UL 1863

STANDARD FOR SAFETY

Communications-Circuit Accessories

UL Standard for Safety for Communications-Circuit Accessories, UL 1863

Fourth Edition, Dated May 14, 2004

Summary of Topics

This revision of ANSI/UL 1863 dated October 14, 2019 includes the addition of reference UL 62368-1 as an alternative to UL 60950-1.

The revised requirements are are substantially in accordance with Proposal(s) on this subject dated July 26, 2019.

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.

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UL 1863

Standard for Communications-Circuit Accessories

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Fourth Edition

May 14, 2004

This ANSI/UL Standard for Safety consists of the Fourth Edition including revisions through October 14, 2019.

The most recent designation of ANSI/UL 1863 as an American National Standard (ANSI) occurred on October 1, 2019. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

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 https://csds.ul.com.

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INTRODUCTION

1 Scope

1.1 These requirements cover telecommunications-circuit accessories, such as jack and plug assemblies, quick-connect terminal assemblies, telephone wall plates, telephone extension cords, cross-connect terminal-block assemblies, maintenance terminal modules, terminal enclosures, cable-splice enclosures, network-interface devices, wire-guide assemblies, and connector boxes.

1.2 These devices are intended to be used in telecommunications networks that have an operating root-mean-square (rms) voltage to ground less than 150 volts and installed or used in accordance with the National Electrical Code, ANSI/NFPA 70.

1.3 These requirements do not cover telephone equipment such as telephone answering devices, residential telephone instruments, telephone dialers, cordless phones, key systems, and private-branch exchange equipment that is covered by the Standard for Information Technology Equipment – Safety – Part I: General Requirements, UL 60950-1, or the Standard for Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements, UL 62368-1. Also, these requirements do not cover:

a) Telephone protectors that are covered by the Standard for Protectors for Paired-Conductor Communications Circuits, UL 497, and

b) Secondary protectors that are covered by the Standard for Secondary Protectors for Communications Circuits, UL 497A.

c) Information Technology and Communications Equipment Cabinets, Enclosure and Rack Systems are investigated to the Standard for Information Technology Equipment – Safety – Part 1, UL 60950-1 or Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements, UL 62368-1.

1.4 These requirements do not cover receiver/transmitter-type devices. Equipment of this type is covered by the Standard for Audio, Video and Similar Electronic Apparatus – Safety Requirements, UL 60065; or the Standard for Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements, UL 62368-1.

1.5 These requirements may be used, directly or by reference, to investigate portions of other equipment, not classified as telecommunications-equipment accessories, that may be connected to a telecommunications network, insofar as they may be applicable to such equipment.

1.6 These requirements do not cover wires and cables intended to be permanently installed in a building in accordance with Article 800 of the National Electrical Code, ANSI/NFPA 70.

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.

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

a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard, or

b) Is superseded by a requirement in this standard.

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

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

2.2 Units of measurement

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

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

2.3 Undated references

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

3 Glossary

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

3.2 COMMON MODE VOLTAGE – When applied to telecommunications leads, this term refers to the voltage between any conductor or connection point and earth ground. Also referred to as Longitudinal Voltage.

3.3 DIFFERENTIAL MODE VOLTAGE – When applied to telecommunications leads, this term refers to the voltage between any conductors or connection points excluding those connected to earth ground. Also referred to as Metallic Voltage.

3.4 ELECTRICAL ENERGY – HIGH-CURRENT LEVELS (POWER SUPPLIES) – The capability for damage or injury to persons (other than by electric shock) from available electrical energy is considered to exist when, between a live part and an adjacent dead-metal part or between live parts of different polarity, there exists a potential of 2 volts or more and either:

a) An available continuous power level of 240 volt-amperes or more or

b) A reactive energy level of 20 joules or more.

For example, a tool (or other metal) short-circuiting a component is capable of posing a risk of fire, electric shock, or injury to persons (burns) when enough energy is available at the component to vaporize, melt, or more than warm the metal.

3.5 ENCLOSURE – The word "enclosure" refers only to parts that house or cover:

a) Uninsulated live parts that involve a risk of electric shock or

b) Parts that involve a risk of fire, electrical energy/high-current levels, or injury to persons.

An enclosure may be an integral part of a component, a separate item or part of an outer cabinet.

3.6 FIXED OR STATIONARY EQUIPMENT – Equipment that is not easily moved, and is intended to be moved from one place to another only when de-energized. Fixed equipment is usually fastened or secured to the building.

3.7 GROUND – A conducting connection, whether intentional or otherwise, between electrical circuits or electrical equipment and either the earth or some conducting body that serves in place of the earth.

3.8 GROUNDING – The act of establishing a conductive connection, whether intentional or otherwise, between an electrical circuit or electrical equipment and earth.

3.9 LONGITUDINAL VOLTAGE – See 3.2, Common Mode Voltage.

3.10 METALLIC VOLTAGE – See 3.3, Differential Mode Voltage.

3.11 NETWORK OPERATING VOLTAGES – Telecommunications networks normally operate at voltages of 56.5 volts DC or less, unless the source impedance is above the range of 300 – 1600 ohms. For equipment connected to a single tip and ring pair, alerting and test voltages higher than 56.5 volts are generally intermittent and will be present over less than 1 percent of the usage of the equipment. [Some telecommunications equipment, such as PBX and Key systems, may have a greater percentage of usage or operate at a higher voltage (such as T type lines)]. Maximum ring voltages may not exceed 200 volts peak-to-ground or 300 volts peak-to-peak.

3.12 NONPROTECTED SIDE – The portion of the loop circuit that rests on the primary side of a telephone protector installed by the operating telephone company. The fault current limitation is subject to the breakdown voltage characteristics of the primary protector and its coordinated fusing system (e.g., fuse link or bridle wire) with which the protector is intended to be used.

3.13 PORTABLE EQUIPMENT – Equipment that is easily moved and can be carried or conveyed by hand. Portable equipment is usually hand-held or hand-supported.

3.14 PRODUCT – This term refers to all types of telephone equipment and appliances likely to be used in residential, commercial, and industrial environments.

3.15 PROTECTED SIDE – Refers to that portion of the loop circuit that is connected to the secondary or output side of the primary telephone protector and is limited to short and long term current requirements for secondary protectors.

3.16 RISK OF ELECTRIC SHOCK – The risk that a person encounters when exposed to live uninsulated parts of a product that have a voltage and current sufficient to cause an electric shock, as defined in Accessibility and Electric Shock, Section 8.

3.17 RISK OF FIRE – The risk that a fire may occur as a result of equipment or component failure or the application of specified test conditions. A risk of fire is considered to exist at any component unless an investigation of the circuit delivering power to that component complies with the power limitations criteria cited in this standard.

3.18 RISK OF INJURY TO PERSONS – A risk of injury to persons is considered likely to occur when one or more of the following conditions exist:

a) Sharp edges, burrs, or projections are present that can cause injury during use or servicing.

b) The stability of a product is such that it can cause injury to persons. See Stability, Section 22.

c) Uninsulated live parts involving a risk of electrical-energy/high-current levels are accessible to personnel. See Accessibility and Electric Shock, Section 8.

d) Contact with accessible live parts can cause an involuntary reaction that is a risk of injury. See Accessibility and Electric Shock, Section 8.

3.19 TELECOMMUNICATIONS – Any transmission or reception of information such as signals, images, writing, or sounds, by electronic means.

3.20 TELECOMMUNICATIONS EXTENSION CORD – A telecommunications line cord that has a male connector on one end and a female connector on the other end.

3.21 TELECOMMUNICATIONS LINE CORD – The flexible cord used to connect a telephone set or other telecommunications device to the telecommunications line at the network interface or connecting blocks within the loop circuit. The cord may have male locking-type modular connectors on one or both ends for a plug-in arrangement or may have spade terminals on either or both ends for screw-type connections.

3.22 TELECOMMUNICATIONS NETWORK – A metallically terminated transmission medium intended for communication between equipment that may be located in separate buildings, excluding:

a) The mains system for supply, transmission and distribution of electrical power, if used as a telecommunications transmission medium;

b) Cable distribution systems; and

c) Interconnecting circuits of information technology equipment.

Examples of telecommunications networks are a public switched telephone network; a public data network; an Integrated Services Digital Network (ISDN); and a private network with electrical interfaces similar to the above.

3.23 TELECOMMUNICATIONS NETWORK INTERFACE DEVICE – A piece of equipment that may have an enclosure that provides a point of interconnection between the telephone company communications network facilities and terminal equipment, protective apparatus or wiring at a subscriber's premises. The network interface or demarcation point is located on the subscriber's side of the telephone company's protector, or what has been determined to be the equivalent, in cases where the protector is not used, as provided under the local telephone company's reasonable and nondiscriminatory standard operating practices. The network interface enclosure may use compatible telephone protectors within the unit.

3.24 TELECOMMUNICATIONS (TELEPHONE) EQUIPMENT – A device intended to be connected to a telecommunications network and used for receiving information or transmitting information, or both, along the network.

3.25 TELEPHONE FIELD-WIRING TERMINAL – Any terminal to which a telephone circuit can be connected by an installer in the field is a telephone field-wiring terminal unless the wire is provided as part of the product and installed within the factory. A telephone field-wiring terminal may consist of a screw-type terminal, quick-connect insulation stripping system, wire wrap terminal, or plug/jack arrangement.

3.26 TELEPHONE LOOP BRANCH CIRCUIT – The circuit that connects telephone equipment to the network interface. For simple wiring, this is a single pair of conductors per circuit. For system wiring, this may consist of multipair conductors. The telephone loop circuit may be branched at a junction point,

usually contained in a cross-connect terminal block, network interface device or assembly, or telephone outlet terminal block.

3.27 TOOL – Any means, other than manual manipulation, needed to open an enclosure of a device.

3.28 USER'S ACCESS AREA – All external surface areas and all internal areas that can be entered without the use of a tool, and all areas that the user is instructed to enter regardless of whether or not tools are needed to gain access.

3.29 USER SERVICING – Any form of servicing that can be performed by personnel other than those who are trained to maintain the equipment. User servicing is limited to user's access area. Some examples of user servicing are:

a) The installation of accessories by means of separable connectors such as modular connectors, attachment plugs and receptacles.

b) The changing or replacement of accessory boards, lamps, fuses, and resetting of circuit breakers.

CONSTRUCTION

4 General

4.1 A communications-circuit accessory shall be constructed so that it will be durable for its intended installation and use, as determined by compliance with the performance requirements of this standard.

4.2 A product shall use materials that have been deemed acceptable for the particular use, as determined by the performance requirements of this standard.

4.3 Metals shall not be used in such combination as to cause galvanic action that will increase the risk of fire, electric shock, or injury to persons.

4.4 When breakage or deterioration of a part such as an enclosure, a frame, a guard, or the like can result in a risk of injury to persons, the part shall be constructed to meet the demand of expected loading conditions.

5 Product Assembly

5.1 Except as specified in 5.2, a product shall be factory-built as a complete assembly and shall include all the essential components necessary for its intended function when installed (used) as intended. The product may be shipped from the factory as two or more subassemblies.

5.2 A product may be shipped from the factory unassembled, or disassembled to the degree necessary to facilitate shipment, when all of the following conditions are met:

a) All of the parts are furnished by the manufacturer;

b) Upon assembly, grounding continuity is provided where required between the field-assembled components;

c) The product is constructed so that the field assembly can be accomplished without requiring drilling, cutting, threading, or any other alteration other than the attachment of field-installed electrical conduit or raceway;

d) The relationship between separate parts is established at the time of manufacture, and is not dependent upon installation personnel;

e) Detailed step-by-step installation instructions are packed with the product, or in the case of multiple product assembly, an installation practice may be used;

f) Protective guards and other features intended to reduce the risk of fire are factory installed wherever possible.

6 Enclosure

6.1 General

6.1.1 An enclosure shall have the strength and rigidity necessary to resist the abuses to which the product is likely to be subjected during intended use without increasing the:

a) Risk of fire, electric shock, or injury to persons due to total or partial collapse, with resulting reduction of spacings to less than required and

b) Loosening, displacement, or exposure of parts, or other defects.

6.1.2 An enclosure or guard of metal shall have a minimum thickness as specified in Table 6.1 or Table 6.2, whichever applies.

Table 6.1
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			
Maximum width,[b]		Maximum length,[c]		Maximum width,[b]		Maximum length,[c]		Uncoated,		Metal coated,	
cm	(inches)	cm	(inches)	cm	(inches)	cm	(inches)	mm	(inch)	mm	(inch)
10.2	4.0	Not limited		15.9	6.25	Not limited		0.51	0.020[d]	0.58	0.023[d]
12.1	4.75	14.6	5.75	17.1	6.75	21.0	8.25				
15.2	6.0	Not limited		24.1	9.5	Not limited		0.56	0.026[d]	0.74	0.029[d]
17.8	7.0	22.2	8.75	25.4	10.0	31.8	12.5				
20.3	8.0	Not limited		30.5	12.0	Not limited		0.81	0.032	0.86	0.034
22.9	9.0	29.2	11.5	33.0	13.0	40.6	16.0				
31.8	12.5	Not limited		49.5	19.5	Not limited		1.07	0.042	1.14	0.045
35.6	14.0	45.7	18.0	53.3	21.0	63.5	25.0				
45.7	18.0	Not limited		68.6	27.0	Not limited		1.35	0.053	1.42	0.056
50.8	20.0	63.5	25.0	73.7	29.0	91.4	36.0				
55.9	22.0	Not limited		83.8	33.0	Not limited		1.52	0.060	1.60	0.063
63.5	25.0	78.7	31.0	88.9	35.0	109.2	43.0				
63.5	25.0	Not limited		99.1	39.0	Not limited		1.70	0.067	1.78	0.070
73.7	29.0	91.4	36.0	104.1	41.0	129.5	51.0				
83.8	33.0	Not limited		129.5	51.0	Not limited		2.03	0.080	2.13	0.084
96.5	38.0	119.4	47.0	137.2	54.0	167.6	66.0				
106.7	42.0	Not limited		162.6	64.0	Not limited		2.36	0.093	2.46	0.097
119.4	47.0	149.9	59.0	172.7	68.0	213.4	84.0				
132.1	52.0	Not limited		203.2	80.0	Not limited		2.74	0.108	2.82	0.111

Table 6.1 Continued on Next Page

Table 6.1 Continued

Without supporting frame[a]				With supporting frame or equivalent reinforcing[a]				Minimum thickness			
Maximum width,[b]		Maximum length,[c]		Maximum width,[b]		Maximum length,[c]		Uncoated,		Metal coated,	
cm	(inches)	cm	(inches)	cm	(inches)	cm	(inches)	mm	(inch)	mm	(inch)
152.4	60.0	188.0	74.0	213.4	84.0	261.6	103.0				
160.0	63.0	Not limited		246.4	97.0	Not limited		3.12	0.123	3.20	0.126
185.4	73.0	228.6	90.0	261.6	103.0	322.6	127.0				

[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) 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 12.7 mm (1/2 inch) wide.

[d] Sheet steel for an enclosure intended for outdoor use (rain resistant) is required to be not less than 0.91 mm (0.036 inch) in thickness when zinc coated and not less than 0.81 mm (0.032 inch) in thickness when uncoated.

Table 6.2
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,[c]			
cm	(inches)	cm	(inches)	cm	(inches)	cm	(inches)	mm	(inch)
7.6	3.0	Not limited		17.8	7.0	Not limited			
8.9	3.5	10.2	4.0	21.6	8.5	24.1	9.5	0.58	0.023[d]
10.2	4.0	Not limited		25.4	10.0	Not limited			
12.7	5.0	15.2	6.0	26.7	10.5	34.3	13.5	0.74	0.029
15.2	6.0	Not limited		35.6	14.0	Not limited			
16.5	6.5	20.3	8.0	38.1	15.0	45.7	18.0	0.91	0.036
20.3	8.0	Not limited		48.3	19.0	Not limited			
24.1	9.5	29.2	11.5	53.3	21.0	63.5	25.0	1.14	0.045
30.5	12.0	Not limited		71.1	28.0	Not limited			
35.6	14.0	40.6	16.0	76.2	30.0	94.0	37.0	1.47	0.058
45.7	18.0	Not limited		106.7	42.0	Not limited			
50.8	20.0	63.5	25.0	114.3	45.0	139.7	55.0	1.91	0.075
63.5	25.0	Not limited		152.4	60.0	Not limited			
73.7	29.0	91.4	36.0	162.6	64.0	198.1	78.0	2.41	0.095
94.0	37.0	Not limited		221.0	87.0	Not limited			
106.7	42.0	134.6	53.0	236.2	93.0	289.6	114.0	3.10	0.122
132.1	52.0	Not limited		312.4	123.0	Not limited			
152.4	60.0	188.0	74.0	330.2	130.0	406.4	160.0	3.89	0.153

Table 6.2 Continued on Next Page

Table 6.2 Continued

Without supporting frame[a]				With supporting frame or equivalent reinforcing[a]				
Maximum width,[b]		Maximum length,[c]		Maximum width,[b]		Maximum length,[c]		Minimum thickness,
cm	(inches)	cm	(inches)	cm	(inches)	cm	(inches)	mm (inch)

[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) 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 12.7 mm (1/2 inch) wide.

[d] Sheet steel for an enclosure intended for outdoor use (rain resistant) is required to be not less than 0.91 mm (0.036 inch) in thickness when zinc coated and not less than 0.81 mm (0.032 inch) in thickness when uncoated.

6.1.3 A conductive coating applied to a nonmetallic surface such as the inside surface of an enclosure, shall comply with the appropriate requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, unless it can be determined by investigation that flaking or peeling of the coating cannot result in the reduction of spacings or the bridging of live parts that may present a risk of electric shock or fire.

6.1.4 A communications-circuit accessory intended for outdoor use shall be provided with a weather resistant cover or enclosure and shall comply with the Rain Test, Section 42. When constructed of polymeric material, rubber, or the like, the accessory shall also comply with the tests described in the Weatherometer and Tensile Test, Section 43, and the Thermal Aging and Flame Test, Section 44.

6.1.5 A door or cover that is accessible from the outside of the enclosure and gives access to a resettable or replaceable overload protective device, shall be hinged or secured such that it is unlikely to be detached during servicing.

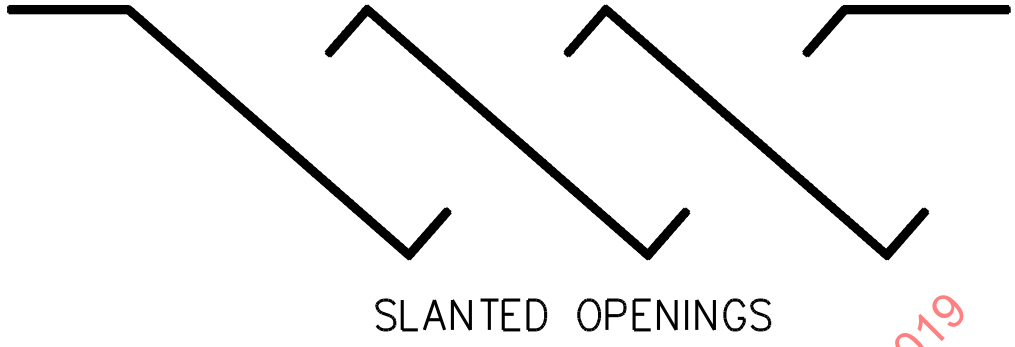
Exception No. 1: A door or cover that, by its function or size, obviously must be in place when the product is to operate as intended, need not be hinged or secured.

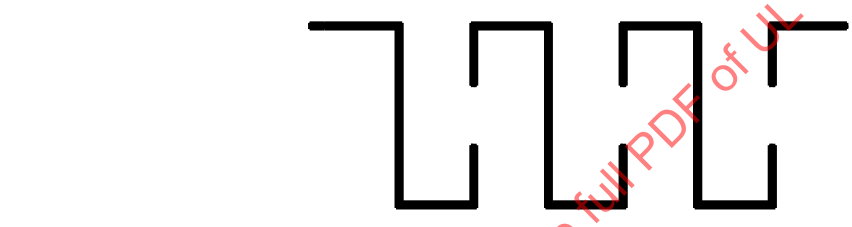
Exception No. 2: When a product complies with the requirements in Accessibility and Electric Shock, Section 8, with the door or cover removed, the door or cover need not be hinged or secured.

6.2 Enclosure top openings

6.2.1 An enclosure top opening or an opening directly over an uninsulated live part involving a risk of fire, electric shock, or electrical-energy/high-current level, shall not exceed 4.8 mm (0.19 inch) for any dimension unless the configuration is such that a vertically falling object cannot fall into the unit and contact an uninsulated live part. See Figure 6.1 for examples of top enclosure designs which may be used.

Figure 6.1
Cross sections of top-cover designs





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6.3 Enclosure side openings

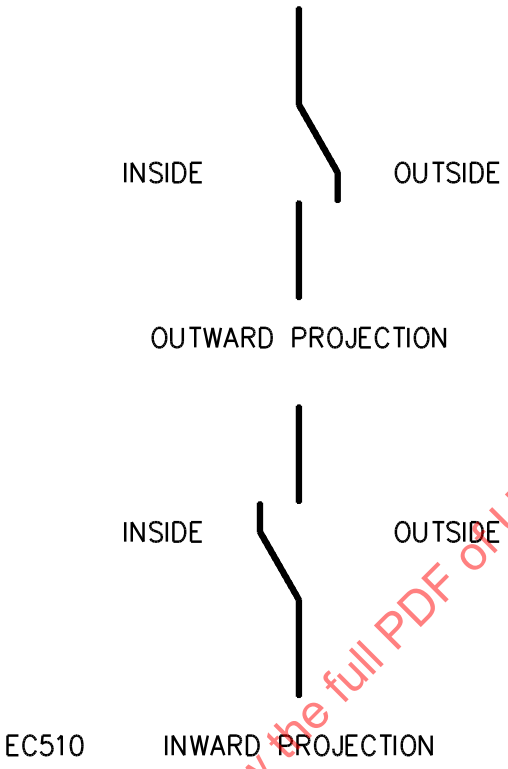
6.3.1 An opening in the side of the enclosure shall:

a) Not exceed 4.8 mm (0.19 inch) in any dimension; or

b) Be provided with louvers shaped to deflect an external falling object outward (see Figure 6.2 for examples of louver designs which may be used); or

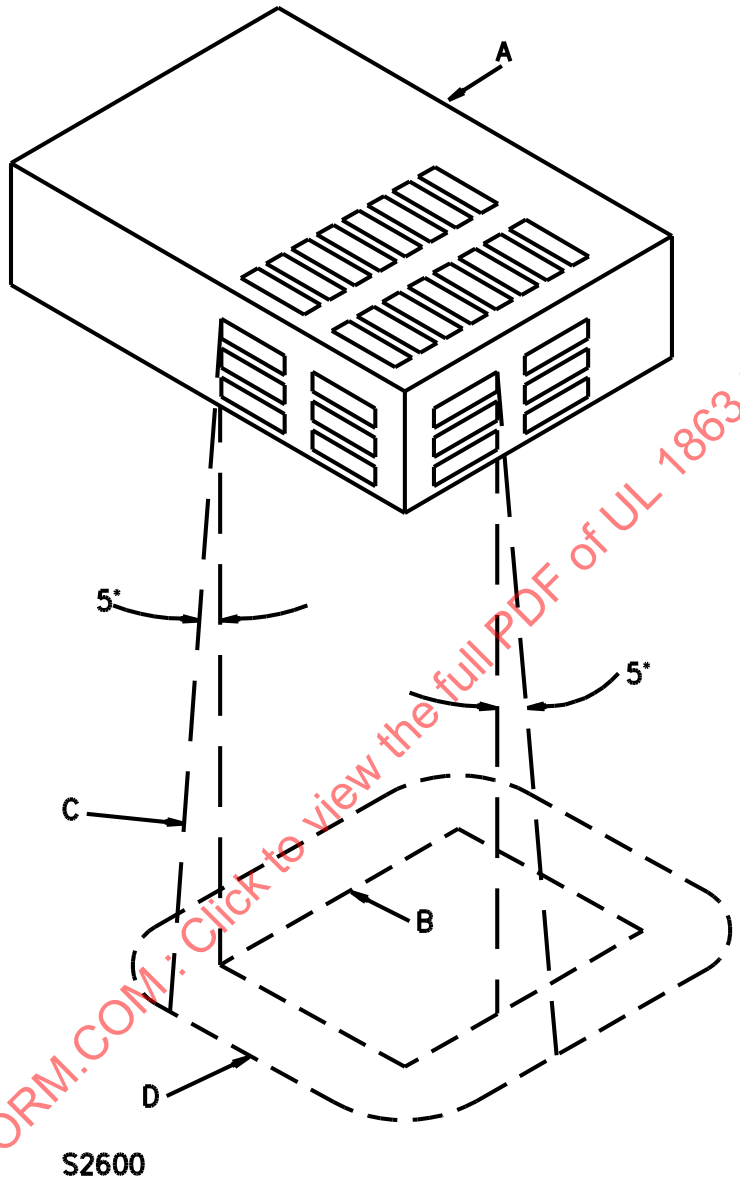
c) Be located and sized so that objects that may be present cannot fall into the unit and drop (with no horizontal velocity) onto uninsulated live parts involving a risk of fire, electric shock, electrical-energy/high-current levels or injury to persons.

Figure 6.2
Louvers



6.3.2 When a portion of a side panel falls within the area traced out by the 5-degree angle in Figure 6.3, that portion of the side panel shall be investigated as a bottom enclosure in accordance with 6.4.1 and 6.4.2.

Figure 6.3
Enclosure bottom



A – The entire component under which an enclosure (flat or dished with or without a lip or other raised edge) of noncombustible material is to be provided. The sketch is of an acceptably enclosed component with ventilation openings shown that the enclosure is required only for those openings through which flaming parts may be emitted. When the component or assembly does not have its own noncombustible enclosure, the area to be protected is the entire area occupied by the component or assembly.

B – Projection of the outline of the area of A that needs a bottom enclosure vertically downward onto the horizontal plane of the lowest point on the outer edge D of the enclosure.

C – Inclined line that traces out an area on the horizontal plane of the enclosure. Moving around the perimeter of the area B that needs a bottom enclosure, this line projects at a 5 degree angle from the line extending vertically at every point around the perimeter of A and is oriented to trace out the largest area; except that the angle may be less than 5 degrees when the enclosure bottom contacts a vertical enclosure or side panel, or when the horizontal extension of the enclosure B to D exceeds 152 mm (6 inch).

D – Minimum outline of the enclosure, except that the extension B to D need not exceed 152 mm (6 inch), flat or dished with or without a lip or other raised edge. The bottom 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 enclosure.

6.4 Enclosure bottom openings

6.4.1 The bottom of an enclosure shall consist of a complete or partial bottom enclosure under a component, groups of components, or assemblies, as shown in Figure 6.3, that complies with the ventilation opening requirements in 6.4.2 unless a test demonstrates that the bottom enclosure provided contains flames, glowing particles, and the like when all combustible material in the interior is ignited. The test procedure shall be conducted in accordance with the Limited Short-Circuit Current and Abnormal Operation Tests described in the Standard for Protectors for Paired-Conductor Communications Circuits, UL 497.

Exception No. 1: Units may have openings without limitation on their size and number in areas that contain only wires, cables, plugs, receptacles, and impedance-protected and thermally-protected assemblies on the protected side of a primary protector.

Exception No. 2: A product intended to be mounted on a concrete floor or other noncombustible surface is not required to be provided with a bottom enclosure when marked in accordance with 45.10.

6.4.2 Ventilation openings may be provided in the bottom of an enclosure under materials that are not rated V-1 or less flammable in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, when the openings are constructed so that materials do not fall directly from the interior of the unit. Other bottom opening constructions which may be used are those that incorporate a perforated metal plate as described in Table 6.3, or a galvanized or stainless steel screen having a 14 by 14 mesh per 25.4 mm (1 inch) constructed of wire with a diameter of 0.4 mm (0.018 inch) minimum. Other constructions are not prohibited from being used when they comply with the Limited Short-Circuit, Abnormal Operation and Glow-Mode Heating Tests described in the Standard for Protectors for Paired-Conductor Communications Circuits, UL 497.

Table 6.3
Perforated metal plates

Minimum thickness,		Maximum diameter of holes,		Minimum spacing of holes center to center,	
mm	(inch)	mm	(inch)	mm	(inch)
0.66	0.026	1.14	0.045	1.70	0.067
0.66	0.026	1.19	0.047	2.37	0.093
0.81	0.032	1.91	0.075	3.18	0.125
0.91	0.036	1.60	0.063	2.77	0.109
0.91	0.036	1.98	0.078	3.18	0.125

7 Materials

7.1 Communications-circuit accessories that use polymeric materials to enclose, support, or indirectly support current-carrying parts or live parts shall comply with the requirements for the flame class indicated in Table 7.1 and in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

Exception: When the material does not comply with the requirements of the specified flame class, it shall comply with the requirements in the Thermal Aging and Flame Test, Section 44.

Table 7.1
Flame classes for communications-circuit accessories

Protection status[a]	Type of use	Required flame class
Protected	Enclosure	V-0
Protected	Support	V-0
Protected	Support within enclosure	V-2
Protected	Indirect support	HB
Nonprotected	Enclosure	5VA
Nonprotected	Support	5VA
Nonprotected	Support within enclosure	V-2
Nonprotected	Indirect support	HB

[a] Protection status pertains to the circuit location of the accessory with respect to the primary telephone protector complying with the Standard for Protectors for Paired-Conductor Communications Circuits, UL 497. A nonprotected status indicates that the accessory is located between the outside plant and primary protector. When the product is located on the protected side of the primary protector, it then carries a protected status.

8 Accessibility and Electric Shock

8.1 Any product designed to be installed with exposed conductive parts shall be tested using the blunt-end accessibility probe shown in Figure 8.1. No contact between the probe and the exposed conducting part shall occur.

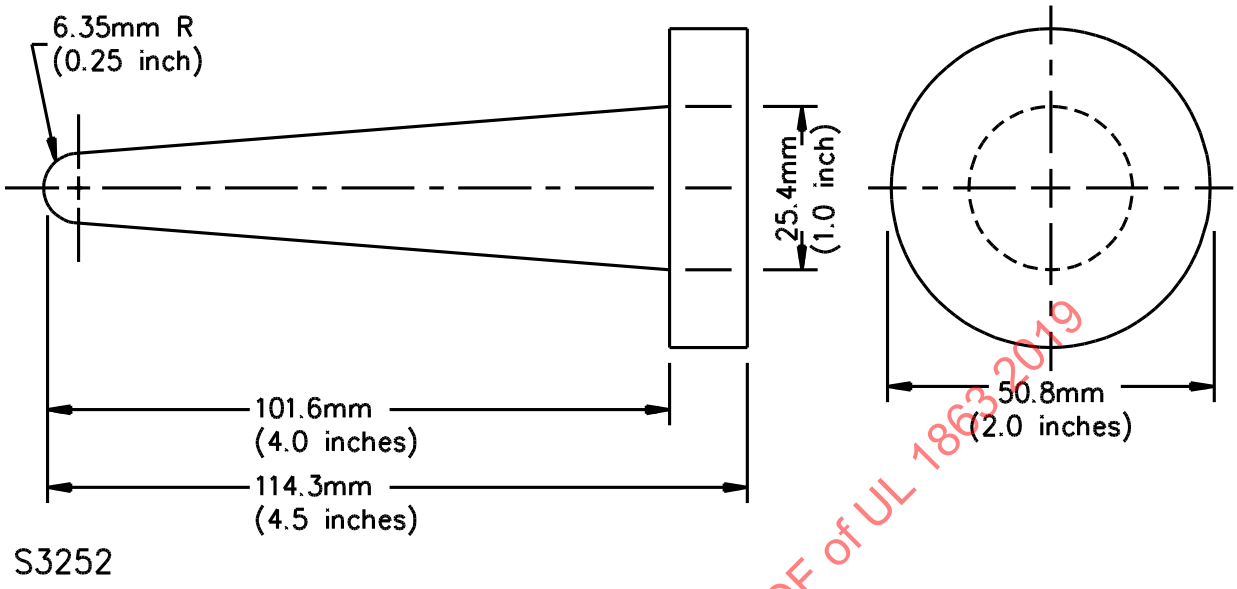
Exception: A product installed in the following locations need not comply with this requirement:

a) Restricted areas accessible to trained service personnel or trained users only.

b) Outside plant terminal equipment owned and serviced by the operating company providing the communications service.

c) Equipment located on subscriber premises, but owned and serviced by the operating company providing the communications service, and requiring special tools for access to the product.

Figure 8.1
Blunt-end accessibility probe



The surface of the conical portion of the probe shall be tangent to the surface of the spherical tip and this entire portion shall be constructed of a metallic conducting material.

8.2 To determine compliance with 8.1, the product shall comply with the Blunt-End Probe Test, Section 41.

9 Mechanical Assembly

9.1 A product shall be assembled so that it will not be affected adversely by vibration resulting from intended operation, such as may result from operation of motors or similar products producing vibrations.

9.2 A switch, fuseholder, lampholder, attachment-plug receptacle, motor-attachment plug, or other similar component shall be mounted securely and shall not turn.

Exception No. 1: When turning of a switch is possible, the following conditions shall be met:

a) The switch shall be of a plunger, slide, or other type that does not tend to rotate when operated (a toggle switch is considered to be subject to forces that tend to turn the switch during intended operation of the switch).

b) The means for mounting the switch makes it unlikely that operation of the switch may loosen it.

c) The spacings are not reduced below the minimum values when the switch rotates.

d) The intended operation of the switch is by mechanical means rather than by direct contact by persons.

Exception No. 2: A lampholder of the type in which the lamp cannot be replaced, such as a neon pilot or indicator light in which the lamp is sealed in a nonremovable jewel, may turn when rotation cannot reduce spacings below the minimum value.

9.3 Friction between surfaces shall not be used for securing the position of the parts mentioned in 9.2. A lock washer may be used as a means to secure the position of a device having a single-hole mounting means.

9.4 A rotating part that by loosening presents a risk of fire, electric shock, electrical-energy/high-current levels, or injury to persons shall be assembled so that the direction of rotation tends to tighten the means that hold the rotating part in place.

Exception: A keyed part, a press fit, a part locked in place with a pin, or means determined equivalent can be used to hold a rotating part in place.

10 Protection Against Corrosion

10.1 Iron and steel parts shall be protected against corrosion by enamelling, galvanizing, plating, or other means determined to be equivalent, when corrosion of the unprotected parts can result in a risk of fire, electric shock, or injury to persons.

Exception No. 1: Surfaces of sheet-steel and cast-iron parts within an enclosure need not be protected against corrosion when oxidation of the metal due to exposure to air and moisture is not likely to weaken the parts so as to result in a risk of fire, electric shock, or injury to persons. The thickness of metal and temperature are also to be considered.

Exception No. 2: Bearings, laminations, or minor parts of iron or steel, such as washers, screws, and the like, need not be protected against corrosion.

11 Cords

11.1 General

11.1.1 A line, extension, or distribution cord or a coiled handset shall use wire suitable for the application and shall comply with applicable flame test requirements in the Standard for Thermoplastic-Insulated Wires and Cables, UL 83.

11.2 Strain relief

11.2.1 Means shall be provided so that a flexible cord cannot be pushed into the product through the cord-entry hole when such displacement can result in damage to the cord or exposure of the cord to a temperature higher than that for which the cord is rated or can reduce spacings, such as to a metal strain-relief attachment, below the minimum values.

11.2.2 A telecommunications cord of any type shall be provided with means to keep tension on the cord from being transmitted to terminals, splices or wiring within the product. The strain-relief means provided shall comply with the Strain-Relief Test, Section 26.

11.3 Bushings

11.3.1 At the point at which a telecommunications cord passes through an opening in a wall, barrier, or the overall enclosure, there shall be a smooth, rounded bushing or the equivalent that shall be secured in

place, or a smooth, rounded surface against which the cord can bear. When other than a jacketed cord is used and the wall or barrier is of metal, an insulating bushing shall be provided.

11.3.2 When the cord hole is in porcelain, phenolic composition, soft rubber, neoprene, or another nonconducting material determined to be acceptable, a smooth, rounded surface is considered equivalent to a bushing.

11.3.3 Ceramic materials and some molded compositions are not prohibited from being used for insulating bushings.

11.3.4 Vulcanized fiber is not prohibited from being used for insulating bushings when the bushing is not less than 1.2 mm (3/64 inch) thick and is formed and secured in place so that it will not be adversely affected by conditions of ordinary moisture.

11.3.5 A separate soft-rubber, neoprene, or polyvinyl chloride bushing is not prohibited from being used on a cord where the cord enters the frame or enclosure when:

a) The bushing is not less than 1.2 mm (3/64 inch) thick and

b) The bushing is so located that it will not be exposed to oil, grease, oil vapor, or other substances that can have a deleterious effect on the compound used.

11.3.6 A bushing of any of the materials mentioned in 11.3.2 can be used on a cord anywhere in a product when it is used in conjunction with a type of cord for which an insulating bushing is not required. The edges of the hole in which such a bushing is used shall be free from burrs, fins, and other conditions that could damage the bushing.

12 Current-Carrying Parts

12.1 Current-carrying parts shall be of silver, copper, a copper alloy, stainless steel, aluminum, or other material determined acceptable for the application.

12.2 Bearings, hinges, and the like are not to be used as current-carrying parts.

13 Internal Wiring

13.1 General

13.1.1 The wiring and connections between parts of a product shall be protected or enclosed, or shall be in a cord or cable that has been determined acceptable.

13.1.2 Internal wiring shall be routed and secured so that the wires and electrical connections are not likely to be subjected to stress or mechanical damage.

13.1.3 A hole through which insulated wires pass in a sheet-metal wall within the overall enclosure of a product shall be provided with a smooth, rounded bushing or shall have smooth, rounded surfaces upon which the wires may bear.

13.1.4 Internal wiring shall be for use with the intended application, with respect to temperature, voltage, and exposure to oil, grease, solvents, acids and other conditions of service to which the wiring is likely to be subjected.

13.1.5 When internal wiring is likely to be exposed to moisture, including any condensation resulting from operation of the product, the wiring shall be determined acceptable for such exposure.

13.1.6 Flexing, vibration, impact, or other movement of wiring and any supplementary wire insulation during intended use, including user servicing, shall not reduce the wire insulation or the wire termination integrity.

13.1.7 Metal clamps and guides used for routing stationary internal wiring shall be provided with smooth, rounded edges. Auxiliary nonconducting mechanical protection shall be provided:

a) Under a clamp at which pressure is exerted on a conductor and not contacting the overall braid and

b) On any wire or wires that are subject to motion.

13.1.8 Wires shall be routed away from sharp edges (such as those found on screw threads, burrs, fins), moving parts, and the like, that can damage the wire insulation.

13.1.9 Insulated wires may be bunched and passed through a single opening in a metal wall within the enclosure of the product.

13.2 Splices and connections

13.2.1 All splices and connections shall be mechanically secure and shall be bonded electrically. A soldered connection shall be made mechanically secure before being soldered, when breaking or loosening of the connection can result in a risk of fire or electric shock. Consideration shall be given to vibration when investigating electrical connections. Pressure wire connectors may be used.

13.2.2 A splice shall be provided with insulation equivalent to that of the wires involved when permanence of spacing between the splice and other metal parts cannot be maintained.

13.2.3 In determining whether or not splice insulation consisting of coated-fabric, thermoplastic, or other type of tape or tubing is acceptable, consideration is to be given to factors such as mechanical strength, dielectric properties, and heat- and moisture-resistant characteristics.

13.2.4 When stranded internal wiring is connected to a wire-binding screw, there shall be no loose strands of wire that can contact other uninsulated live parts or dead-metal parts. This may be accomplished by use of pressure terminal connectors, soldering lugs, crimped eyelets, soldering all strands of the wire together, or other means that have been determined to be equivalent.

14 Interconnecting Cords and Cables

14.1 General

14.1.1 Flexible-cord or -cable assemblies used for external interconnection between sections of a product, or between products, shall be provided with strain relief and bushings in accordance with Section 11.

14.1.2 Inserting a male connector in a female connector other than the one intended to receive it, misalignment of male and female connectors, and other manipulations of parts that are accessible to the user shall not result in a risk of fire, electric shock, or injury to persons.

14.1.3 Connectors provided on interconnecting cords and cables shall comply with the requirements in Accessibility and Electric Shock, Section 8, with the connector out of its receptacle.

14.1.4 Interconnecting cables and external wiring containing Class 3 circuits provided as part of a system shall be determined acceptable for the application.

14.1.5 Interconnecting cables and external wiring containing telephone circuits shall be determined acceptable for the application.

14.2 Separation of circuits

14.2.1 Field-wiring telephone terminals or connectors for communication circuits shall not be in a wiring compartment, box, or other area with conductors or terminals for Class 1 circuits. Field-installed conductors shall be secured so that they cannot contact uninsulated live parts, field-installed wiring, or factory-installed wiring of any other circuit.

Exception No. 1: This requirement does not apply when a solid (unpierced) partition, permanently secured in place, is provided to separate field-installed conductors from field- and factory-installed conductors and live parts of any other circuit.

Exception No. 2: In units for which field connections for some applications are different from the connections for other applications, a removable solid partition or a permanent partition in which there are holes for the passage of conductors is not prohibited from being used. Instructions for use of a removable or pierced partition are to be a permanent part of the unit.

Exception No. 3: Instead of a partition, a wiring diagram may be provided on or with the unit when:

a) Provision is made for routing all conductors;

b) Such routing is clearly and completely shown by the diagram; and

c) Complete wiring instructions accompany the diagram.

Exception No. 4: Separation of some field-installed conductors from others and from uninsulated live parts connected to different circuits can be accomplished by arranging the location of openings in the enclosure for the various conductors (with respect to the terminals or other uninsulated live parts) so that there is no risk that the conductors or parts of different circuits can be intermingled. When no more openings than are necessary are provided in the enclosure for wiring of the unit and each opening is opposite a set of terminals, it is to be assumed in determining compliance with the requirement for the separation of terminals that conductors entering the enclosure through any such opening will be connected only to the terminals opposite that opening. When more openings than are necessary are provided in the enclosure for wiring the unit, it is to be assumed in determining compliance with the requirement for the separation of terminals that conductors will:

a) Enter the enclosure through openings that are not opposite the terminals to which they are intended to be connected and

b) Touch insulated conductors and uninsulated live parts of circuits other than their own.

14.2.2 In determining whether a unit complies with the requirements in 14.2.1, the unit is to be wired as intended in the field. Slack is to be left in each conductor within the enclosure, and care is to be used in stowing the slack in the compartment.

14.3 Terminals and connectors

14.3.1 External circuit connectors provided as part of the equipment shall comply with the applicable requirements in Accessibility and Electric Shock, Section 8.

15 Insulating Material

15.1 Uninsulated live parts involving a risk of fire, electric shock or electrical-energy/high-current levels, shall be mounted on porcelain, phenolic composition, or other material that has been determined acceptable for the application.

15.2 Vulcanized fiber may be used for insulating bushings, washers, separators, and barriers, but not as the sole support for uninsulated live parts when shrinkage, current leakage, or warpage can introduce a risk of electric shock or fire. Thermoplastic materials used for the direct or indirect support of uninsulated live parts involving a risk of fire, electric shock or electrical-energy/high-current levels shall comply with the requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

15.3 Molded parts shall have the mechanical strength and rigidity to withstand the stresses of intended operation.

15.4 An insulating liner shall be evaluated with respect to its usage. Barriers shall be held in place by a means more secure than friction between surfaces. The elasticity of tubing shall not be depended upon to hold the tubing in place. Heat shrink tubing may be used where a sharp edge or point is not involved.

16 Printed-Wiring Board

16.1 A printed-wiring board shall comply with the requirements in the Standard for Printed-Wiring Boards, UL 796.

16.2 A resistor, capacitor, inductor, or other part that is mounted on a printed-wiring board to form a printed-wiring assembly shall be secured so that it cannot be displaced to cause a risk of electric shock or fire by a force likely to be exerted on it during assembly, intended operation, or servicing of the board.

16.3 Consideration is to be given to a barrier or a partition that is part of an enclosure assembly and that provides mechanical protection and electrical insulation of a component connected to the printed-wiring board.

16.4 A printed-wiring board shall be classed in accordance with the requirements in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, as follows:

a) V-0 for a printed-wiring board that contains telecommunications (telephone) network circuits where the power capable of being delivered to an external resistor connected in parallel to the circuit load is 15 watts or more. The electrical measurements shall be in accordance with the Electrical Measurement Test, Section 30.

b) A minimum of V-2 for a printed-wiring board operating at normal telecommunications-network voltage and current level and contained in a complete metal enclosure or a complete polymeric enclosure that complies with the requirements of the 5VA flame test. When the enclosure is restricted to the protected circuit on the secondary side of a primary protector, the enclosure shall have a minimum flammability rating of V-0.

17 Overcurrent (Overload) Devices

17.1 An overcurrent device shall have a current and voltage rating not less than the load it controls, and shall not open the circuit during intended use of the product.

17.2 A protective device, the normal functioning of which requires renewal, replacement or resetting, shall be in a readily accessible location.

Exception: The requirement does not apply when the presence of the protective device would ordinarily be unknown to the user of the product because of its location and the omission of reference to the device in the operating instructions, circuit diagrams, and the like, provided with the product.

18 Spacings

18.1 The spacings between telephone field-wiring terminals of opposite polarity and the spacings between a telephone field-wiring terminal and any other uninsulated metal part, dead or live, not of the same polarity shall not be less than indicated in 18.2 – 18.8.

18.2 In all telecommunications circuits, the acceptability of spacings between an uninsulated live part and any other uninsulated metal part (dead or live) not of the same polarity shall be determined by the Dielectric Voltage-Withstand Test, Section 31.

18.3 At terminal screws and studs that are factory installed and to which connections may be made in the field by means of wire connectors, eyelets, and the like, spacings shall not be less than 3.2 mm (1/8 inch) when such connectors, eyelets, and the like, are in such position that minimum spacings – opposite polarity and to dead metal – exist.

18.4 An insulating lining or barrier of vulcanized fiber or similar material used where spacings would otherwise not comply shall not be less than 0.8 mm (1/32 inch) thick, and shall be so located or of such material that it will not be adversely affected by arcing.

Exception No. 1: Vulcanized fiber not less than 0.4 mm (1/64 inch) thick may be used in conjunction with an air spacing of not less than 50 percent of the spacing required for air alone.

Exception No. 2: An insulating lining or barrier may be less than 0.8 mm thick when the material can be used for the application in accordance with Insulating Material, Section 15.

18.5 When an uninsulated live part is not fixed in position by means other than friction between surfaces, or when a movable dead metal part is in proximity to an uninsulated live part, the construction shall be such that the required minimum spacings shall be maintained with the part in any position.

18.6 Snap or plug-in type connectors such as RJ-11 type jacks shall maintain a spacing between live conductors or parts of opposite polarity of not less than 0.558 mm (0.022 inch).

18.7 Wire insulation piercing terminals such as quick-connect type terminals requiring insertion tools shall maintain a minimum 1.2 mm (3/64 inch) spacing between terminals.

18.8 Wire wrap terminals requiring the use of a wire-wrap tool shall maintain a 1.2 mm (3/64 inch) spacing between adjacent terminals when wired as intended.

RISK OF INJURY TO PERSONS

19 General

19.1 When the operation and maintenance of a product by the user involves a risk of injury to persons, means shall be provided to reduce the risk.

19.2 When evaluating a product with regard to the requirement in 19.1, consideration shall be given to reasonably foreseeable misuse of the product.

19.3 An accessory that is made available or recommended by the manufacturer for use with the basic product shall be included in the evaluation of the product.

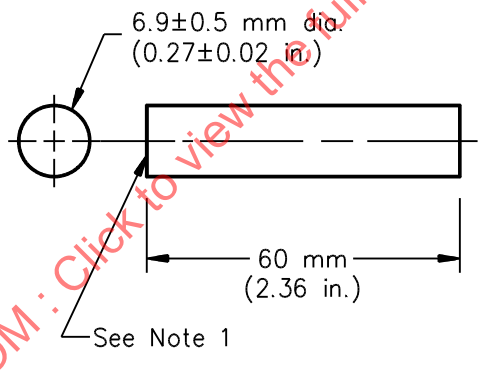
19.4 The acceptability of a guard, a safety release, an interlock and the like, and whether such a device is required, shall be determined from an investigation of the complete product, its operating characteristics, and the risk of injury to persons. The investigation shall include consideration of the results of breakdown or malfunction of any one component; but not more than one component at a time, unless one event contributes to another. When the investigation shows that breakdown or malfunction of a component can result in a risk of injury to persons, the component shall be investigated for reliability.

20 Modular Jacks

20.1 The contact pins of a modular-type jack that are accessible without the use of a tool shall be positioned, shaped, recessed, or the like to reduce the risk of injury to persons.

20.2 Compliance with the requirement in 20.1 is determined by inserting the probe shown in Figure 20.1 into the opening of the jack with a force not exceeding 4.45 N (1 lbf), and a distance not exceeding 4.5 cm (1.77 inches). The results do not comply when the probe cannot be withdrawn from the opening without rotating it or applying a force to the probe of more than 4.45 N.

Figure 20.1
Rubber accessibility probe



Note 1: Material: Soft Rubber Compound
Tensile strength: 80–100 psi
% Elongation: 36–50
Hardness[a]: 56–76

a Hardness as determined by a Type A Shore Durometer for rubber hardness–ASTM D2240

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21 Sharp Edges

21.1 An enclosure, edge, frame, projection, guard, opening, handle, or the like shall be smooth and free from sharp edges that are capable of constituting a risk of injury to persons during intended maintenance and use.

Exception: A sharp edge that must be exposed to enable the product to perform its intended function is acceptable.

21.2 For edges where the degree of sharpness cannot be determined by inspection, compliance with the requirement in 21.1 is determined by the test procedure in the Standard for Tests for Sharpness of Edges on Equipment, UL 1439.

22 Stability

22.1 Under all conditions of servicing and intended use after installation, a fully assembled product shall not become physically unstable to the degree that it can result in a risk of injury to operators or service personnel.

22.2 The requirements in 22.3 – 22.7 apply to freestanding products. A freestanding product is defined as one that is floor standing and not intended to be secured to other units or to the floor or other part of the building.

22.3 In conducting the tests described in 22.4 – 22.7, casters and jacks are to be placed in their most unfavorable positions and wheels are to be locked or blocked. When casters are being used only to transport the product and jacks are lowered after installation, the jacks and not the casters are to be used in their most unfavorable position for the test, consistent with reasonable leveling of the product.

22.4 A freestanding product that has an external surface (work top or ledge) at a height not exceeding 1.00 m (39-3/8 inches) from the floor and that is likely to be stepped or sat upon, shall not tip over when a continuous downward force of 800 N (179.8 lbf) is applied to that surface at the point of maximum moment. For this test all doors, covers, gates, drawers, and the like shall be in place and closed.

22.5 With regard to the requirement in 22.4, delicate parts such as keyboards, control panels, spools, and the like are not considered likely to be stepped on or sat upon.

22.6 A freestanding product more than 1.00 m (39-3/8 inches) high and weighing more than 25.0 kg (55.1 pound) shall not tip over when a force equal to 1/5 the weight of the unit but not more than 250 N (56.2 lbf) is applied in any direction, except upward, at a height not exceeding 2.00 m (78-3/4 inches) from the floor. For this test, all doors, drawers, frames and the like that can be opened are to be opened and placed in the most unfavorable position. Separate tests may be performed when user and service extensions are different or when stabilizers are used in accordance with 22.7.

22.7 A stabilizing means is not prohibited from being used to improve stability when doors, drawers, and the like are opened. The stabilizing means shall be automatic in operation or interlocked when associated with user use.

23 Protection of Service Personnel

23.1 The requirements of this section apply only to products of such size and complexity that it may be necessary for service personnel to reach over, under, across or around uninsulated electrical parts or moving parts to make adjustments or measurements with the product energized.

23.2 An uninsulated part that involves a risk of electric shock (see Accessibility and Electric Shock, Section 8) shall be located or guarded so that unintentional contact with the part is not likely during service operations involving other parts of the product.

23.3 Equipment operating at telecommunications network voltages higher than the typical voltages specified in 3.11 (for example, T-type lines) shall be provided with a marking as specified in 45.11 to warn service personnel of the risk of electric shock.

23.4 Required guards or barriers shall be capable of being removed and replaced with a minimum of effort when removal is necessary for servicing the protected parts.

PERFORMANCE

24 General

24.1 Electronic circuits

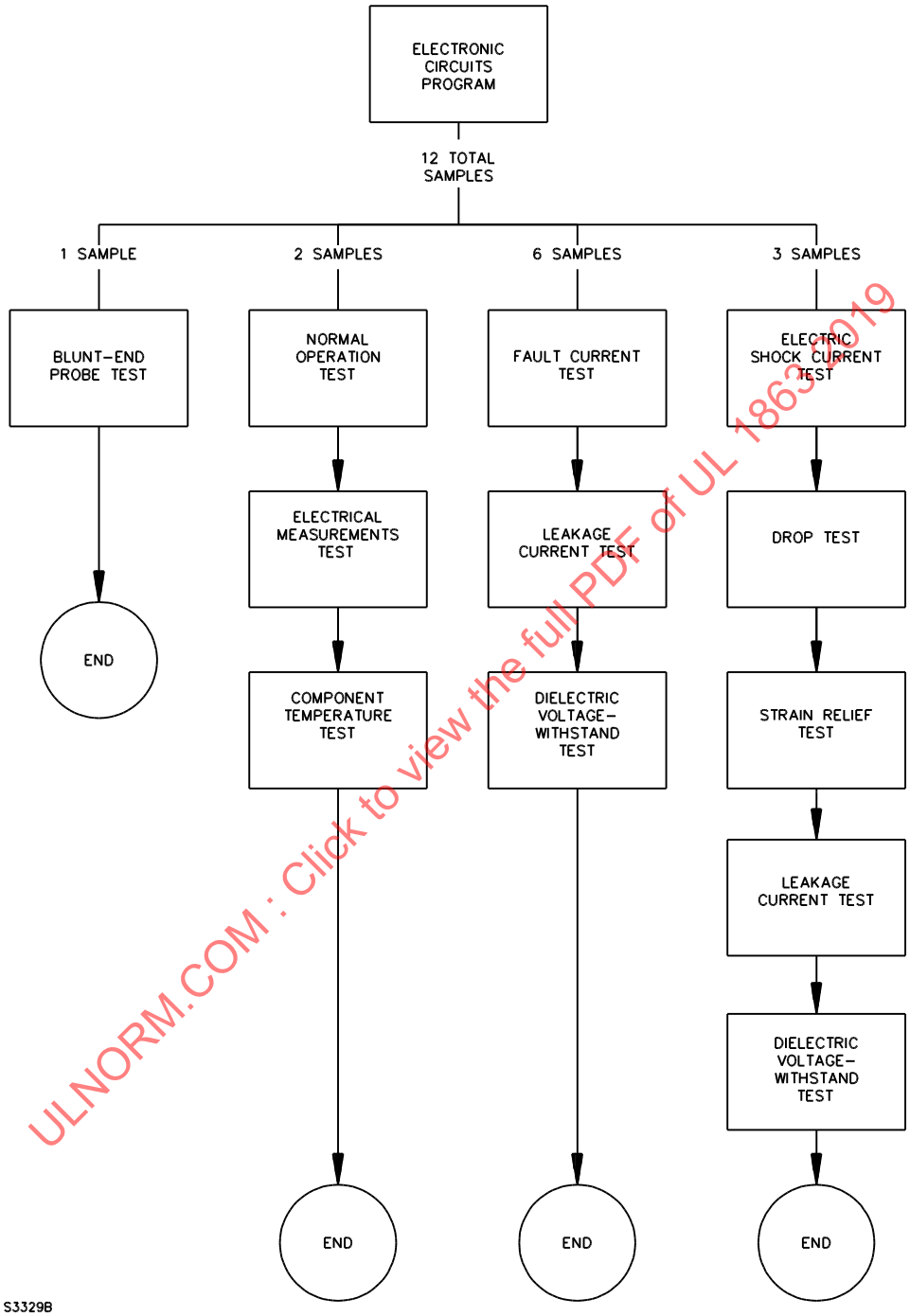
24.1.1 The performance of electronic circuits is to be investigated by subjecting representative samples of each rating to the tests indicated in Table 24.1 and Figure 24.1, in the sequence indicated.

Table 24.1
Required tests

Test	Electronic circuits	Current-carrying parts	Enclosures
Thermal Aging and Flame Test, Section 44	No	Yes	a
Normal Operation Test, Section 29	Yes	No	No
Electrical Measurements Test, Section 30	Yes	No	No
Fault Current Test, Section 25	Yes	Yes	No
Strain-Relief Test, Section 26	Yes	Yes	No
Dielectric Voltage-Withstand Test, Section 31	Yes	Yes	Yes
Leakage Current Test, Section 27	Yes	Yes	No
Electric Shock Current Test, Section 28	a	No	No
Drop Test, Section 33	a	a	a
Component Temperature Test, Section 32	Yes	No	No
Impact Test, Section 34	No	a	a
Crush Test, Section 35	No	a	a
Heat Test, Section 37	No	Yes	No
Millivolt Drop Test, Section 36	No	Yes	No
Torque Test, Section 38	No	a	No
Rain Test, Section 42	No	No	a
Weatherometer and Tensile Test, Section 43	No	No	a
Flex Test, Section 39	No	Yes	No
Pull Test, Section 40	No	Yes	No
Blunt-End Probe Test, Section 41	Yes	Yes	Yes

[a] Indicates that these tests may be required depending on items such as intended use of the product, mounting position, materials used, and the like.

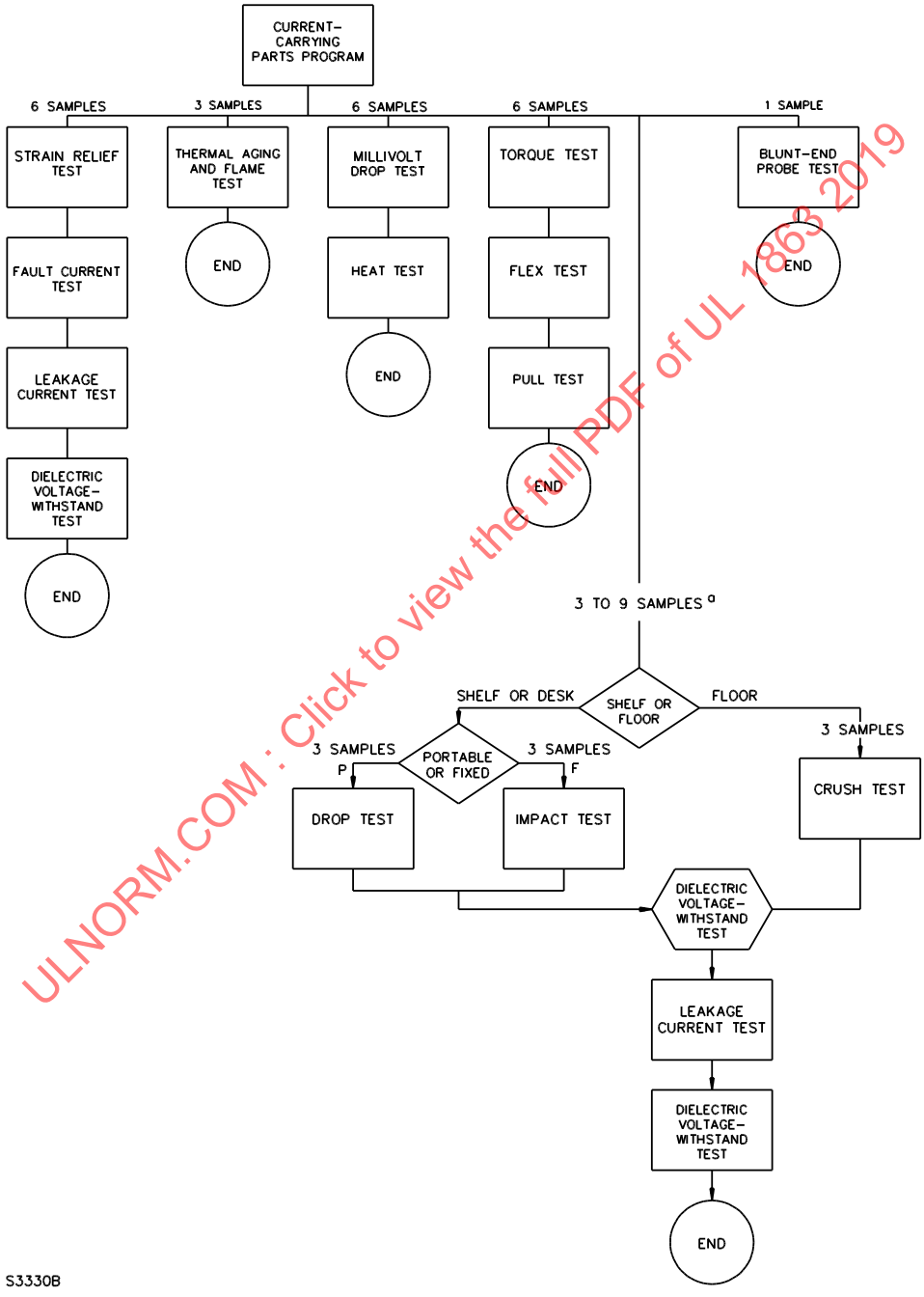
Figure 24.1
Electronic circuits program



24.2 Current-carrying parts

24.2.1 The performance of current-carrying parts is to be investigated by subjecting representative samples of each rating to the tests indicated in Table 24.1 and Figure 24.2, in the sequence indicated.

Figure 24.2
Current carrying parts program

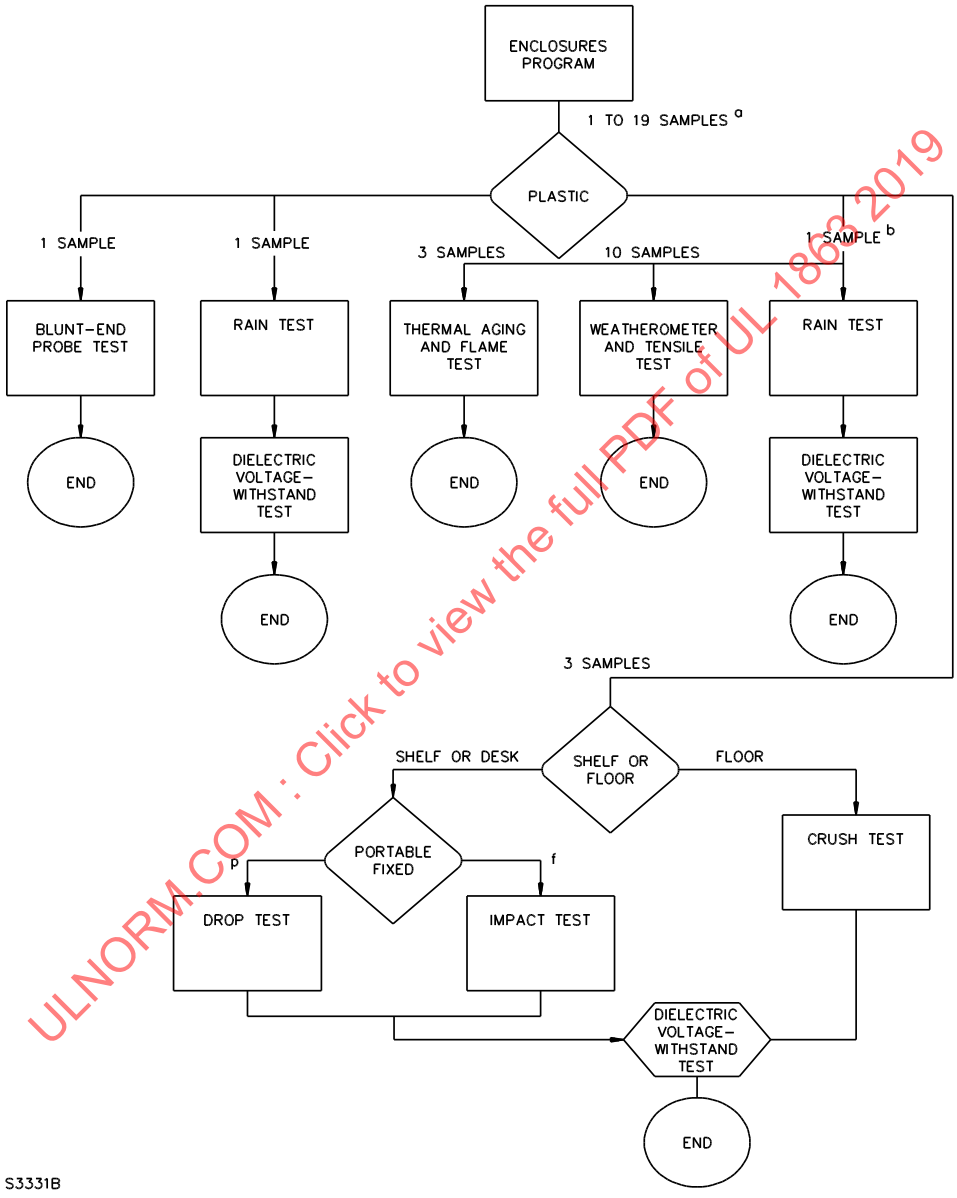


[a] Number of samples needed depends on product's intended use.

24.3 Enclosures

24.3.1 The performance of enclosures is to be investigated by subjecting representative samples to the tests indicated in Table 24.1 and Figure 24.3, in the sequence indicated.

Figure 24.3
Enclosure program



[a] Number of samples needed depends on product's intended use.

[b] Conducted only when product is intended for outdoor use.

25 Fault Current Test

25.1 General

25.1.1 A current-carrying part such as a telephone extension cord, cable assembly, jack and plug assembly, quick-connect terminal block, and the like and electronic telephone circuits such as half-ringer circuits and loop disconnect circuits shall comply with the requirements of this section.

25.2 Current-carrying parts

25.2.1 A fixed or stationary current-carrying part is to be mounted in a position of intended use and connected in a simulated telephone loop circuit in accordance with the manufacturer's installation requirements.

25.2.2 A total of six samples are to be tested. Three samples shall be subjected to each of the following abnormal fault current conditions:

a) An open-circuit test voltage of 600 volts AC, 50 – 60 hertz, with a short circuit current level of 2.2 amperes, is to be applied for a period of 30 minutes.

b) An open-circuit test voltage of 600 volts AC, 50 – 60 hertz, with a short circuit current level of 7.0 amperes, is to be applied for a period of 5 seconds.

25.2.3 When testing a telephone wire or an extension cord, the line or extension cord is to be prepared for testing as follows: a circular loop with an inside diameter of 25 mm (1 inch) is to be formed approximately 76 mm (3 inches) from the end of the cord connected to the telecommunications network. When the cord diameter is too large to form a circular loop of 25 mm, a loop with a diameter as close as practical to 25 mm is to be formed. The loop is to be fixed with a nonmetallic fastener such that the sections of the cord do not cross within the loop. The cord is to be mounted in a vertical plane and draped with a single ply of bleached cotton cheesecloth that is 28 – 30 m^2/kg (14 – 15 square yard/pound) and having a 13 by 11 (32 by 28) count. This count means that for any square centimeter there are 13 threads in one direction and 11 in the other, or for a square inch there are 32 threads in one direction and 28 in the other.

25.2.4 The test voltage is to be applied to a representative tip-and-ring pair of the smallest size (AWG) wires in the cord (at the end of the cord nearest the loop for line or extension cords), with the other end terminating in a short circuit.

25.2.5 When testing a coiled handset cord, it is to be prepared for testing as follows: the cord is to be laid flat and then extended to twice its at rest length. The ends are to be fixed with a nonmetallic fastener. A long cord may be looped around a cylinder such that adjacent coils do not touch.

25.2.6 A line or extension cord or coiled handset shall be subjected to the abnormal fault current conditions described in 25.2.2.

25.3 Electronic circuits

25.3.1 In the case of electronic telephone circuits, each circuit or module is to be connected in accordance with the manufacturer's installation literature and all intentional ground connections made before the circuit is energized. Three samples of each type of electronic circuit shall be subjected to each of the abnormal fault current test conditions described in 25.2.2.

25.3.2 The samples are to be mounted in a vertical plane and draped with a single ply of bleached cotton cheesecloth having a count as specified in 25.2.3.

25.3.3 As a result of the test:

a) There shall be no ignition, charring of the cheesecloth, or emission of flame or molten metal from the product. Charring has occurred when the structural integrity of the threads has been destroyed due to a temperature rise.

b) Each sample shall withstand, without breakdown, the application of 1000 volts applied between the conductors and foil wrapped around the entire assembly. A second application of 1000 volts is to be applied to conductors operating at different potentials.

25.3.4 When series components of a circuit are used, the output of the circuit is to be shorted between tip and ring when this test is conducted.

26 Strain-Relief Test

26.1 A cord-splice lead shall not pull out of the plug, connector, or jack to the extent that bare conductors are exposed when subjected to the conditions specified in 26.2 and 26.3. When, after this test, the assembly is otherwise damaged and still operational, it shall comply with the applicable requirements of the Fault Current Test, Section 25, the Leakage Current Test, Section 27, and the Dielectric Voltage-Withstand Test, Section 31, as shown in Figure 24.1 and Figure 24.2.

26.2 The plug, connector, or jack is to be mounted with the cord hanging in a vertical position. A force of 50 N (11.25 lbf) is to be gradually applied to the cord. The direction of application of the force is to be varied from directly downward to an angle of 45 degrees from the vertical in all directions. The force is to be applied for a period of 1 minute.

26.3 When the strain-relief means utilizes a plastic part, the test shall be repeated on an as-received sample that has been oven aged for 7 days at 70°C (158°F) and then allowed to reach room temperature.

27 Leakage Current Test

27.1 When the open-circuit potential is greater than 42.4 volts peak as measured between any accessible part and earth ground or any other accessible part, the leakage current at any accessible part shall not be more than the following values when tested in accordance with 27.2 – 27.7:

a) 0.5 milliampere for an ungrounded product operating at a rated voltage of 150-volt AC rms or less.

b) 5.0 milliamperes for an ungrounded product operating at a maximum fault voltage of 600 volts rms.

27.2 With reference to the requirements of 27.1, leakage current refers to all currents, including capacitively-coupled currents, that may be conveyed between exposed conductive surfaces of the equipment and ground, or other exposed conductive surfaces of the equipment.

27.3 For this test, the sample is to be placed in the position of its intended use, electrically connected in accordance to manufacturer's instructions and energized at the rated voltage.

27.4 All exposed conductive surfaces are to be tested for leakage currents. Leakage currents from these surfaces are to be measured to the grounded supply conductor individually as well as collectively when simultaneously accessible, and from one exposed surface to another when simultaneously accessible. A part is considered to be exposed unless it is guarded by an enclosure considered to reduce the risk of electric shock. Surfaces are considered to be simultaneously accessible when they can be readily contacted by one or both hands of a person at the same time. For the purpose of these requirements, one hand is considered to be able to contact parts simultaneously, when the parts are within a 10 by 20 cm (3.9

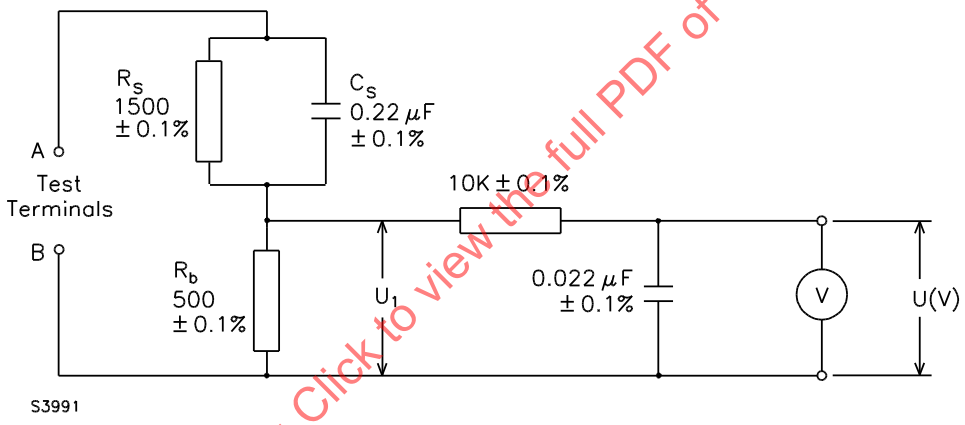
by 7.9 inch) rectangle; and two hands of a person are considered to be able to contact parts simultaneously when the parts are not more than 1.8 m (6 feet) apart.

27.5 When all accessible surfaces are bonded together and connected to the grounding conductor of the system, the leakage current can be measured between the grounding conductor and the grounded supply conductor. When exposed dead-metal parts of a product are connected to the neutral supply conductor, this connection is to be open during the measurement.

27.6 When a conductive surface other than metal is used for an enclosure or part of an enclosure, the leakage current is to be measured using a metal foil with an area of 10 by 20 cm (3.9 by 7.9 inch) in contact with the surface. When the surface is less than 10 by 20 cm, the metal foil is to be the same size as the surface. The metal foil is not to remain in place long enough to affect the temperature of the product.

27.7 The measurement circuit for the leakage current test is to be as shown in Figure 27.1.

Figure 27.1
Measuring instrument for leakage current tests



V = Voltmeter

True r.m.s. reading

Uncertainty: ≤ 2 percent

Input resistance: ≥ 1 MΩ

Input capacitance: ≤ 200 pF

Frequency range: 15 Hz to 1 MHz

$$\text{Weighted leakage current} = \frac{U}{500} A$$

27.8 Unless the meter is being used to measure leakage current from one part of a product to another, the meter is to be connected between the accessible parts and the grounded supply conductor.

28 Electric Shock Current Test

28.1 When the open-circuit potential between any part that is exposed (accessible to contact by the probe shown in Figure 8.1) only during user-servicing and either:

a) Earth ground or

b) Any other exposed accessible part exceeds 42.4 volts peak, the part shall comply with the requirements in 28.2 – 28.4, as applicable.

28.2 The continuous current flow through a 500-ohm resistor shall not exceed the values specified in Table 28.1, when the resistor is connected between any part that is exposed only during user-servicing and either:

a) Earth ground or

b) Any other exposed accessible part.

Table 28.1
Maximum current during operator servicing

Frequency, hertz[a]	Maximum current through a 500-ohm resistor, milliamperes peak
0 – 100	7.1
500	9.4
1000	11.0
2000	14.1
3000	17.3
4000	19.6
5000	22.0
6000	25.1
7000 or more	27.5

[a] Linear interpolation between adjacent values may be used to determine the maximum current corresponding to frequencies not shown. The table applies to repetitive nonsinusoidal or sinusoidal waveforms.

28.3 The duration of a transient current flowing through a 500-ohm resistor connected as described 28.2 shall not exceed:

a) The value determined by the following equation

$$T \leq \left(\frac{20\sqrt{2}}{I} \right)^{1.43}$$

in which:

T is the interval, in seconds, between the time that the instantaneous value of the current first exceeds 7.1 milliamperes peak and the time that the current falls below 7.1 milliamperes peak for the last time and

I is the peak current in milliamperes; and

b) 809 milliamperes, regardless of duration.

The interval between occurrences shall be equal to or greater than 60 seconds when the current is repetitive. Typical calculated values of maximum transient current duration are shown in Table 28.2.

Table 28.2
Maximum transient current duration

Maximum peak current (I) through 500-ohm resistor, milliamperes	Maximum acceptable duration (T) of waveform containing excursions greater than 7.1 millamperes peak
7.1	7.26 seconds
8.5	5.58
10.0	4.42
12.5	3.21
15.0	2.48
17.5	1.99
20.0	1.64
22.5	1.39
25.0	1.19
30.0	919 milliseconds
40.0	609
50.0	443
60.0	341
70.0	274
80.0	226
90.0	191
100.0	164
150.0	92
200.0	61
250.0	44
300.0	34
350.0	27
400.0	23
450.0	19
500.0	16
600.0	13
700.0	10
809.0	8.3

28.4 The maximum capacitance between the terminals of a capacitor that is accessible during user servicing shall comply with the following equations:

$$C = \frac{88{,}000}{E^{1.43}(In\ \ E - 1.26)} \quad \text{for } 42.4 \leq E \leq 400$$

$$C = 35{,}288E^{-1.5364} \quad \text{for } 400 \leq E \leq 1000$$

in which:

C is the maximum capacitance of the capacitor in microfarads and

E is the potential in volts across the capacitor prior to discharge (E is to be measured 5 seconds after the capacitor terminals are made accessible, such as by the removal or opening of an interlocked cover, or the like).

Typical calculated values of maximum capacitance are shown in Table 28.3.

Table 28.3
Electric shock – stored energy

Potential in volts, across capacitance prior to discharge	Maximum acceptable capacitance in microfarads
1000	0.868
900	1.02
800	1.22
700	1.50
600	1.90
500	2.52
400	3.55
380	3.86
360	4.22
340	4.64
320	5.13
300	5.71
280	6.40
260	7.24
240	8.27
220	9.56
200	11.2
180	13.4
160	16.3
140	20.5
120	26.7
100	36.5
90	43.8
80	53.8
70	68.0
60	89.4
50	124.0
45	150.0
42.4	169.0

28.5 With reference to the requirements of 28.2 and 28.3, the current is to be measured while the resistor is connected:

a) Between ground and each accessible part individually and

b) Between ground and all accessible parts collectively, when the parts are simultaneously accessible.

The current also is to be measured while the resistor is connected between one part or group of parts and another part or group of parts, when the parts are simultaneously accessible.

28.6 With reference to the requirements in 28.5, parts are considered to be simultaneously accessible when they can be contacted by one or both hands of a person at the same time. For the purpose of these requirements, one hand is to be considered to be able to contact parts simultaneously when the parts are within a 102 by 203 mm (4 by 8 inch) rectangle; and two hands of a person are considered to be able to contact parts simultaneously when the parts are not more than 1.8 m (6 feet) apart.

28.7 Electric-shock current refers to all currents including capacitively-coupled currents.

28.8 When the product has a direct-current rating, measurements are to be made with the product connected in turn to each side of a 3-wire, direct-current supply circuit.

28.9 Current measurements are to be made:

a) With any operating control, or adjustable control that is subject to user operation, in all operating positions and

b) Either with or without a vacuum tube, separable connector, or similar component in place.

These measurements are to be made with controls placed in the position that causes maximum current flow.

29 Normal Operation Test

29.1 Electronic circuits and modules shall be capable of operating for all conditions of intended performance when connected into the operating telephone loop circuit in accordance with the installation wiring diagram and supplementary information supplied with the product.

29.2 To determine when an electronic circuit or module complies with the requirement of 29.1, two sample units are to be connected into a simulated telephone loop circuit and operated at each condition of intended performance.

30 Electrical Measurements Test

30.1 The input or output of an electronic telephone circuit shall not exceed the marked rating of the product by more than 10 percent when the product is operated under the conditions of intended use and with the product connected to normal operating voltage.

30.2 The measured voltage at the output circuit with the maximum (rated) loads applied shall be compatible with the rating of the device or appliance intended to be connected to the circuit. To simulate an off-hook telephone, a load resistance of 150 ohms is to be used.

30.3 To determine when an electronic circuit or module complies with the requirements of 30.1 and 30.2, two samples of the unit or circuit are each to be connected into a simulated telephone loop circuit and operated at each condition of its intended performance.

31 Dielectric Voltage-Withstand Test

31.1 A unit shall withstand for 1 minute, without breakdown, the application of an essentially sinusoidal AC potential at a frequency within the range of 40 – 70 hertz, or a DC potential, between live parts and the enclosure, live parts and exposed dead-metal parts, and live parts of circuits operating at different potentials or frequencies. The test potential shall be:

a) 500 volts rms (707 volts, when a DC potential is used) – for a unit rated 30 volts AC rms (42.4 volts DC or AC peak) or less and

b) 1000 volts rms (1414 volts, when a DC potential is used) – for a unit rated between 31 and 250 volts AC rms.

Also, see 31.3 for test potential specifications.

31.2 Exposed dead-metal parts are noncurrent-carrying parts that are likely to become energized and accessible from outside of the enclosure of a control unit during operation with the door of the enclosure closed.

31.3 For the application of a potential in accordance with 31.1, the voltage is to be the applicable value specified in 31.1 (a) or (b), based on the highest voltage of the circuits under test instead of the rated voltage of the unit. Electrical connections between the circuits are to be disconnected before the test potential is applied.

31.4 When the charging current through a capacitor or capacitor-type filter connected across the line, or from line to earth ground, is sufficient to prevent maintenance of the specified AC test potential, the capacitor or filter is to be tested using a DC test potential in accordance with 31.1

31.5 The test potential may be obtained from any convenient source having sufficient capacity to maintain the specified voltage. The output voltage of the test apparatus is to be monitored. Starting at zero, the potential is to be increased at a rate of approximately 200 volts per minute until the required test value is reached and is to be held at that value for 1 minute. When a direct-current source is used, the test voltage shall be increased to 1.4 times the AC voltage. The trip current of either test voltage shall be 0.5 milliampere.

31.6 A printed-wiring assembly (or other electronic-circuit component) that is capable of being damaged by – or of short-circuiting with – the application of the test potential, is to be removed or disconnected (or otherwise rendered inoperative) before the test. A representative subassembly is not prohibited from being tested instead of an entire unit. Rectifier diodes in the power supply are not prohibited from being individually shunted before the test to avoid destroying them, in the case of a malfunction elsewhere in the secondary circuits.

32 Component Temperature Test

32.1 The materials used in the construction of a communications-circuit accessory shall not be adversely affected by the temperatures attained under any condition of the intended operation.

32.2 When a material is subjected to a temperature rise greater than that indicated in Table 32.1, it will be considered as being adversely affected.

Table 32.1
Maximum temperature rises

Material	Circuit operation, °C	Circuit operation, (°F)	Standby condition, °C	Standby condition, (°F)
A. COMPONENTS				
1. Capacitors[a]	25	45	40	72
2. Fuses	25	45	25	45
3. Rectifiers – at any point				
a) Germanium	25	45	50	90
b) Selenium	25	45	50	90
c) Silicon	25	45	75	135
4. Relays, transformers, and other coils with:				
a) Class 105 insulated windings				
Thermocouple method	65	117	63	117
Resistance method	75	135	75	135
b) Class 130 insulated windings				
Thermocouple method	85	153	85	153
Resistance method	95	171	95	171
5. Resistors[b]				
a) Carbon	25	45	25	45
b) Wire-wound	50	90	315	585
6. Sealing compounds	See note c			
7. Solid-state devices	See note a or d			
B. INSULATED CONDUCTORS[e]				
1. Appliance wiring material	25°C (77°F) less than the established temperature rating of the wire			
2. Flexible cord – Types SJD, SJT	35	63	35	63
C. ELECTRICAL INSULATION – GENERAL				
1. Fiber used as electrical insulation or cord bushings	25	45	65	117
2. Phenolic composition used as electric insulation or as parts where failure will result in a hazardous condition	25	45	125	225
3. Printed-wiring boards	Based on maximum use temperature rating of printed-wiring board material			
D. GENERAL				
1. Mounting	25	45	65	117
2. Wood or other combustible material	25	45	65	117
3. Enclosure surfaces	40	72	40	72

[a] In lieu of complying with these temperature limits, these components may be evaluated in accordance with the appropriate sections in the Reliability Toolkit: Commercial Practices Edition, published by Rome Laboratory, Reliability Analysis Center.

[b] In lieu of complying with these temperature limits, a resistor may be used when it dissipates no more than one-half of its maximum power rating under the test conditions specified.

[c] Unless a thermosetting material, the maximum sealing compound temperature, when corrected to a 25°C (77°F) ambient temperature, is 15°C (27°F) less than the softening point of the compound as determined in the Standard Test Methods for Softening Point by Ring-and-Ball Apparatus, ASTM E28.

[d] The temperature of a solid-state device (for example, transistor, SCR, integrated circuits), shall not exceed 50 percent of its rating during the normal standby condition. The temperature of a solid-state device shall not exceed 75 percent of its rated temperature under the alarm condition or any other condition of operation which produces the maximum temperature dissipation

Table 32.1 Continued on Next Page

Table 32.1 Continued

Material	Circuit operation, °C	Circuit operation, (°F)	Standby condition, °C	Standby condition, (°F)
of its components. For reference purposes 0°C (32°F) shall be considered as 0 percent. For integrated circuits the loading factor shall not exceed 50 percent of its rating under the normal standby condition and 75 percent under any other condition of operation. Both solid-state devices and integrated circuits may be operated up to the maximum ratings under any one of the following conditions: 1. The component complies with the requirements of MIL-STD-883E. 2. A quality control program is established by the manufacturer consisting of inspection and test of 100 percent of all components, either on an individual basis, as part of a subassembly, or what is determined to be equivalent. 3. Each assembled production unit is subjected to a burn-in test, under the condition which results in the maximum temperatures, for 24 hours while connected to a source of rated voltage and frequency in an ambient of at least 49°C (120°F) followed by an operation test for normal signaling performance. [e] For standard insulated conductors other than those mentioned, reference should be made to the National Electrical Code, ANSI/NFPA 70, the maximum allowable temperature rise in any case is 25°C (77°F) less than the temperature limit of the wire in question.				

32.3 The classes of material used for electrical insulation that are referred to in Item A(4) in Table 32.1 include the following:

a) Class 105 – Impregnated cotton, paper, and similar organic materials when impregnated, and film coatings as applied to coil windings.

b) Class 130 – Inorganic materials, such as mica.

32.4 A component having a temperature exceeding that indicated in Table 32.1 is not prohibited from being used when reliability data is provided by the manufacturer to justify its use.

32.5 Temperature rises are based on an assumed ambient temperature of 25° C (77° F). When equipment is intended specifically for use with a prevailing ambient temperature constantly more than 25° C, the equipment is to be tested using the higher ambient temperature, and the allowable temperature rises specified in Table 32.1 are to be reduced by the amount of the difference between that higher ambient temperature and 25°C.

32.6 A temperature is considered to be constant when three successive readings taken at intervals of 10 percent of the previously elapsed duration of the test, but not less than 5-minute intervals, indicate no change.

32.7 Temperature measurements on equipment intended for recessed mounting are to be made with the unit installed in an enclosure made of 19.1-mm (3/4-inch) thick wood having clearances of 50.8 mm (2 inches) on the top, sides and rear, and the front extended to be flush with the control unit cover.

32.8 Regarding coils, temperatures are to be measured by thermocouples consisting of wires not larger than 0.21 mm^2 (24 AWG) or by the change-in-resistance method. The thermocouple method is not to be used for a temperature measurement where supplementary thermal insulation is used.

32.9 Thermocouples consisting of 0.06 mm^2 (30 AWG) iron and constantan wires and a potentiometer-type indicating instrument are to be used whenever referee temperature measurements by thermocouples are necessary.

32.10 The temperature of a copper coil winding is determined by the change-in-resistance method, wherein the resistance of the winding at the temperature to be determined is compared with the resistance at a known temperature by means of the formula:

$$T = \frac{R}{r}(234.5 + t) - 234.5$$

in which:

T is the temperature to be determined in degrees C;

R is the resistance in ohms at the temperature to be determined;

r is the resistance in ohms at the known temperature; and

t is the known temperature in degrees C.

32.11 As it is generally necessary to de-energize the winding before measuring R, the value of R at shutdown may be determined by taking several resistance measurements at short intervals, beginning as quickly as possible after the instant of shutdown. A curve of the resistance values and the time may be plotted and extrapolated to give the value of R at shutdown.

32.12 The circuit of a current-regulating resistor or reactor provided as a part of a control units is to be adjusted for the maximum resistance or reactance at normal current.

32.13 The duration of the test-operating conditions shall not be less than:

a) Operation until constant temperatures are attained during the normal DC voltage (56.5 volts DC) condition and

b) Operation for 1 hour during the normal ring cycle of a telephone loop circuit. The ring voltage is to be adjusted to 200 volts peak-to-ground, 60 hertz, 1 second ring – 2 seconds off for each ring cycle.

33 Drop Test

33.1 A product intended to be mounted atop a desk or shelf or on a wall and not secured in place by mechanical means shall show no signs of excessive damage that results in live parts becoming accessible and shall not produce a risk of electric shock when subjected to the conditions specified in 33.2 and 33.3.

33.2 Three "as-received" samples of the assembly shall be subjected to a total of nine drops (three drops each) from a height of 0.91 m (3 feet) onto a hardwood surface. The test is to be conducted so that for each drop, the sample strikes the surface in a different position.

33.3 The samples shall then comply with the applicable requirements of the Leakage Current Test, Section 27, and the Dielectric Voltage-Withstand Test, Section 31.

34 Impact Test

34.1 Products intended to be fixed in place by a mechanical means or plugged into place such as by a plug and jack installation shall show no signs of excessive damage that results in live parts becoming accessible and shall not produce a risk of electric shock when subjected to the conditions specified in 34.2 and 34.3.

34.2 Three "as-received" samples of the assembly shall be used for this test. Each test sample is to be held in a fixed position. A smooth, solid steel sphere, 50.8 mm (2 inches) in diameter and having approximately 0.54 kg (1.18 pound) mass, is to be allowed to fall from rest through a vertical distance of

1.3 m (51-3/4 inches) as required to cause the sphere to strike the sample with an impact of 6.8 N·m (5 foot-pounds).

34.3 The samples shall then comply with the Leakage Current Test, Section 27, and the Dielectric Voltage-Withstand Test, Section 31.

35 Crush Test

35.1 A product that may be located below a horizontal work plane of 762 mm (30 inches) or that may rest upon the floor shall show no signs of excessive damage that results in exposure of live parts and shall not produce a risk of electric shock when subjected to the conditions specified in 35.2 and 35.3.

35.2 Three "as-received" samples of the assembly are to be used for this test. A steady crushing force of 334 N (75 lbf) is to be applied at right angles to the surface of the test sample for a period of 1 minute. The sample is to be tested between two parallel, flat, maple blocks, each not less than 12.7 mm (1/2 inch) thick. The crushing force is to be applied gradually in a direction normal to the sample surface.

35.3 The sample, using current-carrying parts, shall then comply with the applicable requirements of the Leakage Current Test, Section 27, and the Dielectric Voltage-Withstand Test, Section 31.

36 Millivolt Drop Test

36.1 Six samples of telephone loop circuit terminals, connectors, plugs, jacks or any other type of wire or cord connection device shall not have a voltage drop in excess of 300 millivolts when subjected to the conditions specified in 36.2 and 36.3. The voltage drop across the connecting wire to the connector shall not be included in this measurement.

36.2 The plug, jack, or connector of a telecommunications cord is to be inserted into a standard mating plug, jack or connector or terminated with the maximum and minimum size wire for which the terminal is rated. The cord is to be connected to a 250-volt AC, 50 – 60 hertz source of supply with a short-circuit current level of 2.2 amperes. The test voltage is to be applied to a representative tip-and-ring pair, with the other end terminating in a short circuit. The voltage drop across the connector is to be measured using a voltmeter. A true rms voltage meter is to be used when measuring AC voltage.

36.3 The test shall then be repeated using a 140-volt DC source of supply with a short-circuit current level of 2.2 amperes.

37 Heat Test

37.1 Six samples of telephone-loop circuit terminals, connectors, plugs, jacks or any other type wire or cord-connection device shall be subjected to the conditions specified in 37.2 and 37.3. The temperature rise for the insulator that serves to support or enclose the connector or terminal shall not exceed 30°C (54° F) above ambient temperature.

37.2 The plug, jack, or connector of a telecommunications cord is to be inserted into a standard mating plug, jack, or connector. The cord is to be connected to a 250-volt AC, 50 – 60 hertz source of supply with a short-circuit current level of 2.2 amperes. The test voltage is to be applied to a representative tip and ring pair with the other end terminating in a short circuit. The assembly is to be operated in this manner until thermal equilibrium is attained. Temperatures on the connector body are to be monitored using a temperature-indicating device.

37.3 The test is then to be repeated using a 140-volt DC source of supply with a short-circuit current level of 2.2 amperes.

38 Torque Test

38.1 A terminal or connector that uses threaded-type fasteners or screws that thread into plastic shall show no signs of damage and shall be capable of maintaining the intended telephone-loop connection after being subjected to the conditions specified in 38.2.

38.2 Six samples of the terminal or connector shall be subjected to this test. Each terminal is to be tested with the maximum and minimum size gauge wire for which the terminal is rated. Each terminal shall be subjected to 25 cycles of insertion and withdrawal using the maximum torque values in Table 38.1. Upon completion of the cycling test, each sample is to be examined for damage and shall comply with the requirements in the Flex Test, Section 39, and the Pull Test, Section 40.

Table 38.1
Tightening torque for slotted head screws smaller than No. 10 intended for use with 8 AWG or smaller conductors

Slot length of screw,		Tightening torque			
		Slot width of screw:			
		smaller than 1.2 mm[a] (0.047 inch[a]),		1.2 mm[a] and larger,	
mm[b]	(inch)[b]	N·m	(pound-inches)	N·m	(pound-inches)
4	Less than 5/32	0.79	7	1.0	9
4	5/32	0.79	7	1.4	12
4.8	3/16	0.79	7	1.4	12
5.6	7/32	0.79	7	1.4	12
6.4	1/4	0.79	7	1.4	12
7.1	9/32	1.7	15	1.4	12
7.1	Above 9/32	2.3	20		

[a] Slot width is the nominal design value.

[b] For slot lengths of intermediate values, select torques pertaining to next larger slot length. Slot length is to be measured at the bottom of the slot.

39 Flex Test

39.1 A terminal or connector shall be capable of retaining the attached wire or cord when subjected to the conditions specified in 39.2.

39.2 Six samples of the terminal or connector are to be mounted in a position of intended use and each terminal is to secure the maximum size wire for which the terminal is rated. Using the direction of the wire member entering the terminal on the "on-axis", the wire is to be flexed or bent to a right angle of 90 degrees, five times. The wire is then to be flexed to a left angle of 90 degrees from the "on-axis" for 5 cycles.

39.3 Upon completion of the 10 cycles of wire flexing, the terminal is to be checked for damage and shall comply with the requirements of the Pull Test, Section 40. The test is then to be repeated using the minimum size wire for which the terminal or connector is rated.

40 Pull Test

40.1 A terminal shall be capable of retaining the maximum and minimum size wire the terminal is rated to use without any indication of loss of contact continuity when subjected to the conditions specified in 40.2 and 40.3.