

UL 639

ISBN 0-7629-0088-1

Intrusion-Detection Units

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UL Standard for Safety for Intrusion-Detection Units, UL 639

Seventh Edition, Dated February 21, 1997

Revisions: This Standard contains revisions through and including April 2, 2007.

Summary of Topics

Revision pages have been issued to delete the ANSI approval information from the title page.

Announcement Bulletin(s): This Standard contains the announcement bulletin(s) dated August 8, 2002. The announcement bulletin is located at the end of the Standard.

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The revisions dated April 2, 2007 include a reprinted title page (page1) for this Standard.

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New product submittals made prior to a specified future effective date will be judged under all of the requirements in this Standard including those requirements with a specified future effective date, unless the applicant specifically requests that the product be judged under the current requirements. However, if the applicant elects this option, it should be noted that compliance with all the requirements in this Standard will be required as a condition of continued Listing and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

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5-8.....	September 30, 2002
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UL 639

Standard for Intrusion-Detection Units

First Edition – April, 1964
Second Edition – October, 1969
Third Edition – December, 1971
Fourth Edition – September, 1978
Fifth Edition – September, 1986
Sixth Edition – July, 1993

Seventh Edition

February 21, 1997

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

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APPENDIX A

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INTRODUCTION

1 Scope

1.1 These requirements cover intrusion-detection units intended to be used in burglary-protection signaling systems. These units are intended to be used in indoor or outdoor locations to automatically indicate the presence of an intruder by actuating electrical control circuits.

1.2 An intrusion detector, as covered by these requirements, consists of one or more unit assemblies of electrical components that are designed to detect the presence, movement, sound or other activity of an intruder. Provision is made for connection to the assembly of power supply, remote control, and signal circuits by a prescribed method of wiring.

1.3 Intrusion-detection units covered by these requirements are intended to be installed in accordance with the Standard for Installation and Classification of Burglar and Holdup Alarm Systems, UL 681.

1.4 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 or of electric shock or injury to persons shall be evaluated using appropriate additional component and end-product requirements to maintain the 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 does not comply with this standard. Revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this standard.

1.4 revised September 30, 2002

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 used in the products covered by this standard.

2.1.1 revised September 30, 2002

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.

2.1.2 revised September 30, 2002

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

2.1.3 revised September 30, 2002

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.

2.1.4 revised September 30, 2002

2.2 Units of measurement

2.2.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

2.2.1 revised September 30, 2002

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.

2.4 Terminology

2.4.1 The term "product" as used in these requirements refers to all types of household burglar-alarm system units.

2.4.2 Unless otherwise indicated, all voltage and current values in this standard are rms.

3 Glossary

3.1 For the purpose of these requirements, the following definitions apply.

3.2 CIRCUITS, ELECTRICAL –

a) High-Voltage (Class 1) – A circuit involving a potential of not more than 600 volts and having circuit characteristics in excess of those of a low-voltage power-limited circuit.

b) Low-Voltage – A circuit involving a potential of not more than 30 volts AC rms, 42.4 volts peak or direct current (DC).

c) Power-Limited – A circuit wherein the power and current are limited as specified in Power-Limited Circuits, Section 26.

d) Class 2 – A circuit in which the voltage and power limitations are in accordance with the requirements of Table 26.1 for AC circuits and Table 26.2 for DC circuits.

e) Class 3 – A circuit in which the voltage and power limitations are in accordance with the requirements of Table 26.1 for AC circuits and Table 26.2 for DC circuits.

3.2 effective April 1, 1998

3.3 CORD-CONNECTED UNIT – A unit intended for connection to the power source by means of a supply cord. Such a unit is intended to be moved for reasons of interchange or realignment of the units of a system.

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3.4 FIXED EQUIPMENT – A product intended to be permanently connected electrically.

3.5 LINE VOLTAGE – The voltage at any field-connected source of supply, nominally 50 – 60 hertz; 115, 208, or 230 volts.

3.6 PORTABLE EQUIPMENT – A cord- and plug-connected product that is capable of being carried or moved about.

3.7 PRIMARY BATTERY – A battery that is not intended to be recharged.

3.8 RADIO FREQUENCY – All frequencies above 20 kilohertz.

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3.9 SAFETY CIRCUIT – Any circuit that is relied upon to reduce the risk of fire, electric shock, or unintentional contact with moving parts that may cause injury to persons (an interlock circuit, for example).

3.10 SECONDARY BATTERY – A battery that is intended to be recharged.

3.11 STANDBY CONDITION – The ready-to-operate condition of the product existing prior to being tripped or operated by an intrusion.

3.12 STATIONARY EQUIPMENT – A cord- and plug-connected product that is intended to be fastened in place or located in a dedicated space.

4 Instructions and Drawings

4.1 A copy of the installation and operating instructions intended to accompany the product, related schematic wiring diagrams, and installation drawings is to be furnished with the sample submitted for investigation and is to be used as a guide in the examination and test of the product. For this purpose, a final printed edition is not required. The information may be included in a manual.

4.2 The instructions and drawings shall include such directions and information as considered by the manufacturer to be necessary to accomplish the intended installation, maintenance, and operation of the product.

CONSTRUCTION – ALL UNITS

ASSEMBLY

5 General

5.1 Unless specifically indicated otherwise, the construction requirements specified for a product shall also apply for any remote accessories with which it is to be employed.

6 Test Features

6.1 If provision is made for testing the operability, battery condition, or proximity to alarm of an intrusion-detection unit, the means provided shall be durable, practical, and shall not result in a risk of injury to the personnel involved.

6.2 The test means shall be constructed and located so that unauthorized personnel can not defeat the system.

6.3 The requirements specified in 6.1 and 6.2 do not apply to a photoelectric unit.

7 Enclosure

7.1 General

7.1.1 The frame and enclosure of the product shall have the strength and rigidity to resist total or partial collapse, with the attendant reduction of spacings, loosening or displacement of parts, or other defects. See the Mechanical Strength Tests for Enclosures, Section 54.

7.1.2 An electrical part of a product shall be located or enclosed to provide protection against unintentional contact with uninsulated high-voltage live parts.

7.1.3 An operating part, such as a gear mechanism, light-duty relay, or similar device, shall be enclosed to reduce the risk of malfunction from dust or from other material that may impair its intended operation. See the Dust Test, Section 58.

7.1.4 The mounting means of an enclosure shall be accessible without disassembly of any operating part of the product. Removal of a completely assembled panel to mount the enclosure is not considered to be disassembly of an operating part.

7.1.5 An enclosure for other than power-limited circuits shall be constructed to reduce the risk of emission of flame, molten metal, flaming or glowing particles, or flaming drops. See the Abnormal Operation Test, Section 44, and the Ignition Through Bottom-Panel Openings Test, Section 53.

7.1.6 The requirement in 7.1.5 necessitates either a nonflammable bottom in accordance with 7.1.11, or a protective barrier as described in Figure 7.1 under all areas containing flammable materials.

Exception: See 7.1.12.

7.1.7 A construction using individual barriers under a component or group of components or assemblies, as specified in Figure 7.1 is to be considered as complying with the requirement in 7.1.5.

7.1.8 An opening directly over an uninsulated high-voltage live part shall not exceed 0.187 inch (4.75 mm) in any dimension unless the configuration is such that direct entry to uninsulated high-voltage live parts is prevented. See Figure 7.2 for examples of top cover designs and Figure 7.3 for side openings that may be used to prevent direct entry. See also 7.1.9.

7.1.9 An opening in the enclosure that will not permit entrance of a 1-inch (25.4-mm) diameter rod shall be sized and so arranged that a probe, as illustrated in Figure 7.4, cannot be made to contact any uninsulated live electrical part (other than low-voltage) when inserted through the opening in a straight or articulated position.

7.1.10 An opening that permits entrance of a 1-inch (25.4-mm) diameter rod may be used under the conditions described in Figure 7.5.

7.1.11 Openings may be provided in the bottom panels or protective pans under areas containing materials not classified as V-1, in accordance with the Standard for Tests for Flammability of Plastic Materials for Use in Devices and Appliances, UL 94, if constructed in a manner that prevents materials from falling directly from the interior of the product onto the supporting surface or any other location under the product. Figure 7.6 illustrates a type of baffle that complies with this requirement. A second construction that complies with this requirement is a 0.040-inch (1.02-mm) sheet-steel bottom-panel in which are 5/64 inch (2.0-mm) maximum, round holes not closer together than 1/8 inch (3.2 mm) center-to-center. Constructions other than these two may be used if they comply with the Ignition Through Bottom-Panel Openings Test, Section 53.

7.1.11 revised March 29, 1999

7.1.12 The bottom of the enclosure under areas containing only materials classified as V-0 or better may have openings not larger than 1/16 square inch (40.3 mm²).

7.1.12 revised March 29, 1999

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7.1.13 An opening, without limitation as to size or number of openings, may be used in areas containing only PVC, TFE, CTFE, FEP, and neoprene insulated wire cable, in areas containing plugs and receptacles, and in areas underneath impedance or thermally-protected motors.

7.1.14 An opening in the enclosure shall not give access to a relay, terminal, control, or related component that might be subject to tampering by hand or with hand tools, wires, hooks, and the like.

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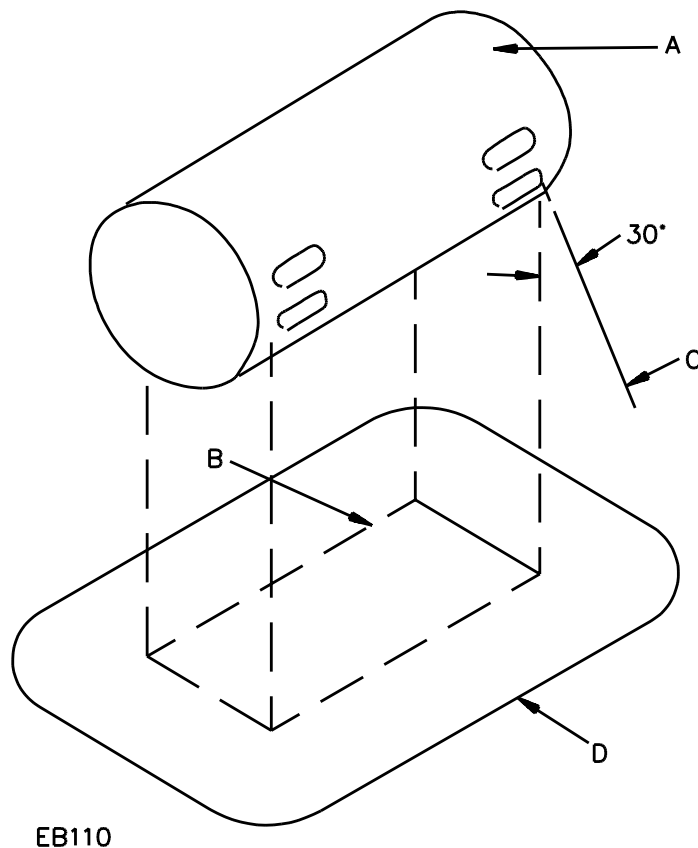


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Figure 7.1
Protective barrier

Figure 7.1 revised March 29, 1999



NOTES

1) The entire component under which a barrier (flat or dished with or without a lip or other raised edge) of nonflammable material is to be provided. The sketch above is a metal enclosed component with ventilating openings to show that the protective barrier is required only for those openings from which flaming parts might come. If the component or assembly does not have its own nonflammable enclosure, the area to be protected would be the entire area occupied by the component or assembly.

2) Projection of the outline of the area of (A) which needs a bottom barrier vertically downward onto the horizontal plane of the lowest point on the outer edge (D) of the barrier.

3) Inclined line that traces out an area (D) on the horizontal plane of the barrier. Moving around the perimeter of the area (B) which needs a bottom barrier, this line projects at a 30-degree angle from the line extending vertically at every point around the perimeter of (A) and oriented to trace out the largest area, except that the angle may be less than 30 degrees if the barrier or portion of the bottom cover contacts a vertical barrier or side panel of nonflammable material, or if the horizontal extension of the barrier (B) to (D) would exceed 6 inches (152 mm).

4) Minimum outline of the barrier, except that the extension B to D need not exceed 6 inches (152 mm) (flat or dished with or without lip or other raised edge). The bottom of the barrier may be flat or formed in any manner provided that every point of area (D) is at or below the lowest point on the outer edge of the barrier.

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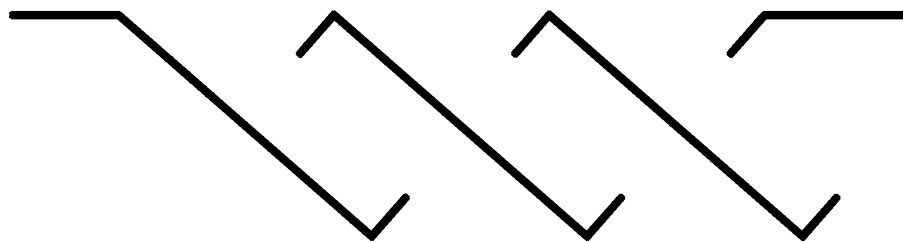


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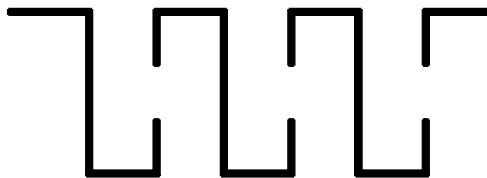
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Figure 7.2
Top panel louver designs

Figure 7.2 revised March 29, 1999



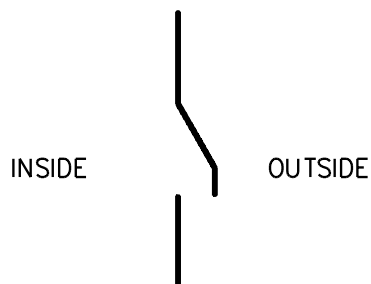
SLANTED OPENINGS



EC500

VERTICAL OPENINGS

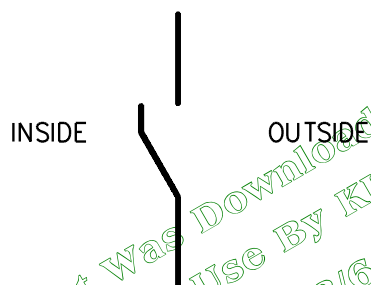
Figure 7.3
Side panel louver designs



INSIDE

OUTSIDE

OUTWARD PROJECTION



INSIDE

OUTSIDE

EC510

INWARD PROJECTION

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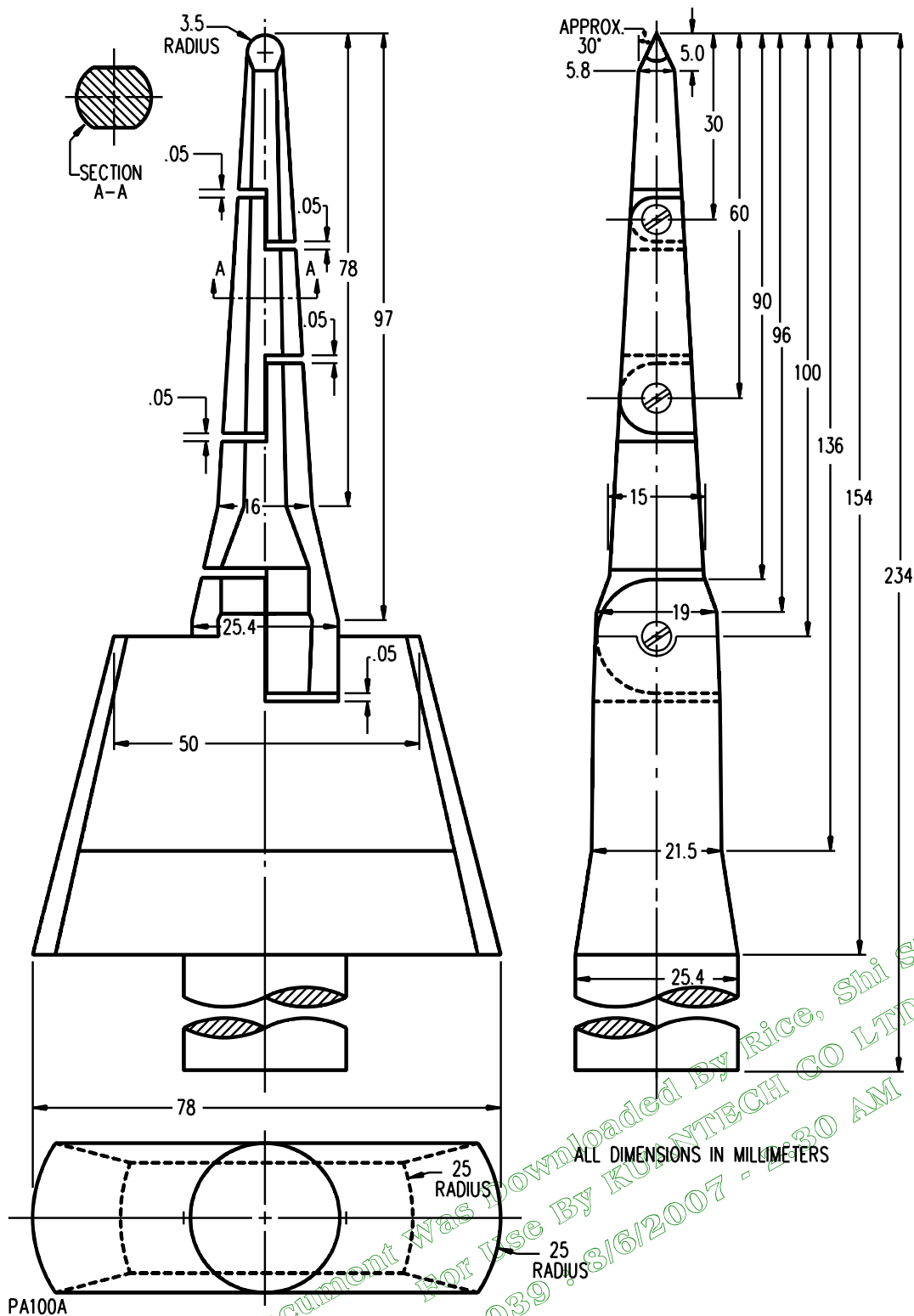


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Figure 7.4
Accessibility probe

Figure 7.4 revised March 29, 1999



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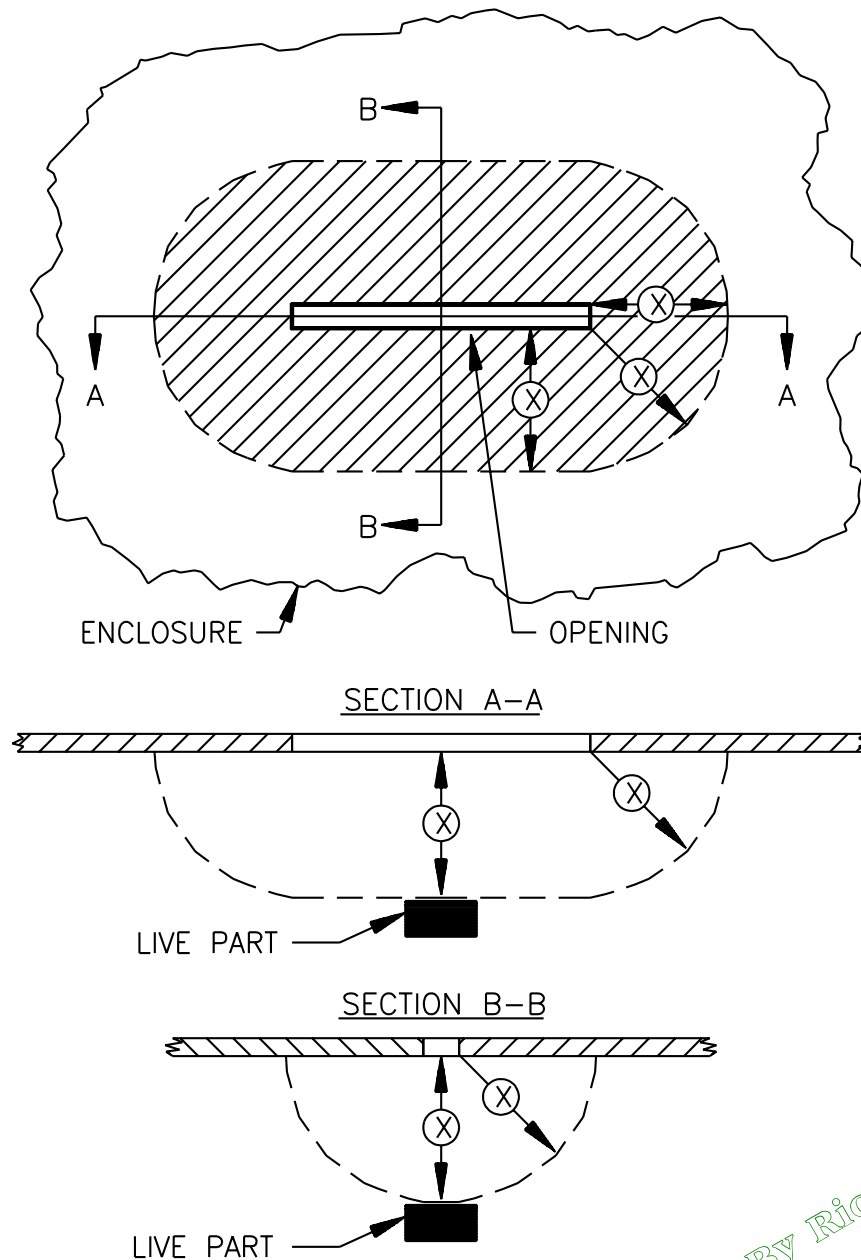


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Figure 7.5
Opening in enclosure

Figure 7.5 revised March 29, 1999



EC100A

NOTE – The opening may be used if, within the enclosure, there is no uninsulated live part or enamel-insulated wire less than X inches (mm) from the perimeter of the opening, as well as within the volume generated by projecting the perimeter X inches (mm) normal to its plane. X equals five times the diameter of the largest diameter rod that can be inserted through the opening, but not less than 6-1/16 inches (154 mm).

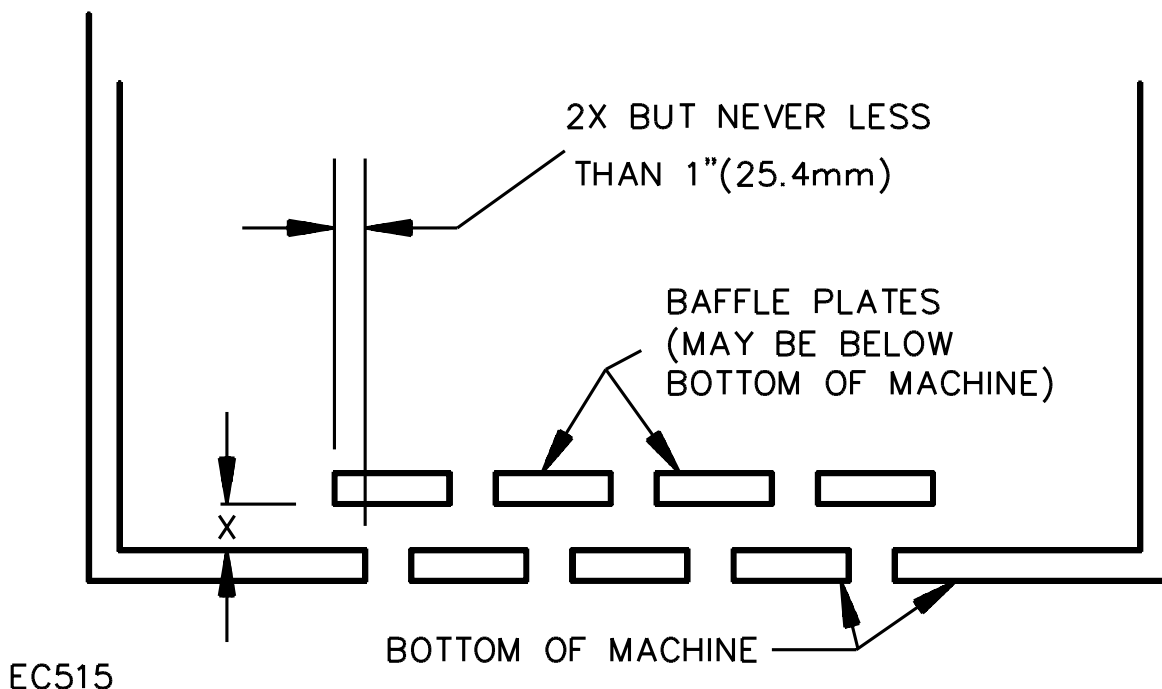
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Figure 7.6
Bottom panel baffles

Figure 7.6 revised March 29, 1999



7.2 Cast metal

7.2.1 The thickness of cast metal for an enclosure shall be as indicated in Table 7.1.

Exception: Cast metal of lesser thickness may be used if considering the shape, size, and function of the enclosure, it provides equivalent mechanical strength. See the Drop Test, Section 51, and the Mechanical Strength Tests for Enclosures, Section 54.

7.3 Sheet metal

7.3.1 The thickness of sheet metal used for the enclosure of a product shall not be less than that indicated in Table 7.2 or 7.3, whichever applies.

Exception: Sheet metal of lesser thickness may be used if considering the shape, size, and function of the enclosure, it provides equivalent mechanical strength. See the Drop Test, Section 51, and the Mechanical Strength Tests for Enclosures, Section 54.

7.3.2 A sheet metal member to which a wiring system is to be connected in the field shall not be less than 0.032 inch (0.81 mm) thick if of uncoated steel, not less than 0.034 inch (0.86 mm) thick if of galvanized steel, and not less than 0.045 inch (1.14 mm) thick if of nonferrous metal.

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Table 7.1
Cast-metal electrical enclosures

Use, or dimension of area involved ^a	Minimum thickness			
	Die-cast metal,		Cast metal of other than the die-cast type,	
	inch	(mm)	inch	(mm)
Area of 24 square inches (155 cm ²) or less having no dimension greater than 6 inches (152 mm)	1/16	1.6	1/8	3.2
Area greater than 24 square inches or having any dimension greater than 6 inches	3/32	2.4	1/8	3.2
At a threaded conduit hole	1/4	6.4	1/4	6.4
At an unthreaded conduit hole	1/8	3.2	1/8	3.2
^a The area limitations for metal 1/16 inch (1.6 mm) thick may be obtained by the provision of reinforcing ribs subdividing a larger area.				

7.4 Nonmetallic

7.4.1 Among the factors to be taken into consideration when judging the use of a nonmetallic enclosure are:

- a) The mechanical strength,
- b) Resistance to impact,
- c) Moisture-absorptive properties,
- d) Flammability and resistance to ignition from electrical sources,
- e) Dielectric strength, insulation resistance, and resistance to arc tracking, and
- f) Resistance to distortion and creeping at temperatures to which the material may be subjected under any conditions of use.

All these factors are to be considered with respect to aging in accordance with the Tests on Polymeric Materials, Section 49. See the Mechanical Strength Tests for Enclosures, Section 54.

7.5 Doors and covers

7.5.1 An enclosure cover shall be hinged, sliding, or similarly attached so it can not be removed if it:

- a) Gives access to a fuse or any other overcurrent protective device, the intended functioning of which requires renewal; or
- b) Is necessary to open the cover in connection with the operation of the unit.

Exception: If its position is supervised by a tamper contact that is connected in the closed protective circuit, an enclosure cover need not comply with this requirement.

Table 7.2
Minimum thickness of sheet metal for electrical enclosures – carbon steel or stainless steel

Without supporting frame ^a		With supporting frame or equivalent reinforcing ^a		Minimum thickness uncoated,		Minimum thickness metal coated,	
Maximum width, ^b inches (cm)	Maximum length, ^c inches (cm)	Maximum width, ^b inches (cm)	Maximum length, ^c inches (cm)	inch (mm) [MSG]		inch (mm) [GSG]	
4.0 (10.2)	Not limited	6.25 (15.9)	Not limited	0.020 (0.51)		0.023 (0.58)	
4.75 (12.1)	5.75 (14.6)	6.75 (17.1)	8.25 (21.0)	[24]		[24]	
6.0 (15.2)	Not limited	9.5 (24.1)	Not limited	0.026 (0.66)		0.029 (0.74)	
7.0 (17.8)	8.75 (22.2)	10.0 (25.4)	12.5 (31.8)	[22]		[22]	
8.0 (20.3)	Not limited	12.0 (30.5)	Not limited	0.032 (0.81)		0.034 (0.86)	
9.0 (22.9)	11.5 (29.2)	13.0 (33.0)	16.0 (40.6)	[20]		[20]	
12.5 (31.8)	Not limited	19.5 (49.5)	Not limited	0.042 (1.07)		0.045 (1.14)	
14.0 (35.6)	18.0 (45.7)	21.0 (53.3)	25.0 (63.5)	[18]		[18]	
18.0 (45.7)	Not limited	27.0 (68.6)	Not limited	0.053 (1.35)		0.056 (1.42)	
20.0 (50.8)	25.0 (63.5)	29.0 (73.7)	36.0 (91.4)	[16]		[16]	
22.0 (55.9)	Not limited	33.0 (83.8)	Not limited	0.060 (1.52)		0.063 (1.60)	
25.0 (63.5)	31.0 (78.7)	35.0 (88.9)	43.0 (109.2)	[15]		[15]	
25.0 (63.5)	Not limited	39.0 (99.1)	Not limited	0.067 (1.70)		0.070 (1.78)	
29.0 (73.7)	36.0 (91.4)	41.0 (104.1)	51.0 (129.5)	[14]		[14]	
33.0 (83.8)	Not limited	51.0 (129.5)	Not limited	0.080 (2.03)		0.084 (2.13)	
38.0 (96.5)	47.0 (119.4)	54.0 (137.2)	66.0 (167.6)	[13]		[13]	
42.0 (106.7)	Not limited	64.0 (162.6)	Not limited	0.093 (2.36)		0.097 (2.46)	
47.0 (119.4)	59.0 (149.9)	68.0 (172.7)	84.0 (213.4)	[12]		[12]	
52.0 (132.1)	Not limited	80.0 (203.2)	Not limited	0.108 (2.74)		0.111 (2.82)	
60.0 (152.4)	74.0 (188.0)	84.0 (213.4)	103.0 (261.6)	[11]		[11]	
63.0 (160.0)	Not limited	97.0 (246.4)	Not limited	0.123 (3.12)		0.126 (3.20)	
73.0 (185.4)	90.0 (228.6)	103.0 (261.6)	127.0 (322.6)	[10]		[10]	

^a A supporting frame is a structure of angle or channel or a folded rigid section of sheet metal which is rigidly attached to and has essentially the same outside dimensions as the enclosure surface and which has sufficient torsional rigidity to resist the bending moments which may be applied via 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 which is as rigid as one built with a frame of angles or channels. Construction considered to be without supporting frame includes:

- 1) A single sheet with single formed flanges (formed edges);
- 2) A single sheet which is corrugated or ribbed; and
- 3) An enclosure surface loosely attached to a frame, for example, with spring clips.

^b The width is the smaller dimension of a rectangular sheet metal piece which 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 which 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 unless the side in question is provided with a flange at least 1/2 inch (12.7 mm) wide.

Table 7.3
Minimum thickness of sheet metal for electrical enclosures aluminum, copper, or brass

Without supporting frame ^a		With supporting frame or equivalent reinforcing ^a		Minimum thickness, inches (mm)
Maximum width, ^b inches (cm)	Maximum length, ^c inches (cm)	Maximum width, ^b inches (cm)	Maximum length, inches (cm)	
3.0 7.6	Not limited	7.0 17.8	Not limited	0.023 0.58
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 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 63.4	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	
37.0 94.0	Not limited	87.0 221.0	Not limited	0.122 3.10
42.0 106.7	53.0 134.6	93.0 236.2	114.0 289.6	
52.0 132.1	Not limited	123.0 312.4	Not limited	0.153 3.89
60.0 152.4	74.0 188.0	130.0 330.2	160.0 406.4	

^a A supporting frame is a structure of angle or channel or a folded rigid section of sheet metal which is rigidly attached to and has essentially the same outside dimensions as the enclosure surface and which has sufficient torsional rigidity to resist the bending moments which may be applied via 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 which is as rigid as one built with a frame of angles or channels. Construction considered to be without supporting frame includes:

- 1) A single sheet with single formed flanges (formed edges),
- 2) A single sheet which is corrugated or ribbed, and
- 3) An enclosure surface loosely attached to a frame, for example, with spring clips.

^b The width is the smaller dimension of a rectangular sheet metal piece which 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 which 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 unless the side in question is provided with a flange at least 1/2 inch (12.7 mm) wide.

7.5.2 An enclosure cover shall be provided with a supervisory contact, connected in the closed protective wiring circuit, if it gives access to a relay, terminal, control, or related component that might be subjected to tampering without causing an alarm signal. See Installation and Performance, General, Control, Section 64.

7.5.3 Fasteners requiring the use of a tool or key shall be used for all enclosure if access is not required for operation of the product.

7.6 Screens and expanded metal

7.6.1 Screens and expanded metal used as a guard, enclosure, or part of an enclosure, shall comply with the requirements in 7.6.2 and 7.6.3 and the Mechanical Strength Tests for Enclosures, Section 54.

Exception: The requirements in 7.6.2 and 7.6.3 apply if removal of a screen or expanded metal mesh used as a guard, enclosure, or part of an enclosure would likely expose high-voltage live parts or create a risk of fire or unintentional contact with moving parts that may cause injury to persons.

7.6.2 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 (1.17 mm) thick if zinc coated] if the mesh openings or perforations are 1/2 square inch (323 mm²) or less in area, and shall not be less than 0.080 inch (2.03 mm) thick [0.084 inch (2.13 mm) thick if zinc coated] for larger openings. The largest dimension shall not exceed 4 inches (102 mm).

Exception: If the indentation of a guard or the enclosure would not likely alter the clearance between uninsulated live parts and grounded metal so as to impair performance or reduce spacings below the minimum required values (see Spacings, General, Section 21), 0.020-inch (0.53-mm) thick expanded steel mesh or perforated sheet steel [0.023 inch (0.58 mm) thick if zinc coated] may be used, if:

- a) The exposed mesh on any one side or surface of the product so protected has an area of not more than 72 square inches (464 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 (89 mm).*

7.6.3 The wires of a screen shall not be less than 0.05 inch (1.3 mm) in diameter if the screen openings are 1/2 square-inch (323 mm²) or less in area, and shall not be less than 0.08 inch (2.1 mm) in diameter for larger screen openings.

8 Electric Shock

8.1 Any part that is exposed only during operator servicing shall not present the risk of electric shock. See the Electric Shock Current Test, Section 33.

8.2 Each terminal provided for the connection of an external antenna shall be conductively connected to the supply circuit grounded conductor. The conductive connection shall have a maximum resistance of 5.2 megohms, a minimum wattage rating of 1/2 watt, and shall be effective with the power switch in either the on or off position.

Exception: The conductive connection need not be provided if:

- a) Such a connection is established in the event of electrical breakdown of the antenna isolating means,*
- b) The breakdown does not result in a risk of electric shock, and*
- c) In a construction using an isolating power transformer, the resistance of the conductive connection between the supply circuit and chassis does not exceed 5.2 megohms.*

8.3 The maximum value of 5.2 megohms mentioned in 8.2 is to include the maximum tolerance of the resistor value used; that is, a resistor rated 4.2 megohms with 20 percent tolerance or a resistor rated 4.7 megohms with a 10 percent tolerance may be used. A component comprised of a capacitor with a built-in shunt resistor that complies with the requirements for antenna isolating capacitors may be rated a minimum of 1/4 watt.

8.4 The insertion in any socket of any vacuum tube or its glass or metal equivalent of like designation used in the product shall not result in a risk of electric shock.

9 Corrosion Protection

9.1 Iron and steel parts, other than bearings and the like, where such protection is impracticable, shall be protected against corrosion by enameling, galvanizing, sherardizing, plating, or other equivalent means, as determined by the requirements of the Corrosion Test, Section 34. Bearing surfaces shall be of such materials and construction so as to resist binding due to corrosion.

9.2 The requirements in 9.1 apply to all enclosures of sheet steel or cast iron, and to all springs and other parts upon which mechanical operation may depend.

Exception No. 1: This requirement applies to a part such as a washer, screw, bolt, and the like, if corrosion of such an unprotected part would likely result in a risk of electric shock, fire, or unintentional contact with moving parts that may cause injury to persons, or impair the intended operation of the unit.

Exception No. 2: Parts made of stainless steel, polished or treated, if necessary, do not require additional protection against corrosion.

9.3 Metal shall be used in combinations that are galvanically compatible. See the Corrosion Test, Section 34.

Exception: This requirement applies if galvanic action would likely impair the intended operation of the product, or would likely result in risk of electric shock, fire, or unintentional contact with moving parts that may cause injury to persons.

9.4 Cabinets and enclosures of corrosion-resistant material may be used without special corrosion protection.

FIELD WIRING

10 Field Wiring Connections

10.1 General

10.1.1 Wiring terminals or leads shall be provided for connection of conductors of at least the size required by the National Electrical Code, NFPA 70.

10.2 Field wiring compartment

10.2.1 The field wiring compartment in which connections are to be made shall be of sufficient size to accommodate all wiring connections as specified by the installation wiring diagram.

10.2.2 Both internal components in the wiring area and wire insulation shall be protected from sharp edges by insulating or metal barriers having smooth, rounded edges or instructions shall be located in the wiring area, including the word "CAUTION" and the following or equivalent text: "When Making Installation, Route Field Wiring Away From Sharp Projections, Corners, and Internal Components."

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