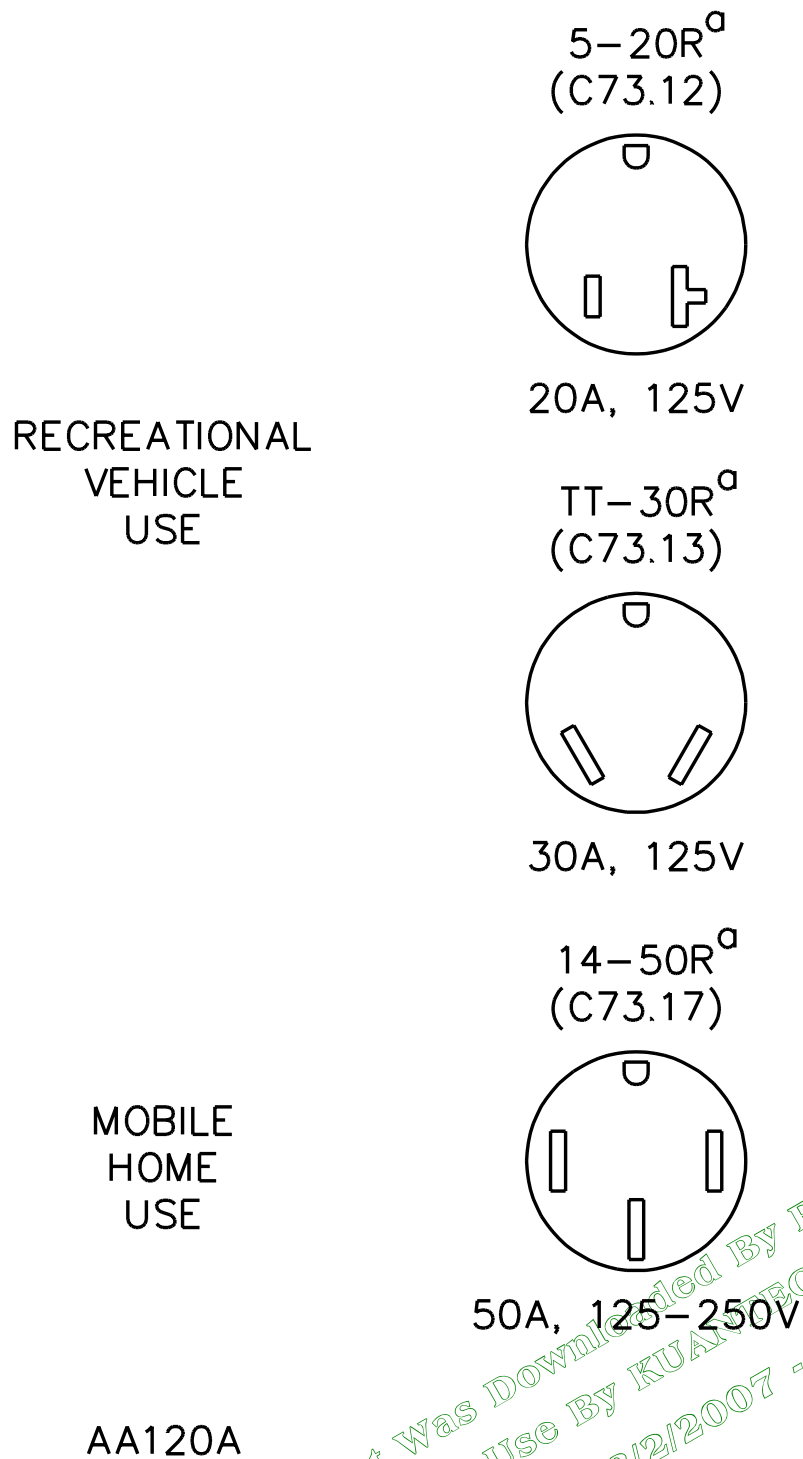
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Figure 8.1
Three American National Standard WD-6 receptacle patterns



^a Receptacle pattern as specified in the Standard for Wiring Devices - Dimensional Requirements, ANSI/NEMA WD-6-1988.