



UL 917

Underwriters Laboratories Inc. Standard for Safety

Clock-Operated Switches



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UL Standard for Safety for Clock-Operated Switches, UL 917

Fifth Edition, Dated November 10, 2006

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NOVEMBER 10, 2006

(Title Page Reprinted: October 7, 2009)

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UL 917

Standard for Clock-Operated Switches

First Edition – August, 1974

Second Edition – April, 1977

Third Edition – May, 1985

Fourth Edition – July, 1994

Fifth Edition

November 10, 2006

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INTRODUCTION

1 Scope

1.1 These requirements cover clock-operated switches rated 600 V or less, to be used in ordinary locations designed to close and open circuits to a load at predetermined intervals, and intended to be employed in accordance with the National Electrical Code, ANSI/NFPA 70.

1.2 These requirements cover only clock-operated switches in which the switching contacts are actuated by a clock-work, by a gear-train, by hand, by electrically-wound spring motors, by electric clock-type motors, or by equivalent arrangements. In addition to closing and opening the switching contacts, the devices may also indicate the time of day or time interval.

1.3 These requirements do not cover devices incorporating electronic timing circuits or switching circuits without separable contacts.

1.4 A clock-operated switch, which is incomplete in construction features or restricted in performance capabilities, is acceptable for use as a factory-installed component provided that the restrictions established for the component are eliminated when the component is installed.

1.5 Specific provisions are included in these requirements for TV rated clock-operated switches.

1.6 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 as determined necessary to maintain the acceptable level of safety as originally anticipated by the intent of this Standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this Standard cannot be judged to comply with this Standard. Where considered appropriate, revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this Standard.

2 Glossary

2.1 For the purpose of this standard the following definitions apply.

2.2 ACCESSIBLE PART – A part so located that it can be contacted by a person, either directly or by means of a probe or tool.

2.3 LEAKAGE CURRENT – Leakage current refers to all currents, including capacitively coupled currents, that may be conveyed between exposed conductive surfaces of an appliance and ground or other exposed conductive surfaces of a device.

2.4 LIVE PARTS – Denotes metal or other conductive parts that have a potential difference with respect to ground or any other conductive part in intended use.

2.5 LOW-VOLTAGE CIRCUIT – A circuit classified as low voltage is one involving a potential of not more than 42.4 V peak (30 V rms) and supplied by a primary battery, by a standard Class 2 transformer, or by a combination of a transformer and a fixed impedance, which, as a unit, complies with all the performance requirements for a Class 2 transformer.

2.6 OPERATING CONTROL – A control, usually a knob, push button, or lever, provided to enable the user to cause the device to perform its intended function, without the use of tools, when the device is in the operating condition.

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2.7 PERMANENTLY CONNECTED – Denotes connection to a supply circuit by way of fixed electrical conductors.

2.8 PILOT DUTY – An application involving the control of an electromagnet.

2.9 PLUG-IN DEVICE – A device provided with integral blades for direct insertion into a receptacle.

2.10 RAINPROOF – So constructed, protected, or treated as to prevent rain from interfering with successful operation of the device under specified test conditions.

2.11 SWITCH – Usage of the word switch without further qualification signifies a clock-operated switch in subsequent paragraphs of this standard.

3 Components

3.1 Except as indicated in 3.2, a component of a product covered by this standard shall comply with the requirements for that component.

3.2 A component need not comply with a specific requirement that:

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

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

3.4 Specific components are recognized as being 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 restricted to use only under those specific conditions for which they have been recognized.

4 Units of Measurement

4.1 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.

5 References

5.1 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.

CONSTRUCTION

6 Frame and Enclosure

6.1 General

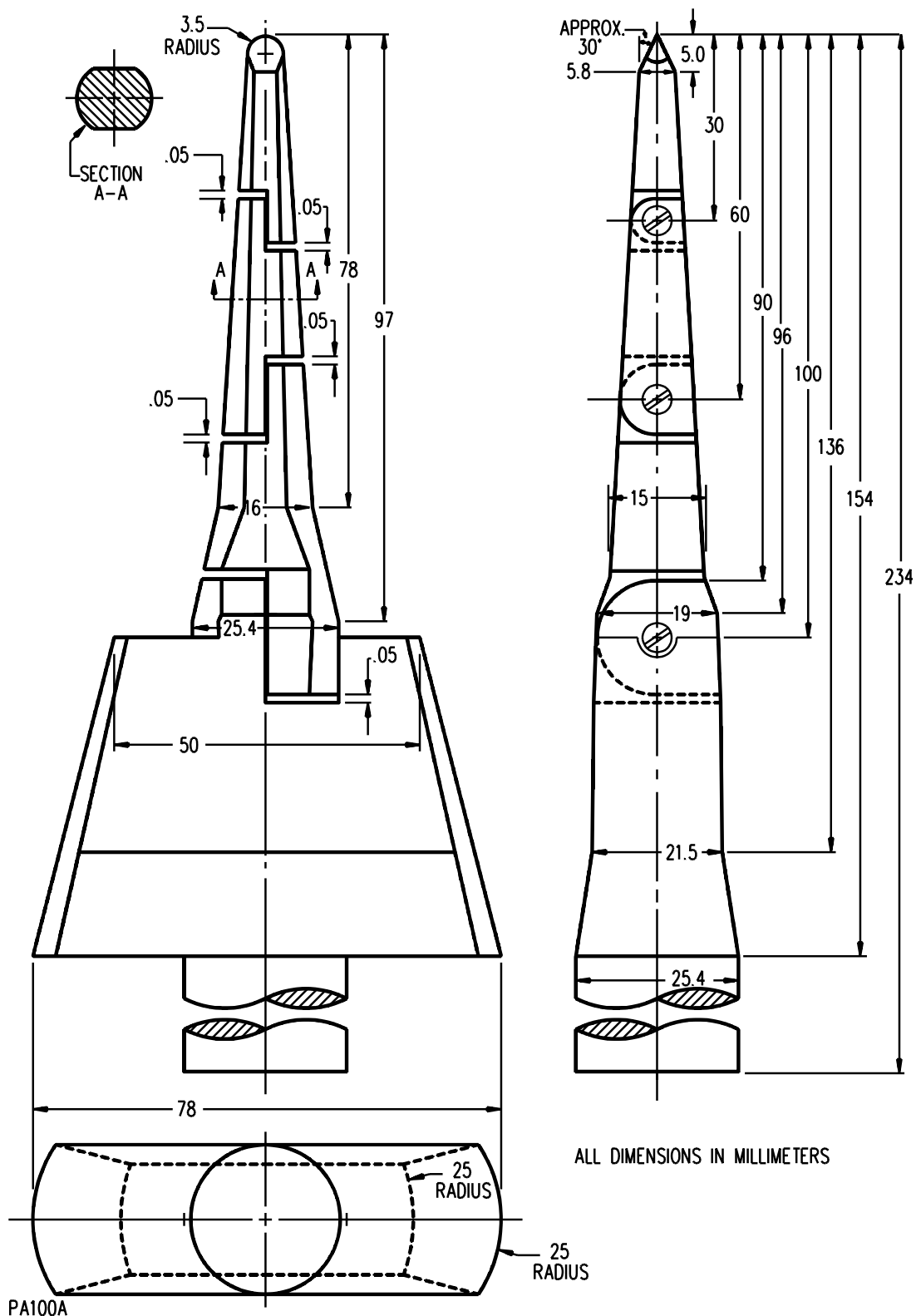
6.1.1 The frame and enclosure shall be strong and rigid to resist the abuses likely to be encountered during service. The degree of structural integrity inherent in the unit shall preclude total or partial collapse with the attendant reduction of spacings, loosening or displacement of parts, and other serious defects that alone or in combination constitute an increase in the risk of fire, electric shock, or injury to persons.

6.1.2 Electrical parts of a clock-operated switch shall be located or enclosed to reduce the risk of unintentional contact with an uninsulated live part. For the purpose of these requirements, film-coated wire is considered to be an uninsulated live part.

Exception: An enclosure is not required for a device intended for assembly as part of another device.

6.1.3 An opening in an enclosure or a clock-operated switch is acceptable if an accessibility probe as illustrated in Figure 6.1, when inserted into the opening, cannot be made to touch any part that involves the risk of electric shock to the end-user or service personnel. However, in no case shall the opening be large enough to permit the entrance of a 1 inch (25.4 mm) diameter rod.

Figure 6.1
Accessibility probe



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6.1.4 The accessibility probe shall be articulated into any configuration and shall be rotated or angled to any position before, during, or after insertion into the opening, and the penetration shall be to any depth allowed by the opening size, including minimal depth combined with maximum articulation.

6.1.5 If any part of the enclosure must be opened or removed as part of normal operation, regular adjustment, or regular or required maintenance (set point adjustment, timer or time of day clock adjustment, battery replacement, and the like) with or without the use of tools, or can be opened or removed without the use of tools, the accessibility probe is to be applied without the part in place.

Exception: An enclosure employing a snap-on cover as indicated in 6.5.2 need not comply with this requirement.

6.1.6 Moving parts of a switch such as rotors of motors, clock works, or gear trains, shall be located or enclosed to reduce the risk of injury to persons.

6.1.7 If a marking draws attention of the user to a hole of any size in the enclosure for an adjustment, it shall not be possible to damage insulation or film-coated wire, or contact uninsulated live parts through the hole with a 1/16-inch-diameter (1.6 mm) rod.

6.2 Nonmetallic

6.2.1 Among the factors that are taken into consideration in determining the acceptability of a nonmetallic enclosure or frame or an enclosure or frame of magnesium are:

- a) Mechanical strength
- b) Resistance to impact
- c) Moisture-absorptive properties
- d) Combustibility
- e) Resistance to arcing
- f) Resistance to temperatures to which the material might be subjected under conditions of normal or abnormal use.
- g) Aging characteristics

6.2.2 A nonmetallic enclosure as indicated in 6.2.1 shall withstand a single impact of 5 ft-lbf (6.8 J) as described in 33.1 without introducing a risk of fire, electric shock, or injury to persons.

6.3 Cast metal

6.3.1 Cast metal for an enclosure shall be at least 1/8 inch (3.2 mm) thick at every point, of greater thickness at reinforcing ribs and door edges, and not less than 1/4 inch (6.4 mm) thick at tapped holes for conduit; except that, other than at plain or threaded conduit holes, die-cast metal shall not be less than 3/32 inch (2.4 mm) thick for an area greater than 24 in² (0.0155 m²) or having any dimension greater than 6 inch (152 mm) and shall not be less than 1/16 inch (1.6 mm) thick for an area of 24 in² or less and having no dimensions greater than 6 inch. The area limitation for metal 1/16 inch thick may be obtained by the provision of reinforcing ribs subdividing a larger area.

6.3.2 A knockout in a die-cast metal enclosure for conduit connection of 1 inch trade size or smaller conduit, shall not be less than 1/16 inch (1.6 mm) thick and the narrow section around the periphery that is reduced in thickness for ease in breaking out shall not be less than 0.020 inch (0.51 mm) thick.

6.3.3 Consideration is to be given to the number of such knockouts required to connect the device in the manner intended. The number of knockouts provided is not to affect the structural integrity or result in unused openings.

6.4 Sheet metal

6.4.1 The thickness of a sheet-metal enclosure shall be as indicated in Tables 6.1 and 6.2 except that steel shall not be less than 0.032 inch (0.81 mm) thick – 0.034 inch (0.86 mm) if zinc coated – and nonferrous metal shall not be less than 0.045 inch (1.14 mm) thick at points where a wiring system is to be connected in the field.

6.4.2 Tables 6.1 and 6.2 are based on a uniform deflection of the enclosure surface for any given load concentrated at the center of the surface regardless of metal thickness.

Table 6.1
Minimum thickness of sheet metal for enclosures carbon steel or stainless steel

Without supporting frame ^a		Without supporting frame or equivalent reinforcing ^a				Minimum thickness in inches (mm)			
Maximum width ^b		Maximum length ^c		Maximum width ^b		Maximum length ^c			
inches	(cm)	inches	(cm)	inches	(cm)	inches	(cm)	Uncoated	Zinc coated
4.0	(10.2)	Not limited		6.25	(15.9)	Not limited		0.020 ^d	(0.51) ^d
4.75	(12.1)	5.75	(14.6)	6.75	(17.1)	8.25	(21.0)	0.023 ^d	(0.58) ^d
6.0	(15.2)	Not limited		9.5	(24.1)	Not limited		0.026 ^d	(0.66) ^d
7.0	(17.8)	8.75	(22.2)	10.0	(25.4)	12.5	(31.8)	0.029 ^d	(0.74) ^d
8.0	(20.3)	Not limited		12.0	(30.5)	Not limited		0.032	(0.81)
9.0	(22.9)	11.5	(29.2)	13.0	(33.0)	16.0	(40.6)	0.034	(0.86)
12.5	(31.8)	Not limited		19.5	(49.5)	Not limited		0.042	(1.07)
14.0	(35.6)	18.0	(45.7)	21.0	(53.3)	25.0	(63.5)	0.045	(1.14)
18.0	(45.7)	Not limited		27.0	(68.6)	Not limited		0.053	(1.35)
20.0	(50.8)	25.0	(63.5)	29.0	(73.7)	36.0	(91.4)	0.056	(1.42)
22.0	(55.9)	Not limited		33.0	(83.8)	Not limited		0.060	(1.52)
25.0	(63.5)	31.0	(78.7)	35.0	(88.9)	43.0	(109.2)	0.063	(1.60)
25.0	(63.5)	Not limited		39.0	(99.1)	Not limited		0.067	(1.70)
29.0	(73.7)	36.0	(91.4)	41.0	(104.1)	51.0	(129.5)	0.070	(1.78)

Table 6.1 Continued

Without supporting frame ^a		Without supporting frame or equivalent reinforcing ^a		Minimum thickness in inches (mm)	
Maximum width ^b	Maximum length ^c	Maximum width ^b	Maximum length	Uncoated	Zinc coated
inches (cm)	inches (cm)	inches (cm)	inches (cm)		
^a See 6.4.3.					
^b The width is the smaller dimension of a rectangular piece of sheet metal that is part of an enclosure. Adjacent surfaces of an enclosure may have supports in common and be made of a single sheet.					
^c For panels that are not supported along one side, for example, side panels of boxes, the length of the unsupported side shall be limited to the dimensions specified.					
^d Sheet steel for an enclosure intended for outdoor use (rainproof) shall not be less than 0.034 inch (0.86 mm) thick if zinc coated and not less than 0.032 inch (0.81 mm) thick if uncoated.					

Table 6.2
Minimum thickness of sheet metal for enclosures aluminum, copper, or brass

Without supporting frame ^a		Without support frame or equivalent reinforcing ^a							
Maximum width ^b		Maximum length ^c		Maximum width ^b		Maximum length		Minimum thickness	
inches	(cm)	inches	(cm)	inches	(cm)	inches	(cm)	inches	(mm)
3.0	(7.6)	Not limited		7.0	(17.8)	Not limited		0.23 ^d	(0.58) ^d
3.5	(8.9)	4.0	(10.2)	8.5	(21.6)	9.5	(24.1)		
4.0	(10.2)	Not limited		10.0	(25.4)	Not limited		0.029 ^d	(0.74)
5.0	(12.7)	6.0	(15.2)	10.5	(26.7)	13.5	(34.3)		
6.0	(15.2)	Not limited		14.0	(35.6)	Not limited		0.036	(0.91)
6.5	(16.5)	8.0	(20.3)	15.0	(38.1)	18.0	(45.7)		
8.0	(20.3)	Not limited		19.0	(48.3)	Not limited		0.045	(1.14)
9.5	(24.1)	11.5	(29.2)	21.0	(53.3)	25.0	(63.5)		
12.0	(30.5)	Not limited		28.0	(71.1)	Not limited		0.058	(1.47)
14.0	(35.6)	16.0	(40.6)	30.0	(76.2)	37.0	(94.0)		
18.0	(45.7)	Not limited		42.0	(106.7)	Not limited		0.075	(1.91)
20.0	(50.8)	25.0	(63.5)	45.0	(114.3)	55.0	(139.7)		
25.0	(63.5)	Not limited		60.0	(152.4)	Not limited		0.095	(2.41)
29.0	(73.7)	36.0	(91.4)	64.0	(162.6)	78.0	(198.1)		

^a See 6.4.3.

^b The width is the smaller dimension of a rectangular piece of sheet metal that is part of an enclosure. Adjacent surfaces may have supports in common and be made of a single sheet.

^c For panels that are not supported along one side, for example, side panels of boxes, the length of the unsupported side shall be limited to the dimensions specified.

^d Sheet copper, brass, or aluminum for an enclosure intended for outdoor use (rainproof) shall not be less than 0.029 inch thick (0.74 mm).

6.4.3 With reference to Tables 6.1 and 6.2, a supporting frame is a structure of angle or channel or a folded rigid section of sheet metal that is rigidly attached to and has essentially the same outside dimensions as the enclosure surface and that has flexural rigidity to resist the bending moments that may be applied by the enclosure surface when it is deflected. Construction that is considered to have equivalent reinforcing may be accomplished by designs that will produce a structure that is as rigid as one built with a frame of angles or channels. Constructions considered to be without supporting frame include:

- a) A single sheet with single formed flanges (formed edges),
- b) A single sheet that is corrugated or ribbed, or
- c) An enclosure surface loosely attached to a frame, for example, with spring clips.

6.4.4 A part such as a knob, lever, or dial that is being depended upon to obtain compliance with 6.1.1 or 6.1.5 shall be of metal or other material as specified for the enclosure in 6.2.1, 6.3.1, and 6.4.1.

6.5 Covers

6.5.1 The enclosure and parts of the enclosure such as doors, covers, and the like shall be provided with means for securing them in place.

6.5.2 A snap-on cover that gives access to uninsulated live parts and does not have a separate tool-operated fastener shall not have any apparent means of removal, such as an extending tab, and shall withstand the tests described in Snap-On Cover Tests, Section 38.

6.5.3 An enclosure cover shall be hinged if it gives access to fuses, thermal cutouts, or any other overload protective device, the normal functioning of which requires renewal.

6.5.4 A hinged cover shall not depend solely upon screws or other similar means requiring the use of a tool to hold it closed, but shall be provided with a spring latch or catch or other hand operable cover securing means.

6.5.5 A door or cover giving access to fuses or thermal cutouts in other than low-voltage circuits shall shut closely against a 1/4 inch (6.4 mm) rabbet or the equivalent, or shall have either turned flanges for the full length of four edges or angle strips fastened to it. Flanges or angle strips shall fit closely with the outside of the walls of the box proper and shall overlap the edges of the box not less than 1/2 inch (12.7 mm). A special construction that affords equivalent protection or a combination of flange and rabbet is acceptable.

6.5.6 Strips used to provide rabbets or angle strips fastened to the edges of a door shall be secured at not less than two points, not more than 1-1/2 inch (38.1 mm) from each end of each strip and at points between these end fastenings not more than 6 inch (152 mm) apart.

6.6 Openings

6.6.1 An opening shall not be provided in an enclosure that houses a fuse or any portion of a circuit breaker other than the operating handle, unless the construction affords containment of electrical fault disturbances equivalent to that provided by an enclosure complying with the requirements in 6.5.4 – 6.5.6.

6.6.2 The following requirements apply to openings:

a) An opening shall not be provided in a compartment or part of an enclosure that contains field-wiring splices in a line-voltage circuit.

b) No openings shall be located in the mounting surface of an enclosure.

Exception: The following openings may be located in the mounting surface of an enclosure:

1) A mounting opening.

2) A maximum of four openings provided for the escape of air or paint during a painting process. The maximum dimension of such an opening shall not exceed 1/8 inch (3.2 mm).

3) A maximum of four unused holes provided for mounting of internal components. The maximum dimension of such an opening shall not exceed 3/16 inch (4.8 mm).

c) If the bottom surface is not the mounting surface, an opening may be provided in the bottom surface of an enclosure if the opening does not permit materials to fall out from the interior of the unit. See Figure 6.2 for an example of a construction complying with this requirement.

d) The shortest distance between an opening and the bottom of an enclosure or a wall-mounting surface shall be at least one-quarter of the enclosure height or depth, respectively, or 1 inch (25.4 mm), whichever is less.

e) Air from an opening, either forced or otherwise, shall not be directed:

1) Into a duct or into a concealed space in a building,

2) Against the mounting surface, or

3) So that a disturbance would be propagated to other equipment.

f) Not more than four holes for mounting an enclosure having a maximum dimension of 18 inches (457 mm); six holes for an enclosure with a maximum dimension of more than 18 inches, but less than 48 inches (1.2 mm); eight holes for an enclosure with a maximum dimension of 48 inches or more. Four of the holes for mounting an enclosure with a maximum dimension of 12 inches (305 mm) may be keyhole slots having the configuration illustrated in Figure 6.3. The dimensions shown in Figure 6.3 may vary if the area is equivalent. Four of the holes for mounting a larger enclosure may be keyhole slots, the dimensions of which are not specified, and which shall be judged with regard to the enclosure dimensions and configuration.

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Figure 6.2
Bottom panel baffles

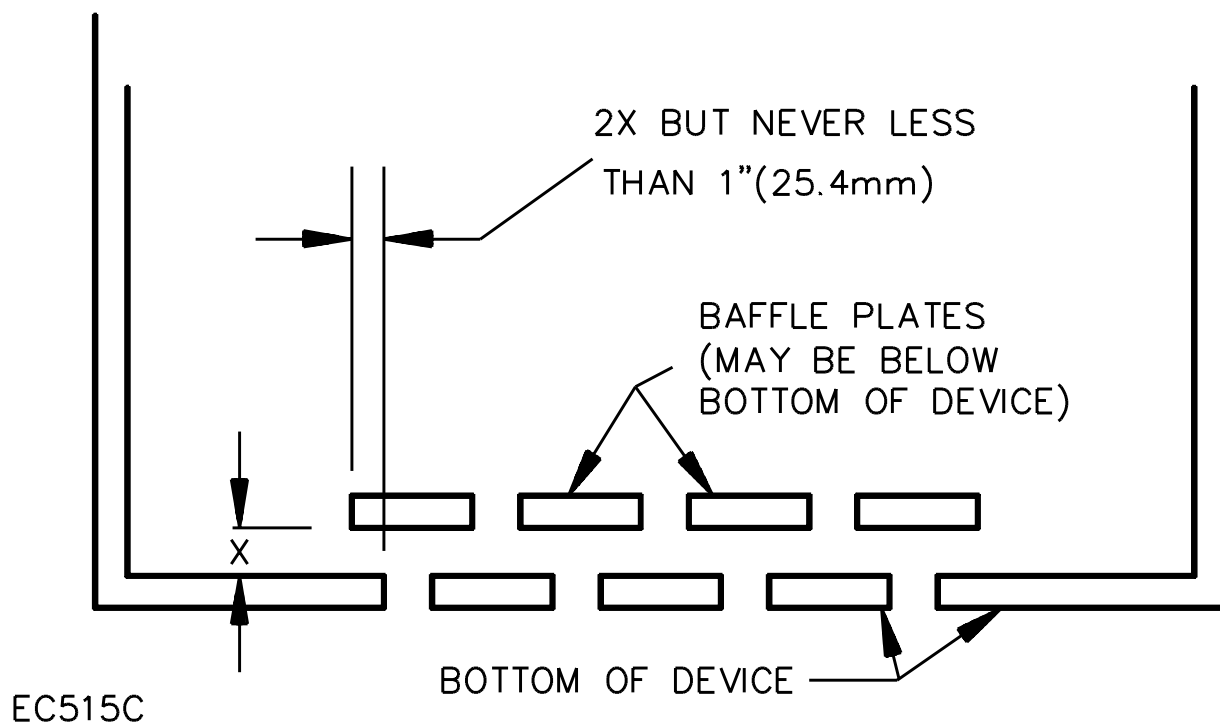
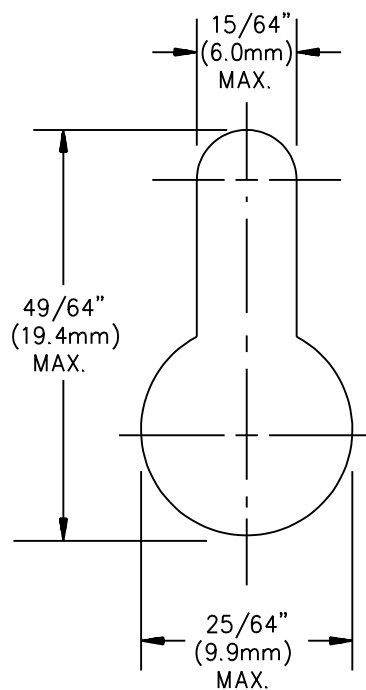


Figure 6.3
Keyhole slot



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6.6.3 The smaller dimension (width) of an opening in an enclosure around a dial, adjusting knob, lever, handle, pointer, or the like shall not be more than 1/8 inch (3.2 mm) for any setting or position of the dial, knob, and the like.

6.7 Screens and expanded metal

6.7.1 The wires of a screen shall not be less than No. 16 AWG (1.3 mm²) for screen openings 1/2 square inch (3.23 cm²) or less in area, and shall not be less than No. 12 AWG (3.3 m²) for larger screen openings.

6.7.2 Perforated sheet steel and sheet steel used for expanded metal mesh shall not be less than 0.042 inch (1.07 mm) thick – 0.045 inch (1.14 mm) if zinc coated – for mesh openings or perforations 1/2 square inch (3.23 cm²) or less in area and shall not be less than 0.080 inch (2.03 mm) thick – 0.084 inch (2.13 mm) if zinc coated – for larger openings.

Exception: Expanded metal mesh that complies with the requirements in 6.7.3 may be used.

6.7.3 In a small device where the indentation of a guard or enclosure will not alter the clearance between uninsulated, moveable, current-carrying parts and grounded metal so as to adversely affect performance or reduce spacings below the minimum values specified in Table 22.1, 0.020 inch (0.51 mm) expanded metal mesh – 0.023 inch (0.58 mm) if zinc-coated– may be used, if:

- a) The exposed mesh on any one side or surface of the device so protected has an area of not more than 72 square inches (464.5 cm²) and has no dimension greater than 12 inches (305 mm), or
- b) The width of an opening so protected is not greater than 3-1/2 inches (88.9 mm).

6.8 Conduit openings

6.8.1 If threads for the connection of conduit are tapped all the way through a hole in an enclosure wall, or if an equivalent construction is used, there shall not be less than 3 threads in the metal, and the construction of the control shall be such that a conduit bushing can be attached as intended.

6.8.2 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 not be less than 3-1/2 threads in the metal and there shall be a smooth, rounded inlet hole for the conductors that affords protection to the conductors equivalent to that provided by a standard conduit bushing and that has an internal diameter approximately the same as that of the corresponding trade size of rigid conduit.

6.8.3 In an enclosure threaded for support by rigid conduit, at least 5 full threads shall be provided for engaging the conduit.