



UL 636

STANDARD FOR SAFETY

Holdup Alarm Units and Systems

12/07/2014 23:26:04 MST

**UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL**



Documents
Document Sharing Hub

Provided by IHS under license with UL

No reproduction or networking permitted without license from IHS
Full document details: [UL 636 1996](#)

Licensee=North Carolina State Univ/5618801100
Not for Resale, 12/07/2014 23:26:04 MST

UL Standard for Safety for Holdup Alarm Units and Systems, UL 636

Tenth Edition, Dated November 26, 1996

Summary of Topics

Revision pages are being issued to reflect the recent reaffirmation of UL 636 as an American National Standard.

Text that has been changed in any manner or impacted by UL's electronic publishing system 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.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form by any means, electronic, mechanical photocopying, recording, or otherwise without prior permission of UL.

UL provides this Standard "as is" without warranty of any kind, either expressed or implied, including but not limited to, the implied warranties of merchantability or fitness for any purpose.

In no event will UL be liable for any special, incidental, consequential, indirect or similar damages, including loss of profits, lost savings, loss of data, or any other damages arising out of the use of or the inability to use this Standard, even if UL or an authorized UL representative has been advised of the possibility of such damage. In no event shall UL's liability for any damage ever exceed the price paid for this Standard, regardless of the form of the claim.

Users of the electronic versions of UL's Standards for Safety agree to defend, indemnify, and hold UL harmless from and against any loss, expense, liability, damage, claim, or judgment (including reasonable attorney's fees) resulting from any error or deviation introduced while purchaser is storing an electronic Standard on the purchaser's computer system.

The requirements in this Standard are now in effect, except for those paragraphs, sections, tables, figures, and/or other elements of the Standard having future effective dates as indicated in the note following the affected item. The prior text for requirements that have been revised and that have a future effective date are located after the Standard, and are preceded by a "SUPERSEDED REQUIREMENTS" notice.

No Text on This Page

*UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL*



Documents

Document Sharing Hub

NOVEMBER 26, 1996
(Title Page Reprinted: January 31, 2013)



ANSI/UL 636-2008 (R2013)

1

UL 636

Standard for Holdup Alarm Units and Systems

First Edition – July, 1933
Second Edition – June, 1945
Third Edition – November, 1952
Fourth Edition – February, 1958
Fifth Edition – September, 1972
Sixth Edition – July, 1973
Seventh Edition – August, 1978
Eighth Edition – July, 1980
Ninth Edition – June, 1987

Tenth Edition

November 26, 1996

This ANSI/UL Standard for Safety consists of the Tenth edition including revisions through January 31, 2013.

The most recent designation of ANSI/UL 636 as a Reaffirmed American National Standard (ANS) occurred on January 31, 2013. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, or effective date information.

The Department of Defense (DoD) has adopted UL 636 on July 30, 1987. The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at <http://csds.ul.com>.

UL's Standards for Safety are copyrighted by UL. Neither a printed nor electronic copy of a Standard should be altered in any way. All of UL's Standards and all copyrights, ownerships, and rights regarding those Standards shall remain the sole and exclusive property of UL.

COPYRIGHT © 2013 UNDERWRITERS LABORATORIES INC.

**UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM**



Documents
Document Sharing Hub

No Text on This Page

**UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL**



Documents
Document Sharing Hub

CONTENTS

INTRODUCTION

1 Scope	7
2 General	7
2.1 Components	7
2.2 Units of measurement	8
2.3 Undated references	8
2.4 Terminology	8
3 Glossary	8

INSTRUCTIONS AND DRAWINGS

4 General	9
-----------------	---

CONSTRUCTION

ASSEMBLY

5 General	10
6 Protection of Service Personnel	10
7 Enclosures	10
7.1 General	10
7.2 Openings	11
7.3 Cast Metal	16
7.4 Sheet Metal	16A
7.5 Nonmetallic	16A
7.6 Doors, covers, and guards	19
7.7 Screens and expanded metal	19
8 Electric Shock	20
9 Corrosion Protection	20

FIELD WIRING CONNECTIONS

10 General	20A
10.1 General	20A
10.2 Field wiring compartment	21
10.3 Terminals – general application	21
10.4 Terminals – qualified application	21
10.5 Leads	22
10.6 Cords and plugs	23
10.7 Polarity identification	23
11 Grounding	24

INTERNAL WIRING

12 General	24
13 Separation of Circuits	25
14 Bonding for Grounding	25

**UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL**



Documents

Document Sharing Hub

COMPONENTS – ELECTRICAL

15	General	27
15.1	Mounting of components	27
15.2	Insulating materials	27
15.3	Current-carrying parts	27
15.4	Bushings	28
16	Capacitors	28
17	Overcurrent Protection	29
18	Semiconductors	29
19	Switches	29
20	Transformers, Coils, and Relays	29

SPACINGS

21	General	29
----	---------	----

PERFORMANCE

22	General	30
23	Test Samples and Miscellaneous Data	30
24	FCC Requirements	30
25	Test Voltages	30

TESTS

26	Normal Operation Test	32
27	Circuit Protection Test	32
28	Input Test	32
29	Power Supply Test	33
29.1	General	33
29.2	Battery tests	33
30	Power Failure Test	34
31	Component Malfunction Test	34
32	Undervoltage Operation Test	34
33	Overvoltage Operation Test	35
34	Variable Ambient Temperature Test	35
35	Humidity Test	35
36	Leakage Current Tests for Cord-Connected Products	35
37	Electric Shock Current Test	37
38	Overload Test	43
38.1	General	43
38.2	Separately energized circuits	43
39	Endurance Test	43
39.1	General	43
39.2	Separately energized circuits	43
40	Jarring Test	44
41	Temperature Test	44A
42	Dielectric Voltage-Withstand Test	48
43	Abnormal Operation Test	49
44	Electrical Transient Tests	50
44.1	General	50
44.2	Supply line transients	50

UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL



Documents

Document Sharing Hub

44.3 Internally induced transients	50A
44.4 Input/output circuit transients	50A
45 AC Induction Test	51
46 Radio Frequency Interference Test	52
47 Polymeric Materials Test	54
48 Battery Replacement Test	54
49 Drop Test	54
50 Strain Relief Test	54
50.1 Flexible cords	54
50.2 Field-wiring leads	54
51 Ignition Through Bottom-Panel Openings Tests	55
51.1 General	55
51.2 Hot, flaming oil	55
51.3 Molten PVC and copper	55
52 Mechanical Strength Tests for Enclosures	56
53 Tests on Special Terminal Assemblies	56
53.1 General	56
53.2 Disconnection and reconnection	56
53.3 Mechanical secureness	57
53.4 Flexing test	57
53.5 Millivolt drop test	57
53.6 Temperature test	57
54 Marking Permanency Tests	57

SHORT RANGE RADIO FREQUENCY (RF) OPERATED INITIATING DEVICES

55 General	58
56 Time to Report Alarm	58
57 Inoperative Transmitter Reporting	58
58 Battery Status Indication	59
59 Tamper Protection	59
60 Interference Protection	59
61 Reference Level Determination	60
61.1 Method I	60
61.2 Method 2	62
62 Interference Immunity	64
63 Frequency Selectivity	65
64 Clash	66
65 Clash Error	67
66 Error (Falsing) Rate	67
67 Throughput Rate	68
68 Transmitter Stability Test	69
69 Transmitter Accelerated Aging Test	70
70 Installation Instructions and User Manual	70
71 Test	70
72 Drop Test	70

MANUFACTURING AND PRODUCTION TESTS

73 General	70
74 Production Line Dielectric Voltage-Withstand Test for High-Voltage Products	71
75 Production Line Grounding Continuity Test for High-Voltage Cord-Connected Products	71

**UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL**



Documents

Document Sharing Hub

MARKING

76 General	72
------------------	----

ACCESSORY EQUIPMENT

77 General	74
78 Construction	74
79 Performance (Installation) Test	75
80 Markings	75

OPERATION AND ELECTRICAL SUPERVISION

81 General	75
------------------	----

POWER SUPPLIES

82 General	76
83 Battery Standby	76
84 Rechargeable Batteries	76
85 Nonrechargeable Batteries	77

INSTALLATION

86 Types of Remote Stations	78
87 Extent of Protection	78
87.1 General	78
87.2 Bandit-Resisting Enclosure and Alarm	78
87.3 Semiautomatic Alarm	78
87.4 Manual Alarm	79

OUTSIDE CABLES

88 General	79
88.1 General	79
88.2 Underground wires	79
88.3 Overhead wires	80

WIRES INSIDE BUILDING

89 General	80
89.1 General	80
89.2 Running and fastening	81
89.3 Splices and connections	81
89.4 Separation of interconnecting and protective wiring from other wiring or objects	81
89.5 Passage through floors and walls	81

MAINTENANCE

90 General	82
------------------	----

Appendix A

Standards for Components.....	A1
-------------------------------	----



This page intentionally left blank.

*UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL*



Documents
Document Sharing Hub

INTRODUCTION

1 Scope

1.1 These requirements cover holdup alarm systems of the remote-station type intended for installation in banks, stores, cashiers' cages, pay offices, and the like to provide a means of transmitting a silent call for help in the event of interior robbery. These systems are divided into the three classes listed in 1.2 and are defined under Extent of Protection, Section 87.

1.2 The three classes are: Bandit-Resisting Enclosure and Alarm, Semiautomatic Alarm, and Manual Alarm.

1.3 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.

1.3 revised March 30, 2001

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 March 30, 2001

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 March 30, 2001

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

2.1.3 revised March 30, 2001

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 March 30, 2001

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 March 30, 2001

2.2.2 Unless otherwise indicated, all voltage and current values mentioned in this standard are 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 this standard refers to all types of holdup alarm units.

3 Glossary

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

3.2 ALARM INITIATING DEVICE – A switch operated by hand or foot, by key, by removal of currency bills, or by other means to initiate a holdup alarm signal.

3.3 CIRCUITS, ELECTRICAL :

a) HIGH-VOLTAGE – 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 DC or AC peak.

c) POWER LIMITED – A circuit whose output is limited as specified in Tables 3.1 and 3.2. The power limitation shall be provided by the construction of the transformer, a fixed impedance, a noninterchangeable fuse, a nonadjustable manual reset circuit protective device, or a regulating network.

Table 3.1
Power limitations for inherently limited power source (Overcurrent protection not required)

Circuit voltage V_{max}^a AC-DC, (volts)	Maximum nameplate ratings		Current limitation I_{max}^b (amperes)
	VA, (volt amperes)	Current, (amperes)	
0 to 20	$5.0 \times V_{max}^a$	5.0	8.0
over 20 to 30	100	$100/V_{max}^a$	8.0
over 30 to 100	100	$100/V_{max}^a$	$100/V_{max}^a$
over 100 to 250 DC only	$0.030 \times V_{max}^a$	0.030	0.030
NOTE – Reproduced in part from the National Electrical Code (NFPA 70), 1996 Edition, copyright National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.			
^a V_{max} : Maximum output voltage regardless of load with rated input applied.			
^b I_{max} : Maximum output after 1 minute of operation under any noncapacitive load, including short circuit.			

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

No Text on This Page

*UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL*



Documents

Document Sharing Hub

Table 3.2
Power limitations for power sources not inherently limited (Overcurrent protection required)

Circuit voltage V_{max}^a AC-DC, (volts)	Maximum nameplate ratings		Current limitation I_{max}^b (amperes)	Power limitation (VA) $_{max}^c$ (volt amperes)	Maximum overcurrent protection, (amperes)
	VA, (volt amperes)	Current, (amperes)			
0 to 20	$5.0 \times V_{max}^a$	5.0	$1000/V_{max}^a$	250 ^d	5.0
over 20 to 100	100	$100/V_{max}^a$	$1000/V_{max}^a$	250 ^d	$100/V_{max}^a$
over 100 to 150	100	$100/V_{max}^a$	1.0	NA	1.0

NOTE – Reproduced in part from the National Electrical Code (NFPA 70), 1996 Edition, copyright National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

^a V_{max} : Maximum output voltage regardless of load with rated input applied.

^b I_{max} : Maximum output after 1 minute of operation under any noncapacitive load, including short circuit, and with overcurrent protection bypassed.

^c (VA) $_{max}$: Maximum volt-ampere output regardless of load with overcurrent protection bypassed.

^d If the power source is a transformer (VA) $_{max}$ is 350 or less when V_{max} is 15 or less.

3.5 NORMAL STANDBY CONDITION – The ready-to-operate condition existing prior to tripping or operation of the product.

3.6 PRIMARY BATTERY – Any battery which by design or construction is not intended to be recharged.

3.7 RADIO FREQUENCY – Electromagnetic radiation generally greater than 20 kHz.

3.8 SAFETY CIRCUIT – Any primary or secondary circuit that is relied upon to reduce the risk of fire, electric shock, or injury to persons (for example, an interlock).

3.9 SECONDARY BATTERY – Any battery which by construction is intended to be recharged.

INSTRUCTIONS AND DRAWINGS

4 General

4.1 Each product shall be provided with installation instructions and drawings which shall include the following information:

a) Typical installation drawing layouts and complete representative installation wiring diagram for the product(s) indicating recommended locations and wiring methods which shall be in accordance with the National Electrical Code, NFPA 70-1996. See 62.1(g).

b) A concise description of the operation, testing, and intended maintenance procedures for the product(s). The frequency of testing shall be in accordance with the requirements of the manufacturer and shall not exceed 1 year.

c) Replacement parts, such as lamps or batteries, shall be identified in the instructions by a part number, manufacturer's model number, or the equivalent.

d) A description of the conditions which might be expected to result in false alarms or impaired operation of the product(s).

4.2 The instructions may be incorporated on the inside of the product, on a separate sheet, or as part of a manual. If not included directly on the product, the instructions or manual shall be referenced in the marking information on the product.

CONSTRUCTION

ASSEMBLY

5 General

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

5.2 The system shall be constructed to reduce the risk of unintentional transmission of an alarm by employees, by janitors, and cleaners working about the premises, by falling objects, by customers, by building vibration, and by similar causes.

6 Protection of Service Personnel

6.1 An uninsulated part that can cause a risk of electric shock or that operates at high-voltage, and that is made accessible by opening or removing a cover, door, panel, or other closure on or within the product (see 7.6.2), shall be provided with a guard over the part to reduce the risk that service personnel can unintentionally touch it during servicing of the product or the product shall be provided with a safety circuit. See also 6.2 and 6.3.

6.2 A guard shall be provided for a part that must be in motion during servicing operations and presents a pinching, snagging, or cutting action, or other risk of unintentional contact with moving parts that may cause injury to persons when made accessible by opening or removing a cover, door, panel, or other closure on the product to provide access to the interior of the product. This guard shall reduce the risk that service personnel can unintentionally contact the moving parts that may cause injury to persons. See also 6.3.

6.3 If the guards specified in 6.1, 6.2, and 7.6.2 must be removed during servicing of the parts mentioned in 6.1 and 6.2, the guards shall be constructed and arranged so they can be removed and replaced with hand-operated fasteners or hand tools.

7 Enclosures

7.1 General

7.1.1 The term "enclosure" refers to parts that enclose moving parts that may cause injury to persons, or electrical components, including uninsulated live parts, involving a risk of electric shock. It may be an integral part of a component, a separate item, part of the ultimate enclosure (outer cabinet), or the ultimate enclosure.

7.1.2 An enclosure without provision for the connection of field wiring is acceptable if it is furnished with instructions indicating the sections of the product which are intended to be drilled in the field for the connection of raceways or if the product is portable or a low energy device.

7.1.3 An electrical part of a product shall be located or enclosed to reduce the risk of unintentional contact with uninsulated high-voltage live parts.

7.1.4 An operating part, such as a gear mechanism, light-duty relay, and similar devices, shall be enclosed to reduce the risk of malfunction from dust or other material which may impair its intended operation.

7.1.5 A mounting provision of an enclosure shall be accessible without the 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.

7.1.6 An enclosure containing 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 Ignition Through Bottom-Panel Opening Tests, Section 51.

7.1.7 The requirement specified in 7.1.6 necessitates either a nonflammable bottom in accordance with 7.2.4 or a barrier as described in Figure 7.1 under all areas containing flammable materials. See also 7.2.5.

7.1.8 A construction using an individual barrier under a component, or group of components or assemblies, as specified in Figure 7.1, is to be considered as complying with the requirement specified in 7.1.6. However, material or assemblies classified as V-1 need not comply with this requirement; see the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

7.1.8 revised March 30, 2001

7.2 Openings

7.2.1 Openings directly over an uninsulated high-voltage live part shall not exceed 0.187 inch (4.75 mm) in any dimension, or shall be of a configuration illustrated by Figure 7.2 for top cover designs and Figure 7.3 for side openings.

7.2.2 An opening that does 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 an uninsulated live electrical part (other than low-voltage) or moving part that may cause injury to persons when inserted through the opening in a straight or articulated position.

7.2.3 An opening that permits entrance of a 1 inch (25.4 mm) diameter round rod is acceptable under the conditions described in Figure 7.5.

7.2.4 Openings may be provided in the bottom panel or pan under an area containing a material not classified V-1 in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, if constructed in a manner that reduces the risk that a material can fall directly from the interior of 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 5/64 inch (2.0 mm), or smaller, round holes are spaced no closer together than 1/8 inch (3.2 mm) center-to-center. Other constructions than these two are acceptable if they comply with the requirements specified in the Ignition Through Bottom-Panel Opening Tests, Section 51.

7.2.4 revised March 30, 2001

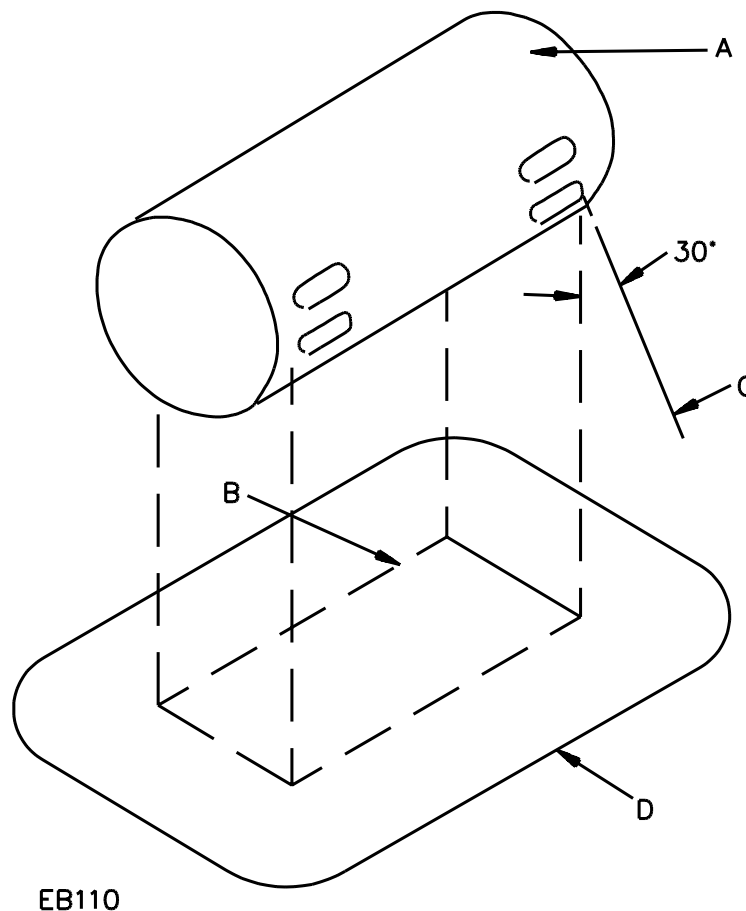
7.2.5 The bottom of an enclosure under an area containing only a material classified as V-1 or better may have square openings not larger than 1/4 inch (6.4 mm). Openings which are not square are acceptable if they have an area no greater than 1/16 square inch (40.3 mm²).

7.2.5 revised March 30, 2001



Figure 7.1
Protective pan

Figure 7.1 revised June 29, 1998



EB110

A. The entire component under which a barrier (flat or dish with or without a lip or other raised edge) of noncombustible material is to be provided. The above sketch is of 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 noncombustible enclosure, the area to be protected would be the entire area occupied by the component or assembly.

B. 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.

C. 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 noncombustible material, or if the horizontal extension of the barrier (B) to (D) would exceed 6 inches (150 mm).

D. Minimum outline of the barrier, except that the extension B-D need not exceed 6 inches (150 mm) (flat or dish 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.

UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL

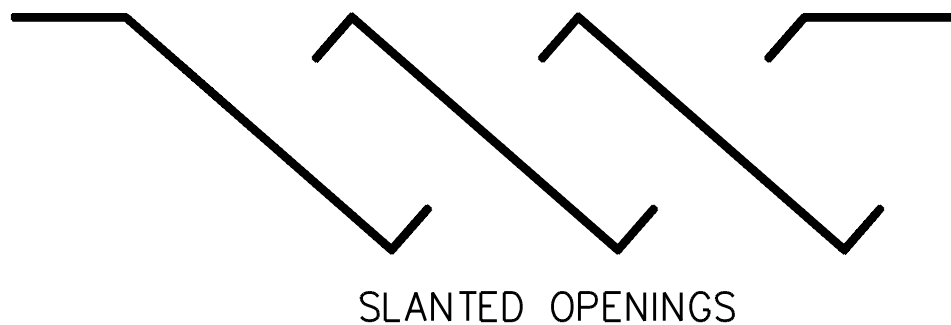


Documents
Document Sharing Hub

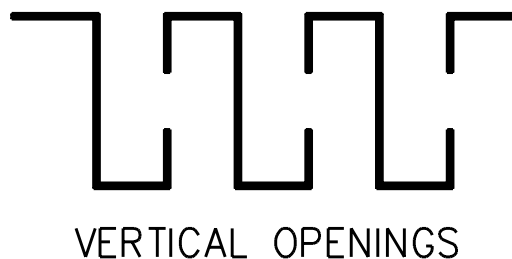
7.2.6 Openings are acceptable without limitation of their size or number in areas containing only PVC, TFE, CTFE, FEP, and neoprene insulated wire cable, in an area containing a plug and receptacle, and in an area underneath an impedance or thermally protected motor.

7.2.7 Openings in the enclosure shall not give access to any relay, terminal, control, or related component that might be subject to tampering by hand or with ordinary hand tools, wires, hooks, and the like.

Figure 7.2
Cross sections of top cover designs



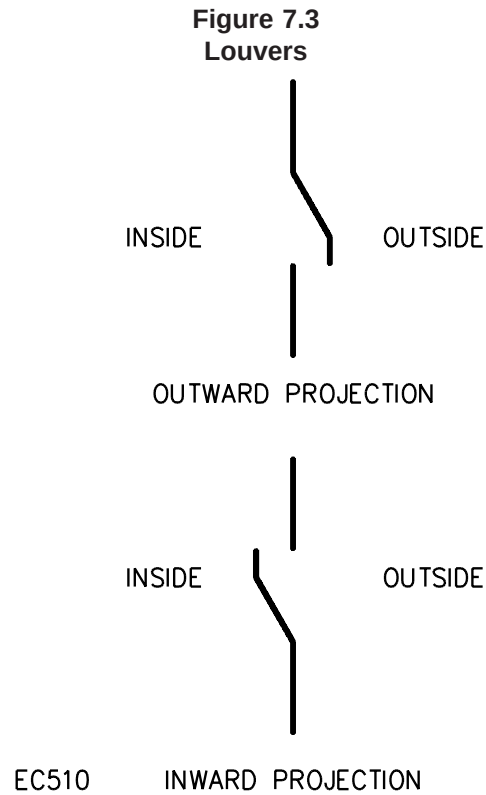
EC500



UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL



Documents
Document Sharing Hub



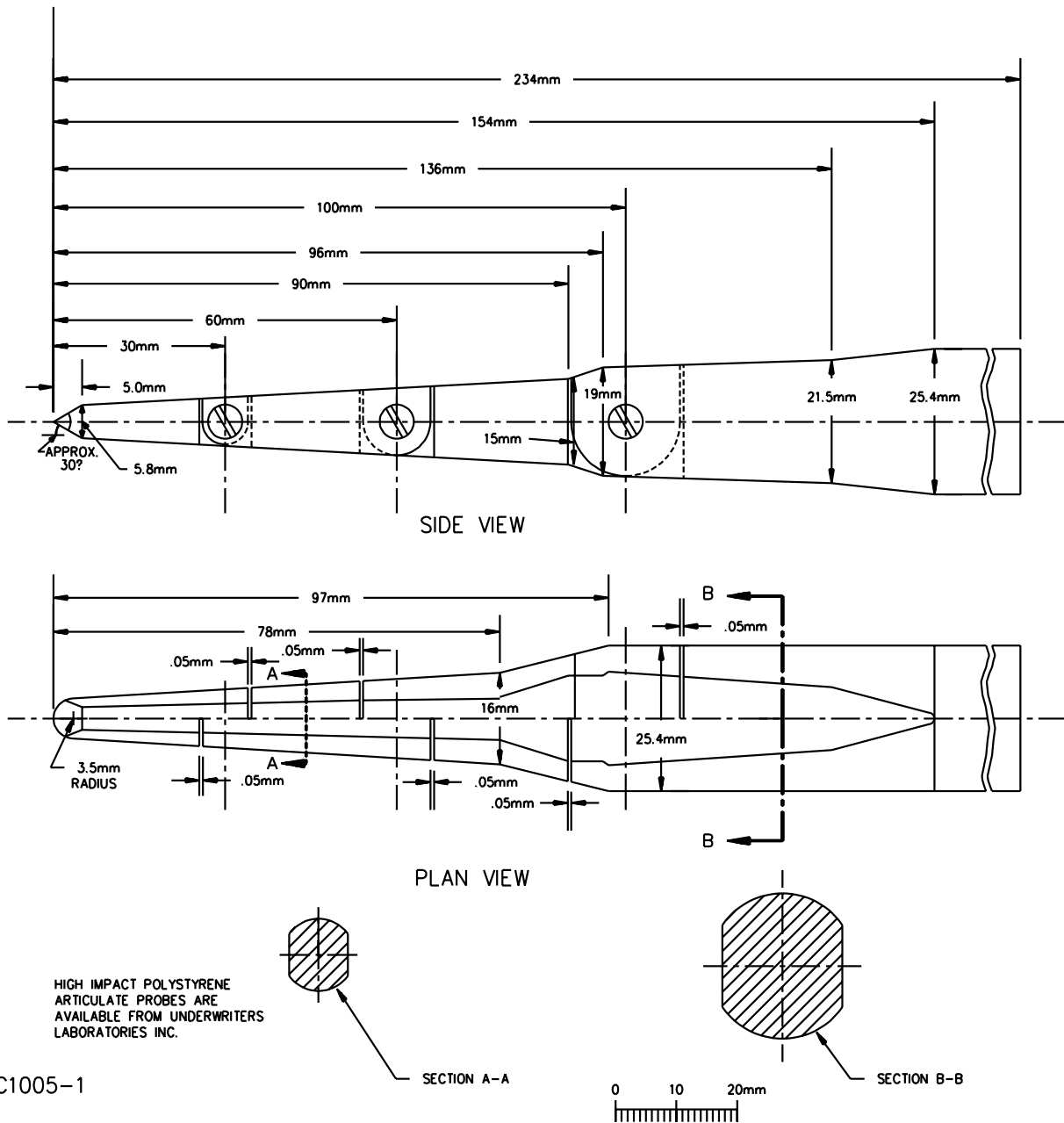
UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL



Documents
Document Sharing Hub

Figure 7.4
Articulated probe

Figure 7.4 revised June 29, 1998



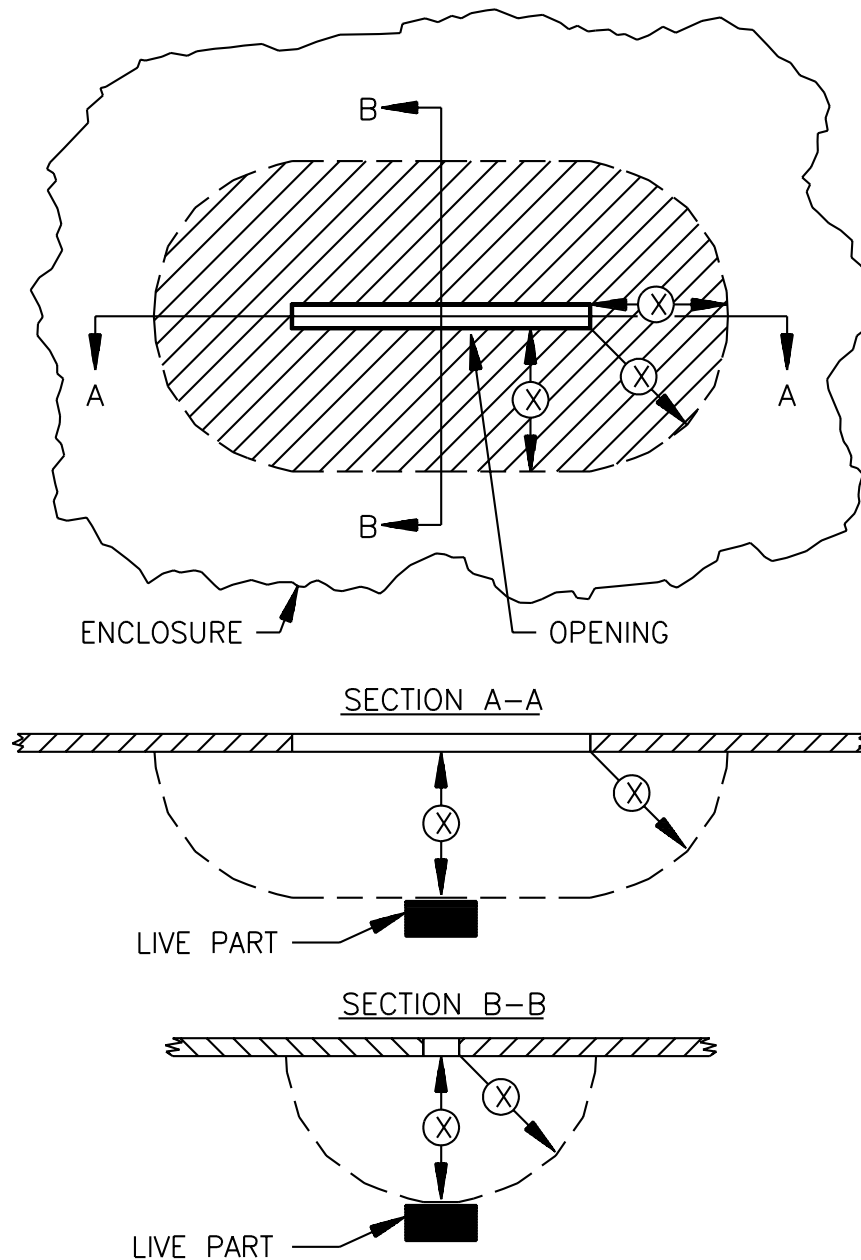
UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL



Documents
Document Sharing Hub

Figure 7.5
Forbidden volume

Figure 7.5 revised June 29, 1998



EC100A

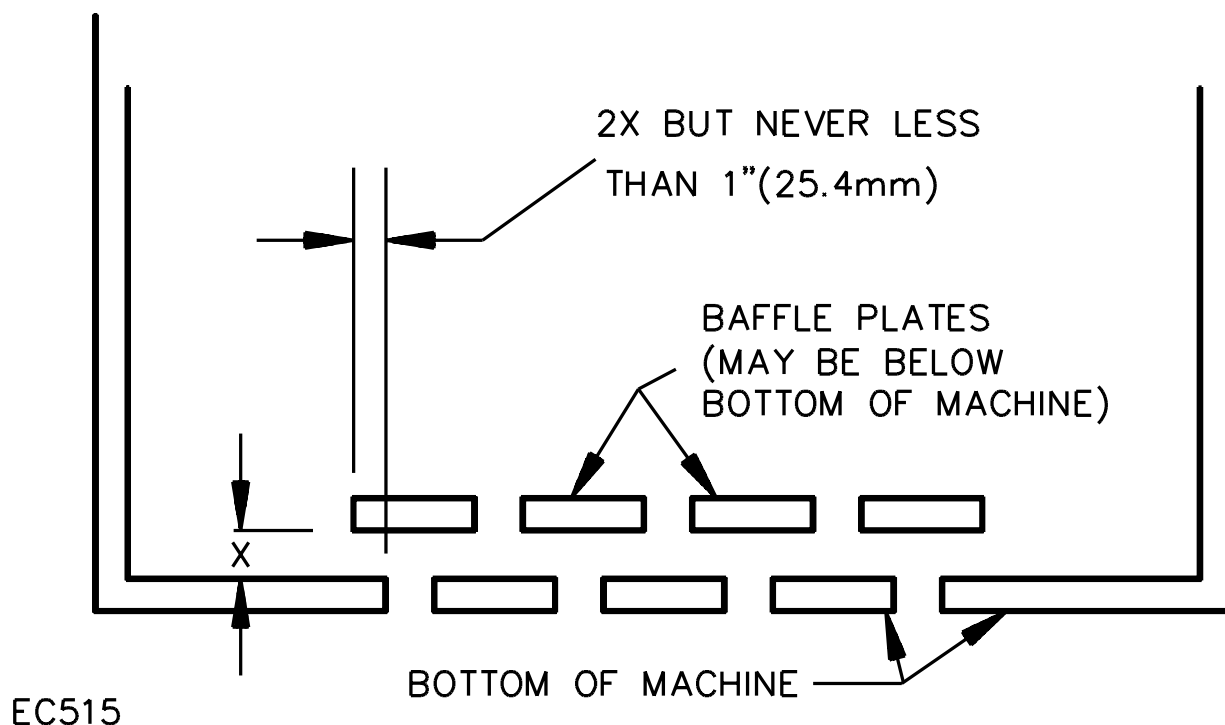
The opening is acceptable if, within the enclosure, there is no uninsulated live part or enamel-insulated wire, or hazardous moving part less than X inches (mm) from the perimeter of the opening, as well as within the volume generated by projecting the perimeter X inches (mm) normal to its plane. X equals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

UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM



Documents
Document Sharing Hub

Figure 7.6
Baffle



7.3 Cast Metal

7.3.1 The thickness of cast metal for an enclosure shall be as specified in Table 7.1. However, cast metal of lesser thickness may be used if the enclosure complies with the requirements specified in the Mechanical Strength Tests for Enclosures, Section 52.

Table 7.1
Cast-metal electrical enclosures

Use, or dimension of area involved ^a	Minimum thickness, inch (mm)			
	Die-cast metal		Cast metal of other than the die-cast type	
Area of 24 square inches (155 cm ²) or less and 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 limitation for metal 1/16 inch (1.6 mm) in thickness may be obtained by the provision of reinforcing ribs subdividing a larger area.

7.4 Sheet Metal

7.4.1 The thickness of sheet metal used for the enclosure of a product shall be not less than that specified in Table 7.2 or 7.3, whichever applies. However, sheet metal of lesser thickness may be used if the enclosure complies with the requirements specified in the Mechanical Strength Tests for Enclosures, Section 52.

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

7.5 Nonmetallic

7.5.1 Among the factors taken into consideration when judging the acceptability of a nonmetallic enclosure are:

- a) 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.

All these factors are considered with respect to aging as specified in the Polymeric Materials Tests, Section 47, and the Mechanical Strength Tests for Enclosures, Section 52. See also the Standard for Tests for Flammability of Plastic Materials in Devices and Appliances, UL 94.

No Text on This Page



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 in inches (mm)			
Maximum width, ^b		Maximum length, ^c		Maximum Width, ^b		Maximum length, ^c		Uncoated (MSG)		Metal coated (GSG)	
inches	(cm)	inches	(cm)	inches	(cm)	inches	(cm)				
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 that is as rigid as one built with a frame of angles or channels. Construction considered to be without supporting frame includes a single sheet with single formed flanges (formed edges), a single sheet which is corrugated or ribbed, and 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,
Maximum width, ^b	Maximum length, ^c	Maximum width, ^b	Maximum length,	
inches (cm)	inches (cm)	inches (cm)	inches (cm)	inches (mm)
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 a single sheet with single formed flanges (formed edges), a single sheet which is corrugated or ribbed, and 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.

7.6 Doors, covers, and guards

7.6.1 An enclosure cover shall be hinged, sliding, or similarly attached so that it cannot be removed if it gives access to fuses or any other overcurrent protective device, the intended functioning of which requires renewal or if it is necessary to open the cover in connection with the intended operation of the product. However, if its position is supervised by a tamper contact which is connected in the closed protective circuit, an enclosure cover need not comply with the requirements of this paragraph.

7.6.2 Any cover, door, panel or mounting means for other than alarm initiating devices shall be electrically supervised if it gives access to any relay, terminal, control, or related component that might be subject to tampering, so that opening or removal shall result in an alarm or trouble signal.

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

7.7 Screens and expanded metal

7.7.1 A screen and expanded metal used as a guard, enclosure, or part of an enclosure shall comply with the requirements specified in 7.7.2 and 7.7.3 and the Mechanical Strength Tests for Enclosures, Section 52. However, if removal of a screen or expanded metal mesh used as a guard, enclosure, or part of an enclosure does not result in risk of fire, electric shock, or unintentional contact with a moving part that may cause injury to persons, 7.7.2 and 7.7.3 do not apply.

7.7.2 Perforated sheet steel and sheet steel used for expanded metal mesh shall be not less than 0.042 inch (1.07 mm) thick [0.045 inch (1.17 mm) if zinc coated] if the mesh openings or perforations are 1/2 square inch (323 mm²) or less in area, and shall be not less than 0.080 inch (2.03 mm) thick [0.084 inch (2.13 mm) if zinc coated] for larger openings. The largest dimension shall not exceed 4 inches (102 mm). However, if the indentation of a guard or the enclosure will not alter the clearance between uninsulated live parts and grounded metal so as to impair intended performance or reduce spacings below the minimum required values, see (Spacings) General, Section 21, 0.020 inch (0.51 mm) expanded steel mesh or perforated sheet steel [0.023 inch (0.58 mm) if zinc coated] may be used, if the exposed mesh on any one side or surface of the product has an area of not more than 72 square inches (464 cm²) and has no dimension greater than 12 inches (305 mm) or the width of an opening is not greater than 3-1/2 inches (89 mm).

7.7.3 The wires of a screen shall be not smaller than No. 16 AWG (1.3 mm²) steel if the screen openings are 1/2 square inch (323 mm²) or less in area, and shall be not smaller than No. 12 AWG (2.1 mm²) steel 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 37.

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 employing 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 is acceptable. 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 An iron or steel part, other than a bearing and the like, where such protection is impracticable, shall be made resistant to corrosion by enameling, galvanizing, sherardizing, plating, or equivalent means. However, this requirement does not apply to a part, such as a washer, screw, bolt, or the like if malfunction of such a part would not result in a risk of fire, electric shock, or unintentional contact with moving parts that may cause injury to persons, or not impair the intended operation of the product. This requirement also does not apply to a part made of stainless steel that, polished or treated, if necessary, is inherently resistant to corrosion.

9.2 The requirement specified in 9.1 applies to all enclosures of sheet steel or cast iron, and to all springs and other parts upon which intended mechanical operation may depend. Bearing surfaces shall be of such materials and construction as to resist binding due to corrosion.

9.3 Metals used shall be galvanically compatible. However, if galvanic action does not result in impaired intended operation of the product, impaired security, or in a risk of fire, electric shock, or unintentional contact with moving parts that may cause injury to persons, this requirement does not apply.