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Standard for Signaling Devices for the Hearing Impaired

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November 29, 2002

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StandardsforComponents.....A1

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INTRODUCTION

1 Scope

1.1 These requirements cover emergency-signaling devices for the hearing impaired. The devices and/or systems covered by this standard are suitable for use in a controlled environment, or in an uncontrolled environment as indicated in the product marking. These devices are to be used in accordance with the requirements of the National Fire Alarm Code, NFPA 72.

1.1 revised November 29, 2002

1.2 A signaling device as covered by these requirements consists of a unit assembly of electrical parts having provision for the connection of power supply circuits routed through the equipment by a prescribed scheme of circuiting. Also included are circuits that extend to separate devices by which additional units are actuated for signals. An installation wiring diagram attached to the product, or referenced in the product marking, indicates the devices and circuits that are acceptable for connection to the signaling device.

1.3 These requirements are to evaluate visible signaling appliances for public mode operation. These appliances are designed to alert occupants or inhabitants within the protected area. These requirements do not cover lights intended for private mode fire alarm signaling, lights intended for non-fire-alarm signaling applications, manual boxes, automatic fire detectors, or other initiating devices; nor do they cover bells, registers, or other indicating devices not provided as part of the product.

1.3 revised November 29, 2002

1.4 Deleted November 29, 2002

2 General

2.1 Components

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

2.1.2 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- b) Is superseded by a requirement in this standard.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.

2.3 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. Additionally, the terms “visual” and “visible” are considered equivalent in meaning throughout the Standard.

3.1 revised November 29, 2002

3.2 CANDELA – For the purpose of this Standard, the light output of a flashing light is measured with an integration radiometer and the summation of light intensity over time (I_{dt}) is used in the following equation to determine the effective light intensity. The candela (Cd) value assigned to a flashing light is calculated and corresponds to the same value of candela of a fixed light operating under identical conditions of observation, color, size, and shape:

$$Cd = (I_{dt}) / (0.2 + t_2 - t_1)$$

in which:

I_{dt} is the measured lumens recorded by the photometer over time for ten consecutive pulses;

0.2 is two-tenths of one second, the value which represents nighttime threshold effective illumination as specified in the Illuminating Engineering Society Handbook, 5th Edition; and

$t_2 - t_1$ represents the time period of the light pulse.

3.3 CONTROLLED ENVIRONMENT – An area where ambient temperatures, humidity, and exposure to water (rain) are controlled or limited. For the purpose of this standard, the limits noted in these requirements identify the controlled environment for the interior of a typical building that uses heating and/or air cooling systems.

3.4 CRITICAL ANGLE – The five-degree (5°) dispersion angle that has the lowest ratio of measured light output to minimum required light output for all five-degree increments within the plane of measurement. This angle is identified by comparison of all ratios of measurements obtained within the plane during the Signal Strength and Format Test, Section 27. All ratios of measured light to required minimum light shall be equal to or greater than 1. For example:

$$\text{Ratio} = \text{Measured light} / \text{Minimum required light}$$

$$15 \text{ Cd} / 12 \text{ Cd}$$

$$5/4 = 1.25$$

3.5 INITIATING DEVICE – A manually or automatically operated device, the normal intended operation of which results in a fire or emergency alarm.

3.6 REMOTE RECEIVER – A unit intended to receive an electrical, mechanical, or electromagnetic signal from a transmitter. When operation is initiated, the unit serves to control a signaling device such as a vibrator, flashing light, or the like.

3.7 REMOTE TRANSMITTER – A unit intended to transmit an electrical, mechanical, or electromagnetic signal to a remote receiver. Actuation of transmitter is initiated by an initiating device such as a smoke detector, thermostat, manual box, or the like.

3.8 SIGNALING DEVICE – A unit or equipment intended to convey a message or effect by means of the senses of sight or touch.

3.9 SIGNALING SYSTEM – A group of units or components that serve to make up a communication link between the initiating device and occupant where signaling is to occur.

3.10 SUPERVISED CIRCUIT – A circuit using a means to detect and indicate a fault condition that would prevent the transmission of an alarm signal. A fault condition is considered an open or ground in any electrical circuit interconnecting separate components necessary to form the signaling system.

3.11 UNCONTROLLED ENVIRONMENT – An area subjected to the natural environment conditions which make up the typical ambient and moisture conditions of this planet. For the purpose of this standard, the environmental limits are defined in the marking on the product. Where the conditions have not been addressed in the product marking, the product has only been evaluated for use in a controlled environment.

4 Instructions and Drawings

4.1 A copy of the operating and installation instructions and related schematic wiring diagrams shall be furnished with the sample submitted for investigation to be used in the examination and testing of the product or system. For this purpose a printed edition is not required.

4.2 The instructions and drawings shall include such directions and information for attaining the intended installation, maintenance, and operation of the product, including information as to classification, ratings, and the like, as applicable.

CONSTRUCTION

5 Enclosures

5.1 General

5.1.1 All electrical parts of a unit shall be enclosed to provide protection against contact with uninsulated live parts.

5.2 Cast metal

5.2.1 The thickness of cast metal for an enclosure shall be as indicated in Table 5.1. Cast metal having a thickness 1/32 inch (0.8 mm) less than that indicated in the table shall not be used unless the surface under consideration is curved, ribbed, or otherwise reinforced, or unless the shape or size or both of the surface is such that equivalent mechanical strength is provided.

Table 5.1 Cast metal enclosures

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

5.2.2 If threads for the connection of conduit are tapped all the way through a hole in an enclosure wall, or if an equivalent construction is used, there shall not be less than 3-1/2 nor more than 5 threads in the metal, and the construction shall be such that a standard conduit bushing is capable of being attached.

5.2.3 If threads for the connection of conduit are tapped only part of the way through a hole in an enclosure wall, there shall not be less than five full threads in the metal, and there shall be a smooth, rounded inlet hole for the conductors which shall afford protection to the conductors equivalent to that provided by a standard conduit bushing.

5.2.4 There shall be adequate space within a terminal or wiring compartment to permit the use of a standard conduit bushing if a bushing is required for installation.

5.3 Sheet metal

5.3.1 The thickness of sheet metal used for the enclosure of a unit shall not be less than that indicated in Table 5.2 or 5.3 as applicable. Sheet metal of two gage sizes lesser thickness shall not be used unless the surface under consideration is curved, ribbed, or otherwise reinforced, or the shape or size or both of the surface is such that equivalent mechanical strength is provided. At any point where conduit or metal-clad cable is to be attached, sheet metal shall be of such thickness or shall be formed or reinforced so that it will have stiffness at least equivalent to that of an uncoated flat sheet of steel having a minimum thickness of 0.032 inch (0.81 mm).

Table 5.2 Minimum thickness of sheet metal for electrical enclosures – carbon steel or stainless steel

Maximum width, ^b inches (cm)	Maximum length, ^c inches (cm)	With supporting frame or equivalent reinforcing ^a		Minimum thickness uncoated, inch (mm)	Minimum thickness metal coated, inch (mm)
		Without supporting frame	With supporting frame or equivalent reinforcing ^a		
4.0 10.2 4.75 12.1	Not limited 5.75 14.6	6.25 15.9 6.75 17.1	Not limited 8.25 21.0	0.020 ^d 0.51 ^d	0.023 ^d 0.58 ^d
6.0 15.2 7.0 17.8	Not limited 8.75 22.2	9.5 24.1 10.0 25.4	Not limited 12.5 31.8	0.026 ^d 0.66 ^d	0.029 ^d 0.74 ^d
8.0 20.3 9.0 22.9	Not limited 11.5 29.2	12.0 30.5 13.0 33.0	Not limited 16.0 40.6	0.032 0.81	0.034 0.86
12.5 31.8 14.0 35.6	Not limited 18.0 45.7	19.5 49.5 21.0 53.3	Not limited 25.0 63.5	0.042 1.07	0.045 1.14
18.0 45.7 20.0 50.8	Not limited 25.0 63.5	27.0 68.6 29.0 73.7	Not limited 36.0 91.4	0.053 1.35	0.056 1.42
22.0 55.9 25.0 63.5	Not limited 31.0 78.7	33.0 83.8 35.0 88.9	Not limited 43.0 109.2	0.060 1.52	0.063 1.60
25.0 63.5 29.0 73.7	Not limited 36.0 91.4	39.0 99.1 41.0 104.1	Not limited 51.0 129.5	0.067 1.70	0.070 1.78
33.0 83.8 38.0 96.5	Not limited 47.0 119.4	51.0 129.5 54.0 137.2	Not limited 66.0 167.6	0.080 2.03	0.084 2.13
42.0 106.7 47.0 119.4	Not limited 59.0 149.9	64.0 162.6 68.0 172.7	Not limited 84.0 213.4	0.093 2.36	0.097 2.46
52.0 132.1 60.0 152.4	Not limited 70.0 177.8	80.0 203.2 84.0 213.4	Not limited 103.0 261.6	0.108 2.74	0.111 2.82
63.0 160.0 73.0 185.4	Not limited 90.0 228.6	97.0 246.4 103.0 261.6	Not limited 127.0 322.6	0.123 3.12	0.126 3.20

Table 5.2 Continued on Next Page

Table 5.2 Continued

		With supporting frame or equivalent reinforcing ^a	Minimum thickness uncoated, inch (mm)	Minimum thickness metal coated, inch (mm)	Maximum width, ^b inch (cm)
Without supporting frame ^a	Maximum length, ^c inches (cm)				
^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 are applied via the enclosure surface when it is deflected. One method of construction that is considered to have equivalent reinforcing is accomplished by constructions that produce a structure which is as rigid as one built with a frame of angles or channels. Constructions considered to be without supporting frame include: 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 that are not supported along one side, for example, side panels of boxes, the length of the unsupported side shall be limited to the dimensions specified unless the side in question is provided with a flange at least 1/2 inch (12.7 mm) wide. ^d Sheet steel for an enclosure intended for outdoor use (rain resistant) shall not be less than 0.036 inch (0.91 mm) thick if zinc coated and not less than 0.032 inch (0.81 mm) thick if uncoated.					

Table 5.3 Minimum thickness of sheet metal for electrical enclosures – aluminum, copper, or brass

Without supporting frame ^a		With supporting frame or equivalent reinforcing ^a		Minimum thickness, inch (mm)	Maximum width, ^b inch (cm)
Maximum width, ^b inches (cm)	Maximum length, ^c inches (cm)				
3.0 7.6 3.5 8.9	Not limited 4.0 10.2	7.0 17.8 8.5 21.6	Not limited 9.5 24.1	0.023 ^d 0.58 ^d	
4.0 10.2 5.0 12.7	Not limited 6.0 15.2	10.0 25.4 10.5 26.7	Not limited 13.5 34.3	0.029 0.74	
6.0 15.2 6.5 16.5	Not limited 8.0 20.3	14.0 35.6 15.0 38.1	Not limited 18.0 45.7	0.036 0.91	
8.0 20.3 9.5 24.1	Not limited 11.5 29.2	19.0 48.3 21.0 53.3	Not limited 25.0 63.5	0.045 1.14	
12.0 30.5 14.0 35.6	Not limited 16.0 40.6	28.0 71.1 30.0 76.2	Not limited 37.0 94.0	0.058 1.47	
18.0 45.7 20.0 50.8	Not limited 25.0 63.5	42.0 106.7 45.0 114.3	Not limited 55.0 139.7	0.075 1.91	
25.0 63.5 29.0 73.7	Not limited 36.0 91.4	60.0 152.4 64.0 162.6	Not limited 78.0 198.1	0.095 2.41	
37.0 94.0 42.0 106.7	Not limited 53.0 134.6	87.0 221.0 93.0 236.2	Not limited 114.0 289.6	0.122 3.10	
52.0 132.1 60.0 152.4	Not limited 74.0 188.0	123.0 312.4 130.0 330.2	Not limited 160.0 406.4	0.153 3.89	

Table 5.3 Continued on Next Page

Table 5.3 Continued

Without supporting frame ^a		With supporting frame or equivalent reinforcing ^a	Minimum thickness, inch (mm)	Maximum v inches (cm)
Maximum width, ^b inches (cm)	Maximum length, ^c inches (cm)			
^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 are applied via the enclosure surface when it is deflected. One method of construction that is considered to have equivalent reinforcing is accomplished by constructions that produce a structure which is as rigid as one built with a frame of angles or channels. Constructions considered to be without supporting frame include: 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 that are not supported along one side, for example, side panels of boxes, the length of the unsupported side shall be limited to the dimensions specified unless the side in question is provided with a flange at least 1/2 inch (12.7 mm) wide. ^d Sheet copper, brass, or aluminum for an enclosure intended for outdoor use (rain resistant) shall not be less than 0.029 inch (0.74 mm) thick.				

5.3.2 An enclosure shall have means for mounting, which shall be accessible without disassembling any operating part of the product.

5.3.3 In reference to the requirement in 5.3.2, removal of the completely assembled panel, such as an internal mounting plate, is not considered to be disassembly of an operating part.

5.4 Plastic

5.4.1 Integrity of enclosure and the ability of the signaling unit to operate unimpaired after mechanical abuse shall be determined by any combination of the Drop Test, Section 42; the Impact Test, Section 43; and the Crush Test, Section 44; as applicable.

5.4.2 Units operating from a voltage source greater than 30 V rms or 42.4 V DC, and 15 W or higher, shall comply with the flammability requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. Refer to Figure 5.1 for flammability requirements concerning portable, fixed, and stationary appliances.

Exception: The plastic material that makes up the lens shall have a minimum rating of V-2 when it does not serve as the enclosure. The lens shall maintain the same level of mechanical integrity as specified for the enclosure.

5.4.2 revised November 29, 2002

5.4.3 Units operating at less than 30 V rms or 42.4 V DC and less than 15 W shall use plastic having a minimum flammability rating of HB.

5.5 Wood

5.5.1 Enclosures constructed of wood shall comply with the Drop Test, Section 42; the Impact Test, Section 43; and the Crush Test, Section 44.

5.5.2 If wood is used as the overall enclosure of a product used as part of a system, such as a bedside table, the current-carrying components shall be mounted on a metal chassis, box, plate, or the like. All exposed live parts shall be totally enclosed and shall be inaccessible to the user.

Figure 5.1 Flame rating for plastic enclosures

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6 Covers

6.1 General

6.1.1 An enclosure cover shall be hinged, sliding, pivoted, or similarly attached if:

- a) It provides access to fuses or any other overcurrent-protective device, the intended functioning of which requires renewal or
- b) It is necessary to open the cover in connection with the normal operation of the unit.

Exception: A hinged, sliding, or pivoted cover is not required to be used when supervision of the enclosure cover is by means of a tamper feature, which upon operation results in either a trouble or alarm signal. This applies only to overcurrent devices such as fuses or circuit breakers or other components that are not used on a continuing basis.

6.1.2 A hinged cover is not required when the only fuse or fuses that are enclosed are those intended to provide protection to portions of internal circuits such as are used on a separate printed-wiring board or circuit subassembly to prevent circuit damage resulting from a fault. This type of fuse (or fuses) shall not be used unless the following or equivalent marking is indicated on the cover: "Only Circuit Fuse(s) Inside – Return to Factory for Repair."

6.1.3 An unhinged cover shall be securely held in place by screws or the equivalent.

6.2 Transparent covers

6.2.1 Glass covering an observation opening shall: a) Be tempered, b) Be secured in place so that it cannot be displaced in service, and c) Provide mechanical protection for the enclosed parts.

The thickness of a glass cover shall not be less than that indicated in Table 6.1.

Table 6.1 Thickness of glass covers

Maximum size of opening, Length or width, inches (mm)			Minimum thickness, inch (mm)	Area, inch
4	102	12 305 Over 12 Over 305	16 144 Over 144 103 929 Over 929	
			1/16 1.6 1/8 3.2 See footnote a	
a The minimum thickness shall be 1/8 inch (3.2 mm) or more, depending upon the size, shape, and mounting of the glass panel.				

6.2.2 A glass panel for an opening having an area of more than 144 square inches (929 cm²), or having any dimension greater than 12 inches (305 mm), shall be supported by a continuous groove not less than 3/16 inch (4.8 mm) deep along all four edges of the panel, or by an arrangement that has been determined to be equivalent.

6.2.3 A transparent material other than glass shall not be used for the cover of an observation opening unless the material does not introduce a risk of fire, distort, or become less transparent when subjected to varying temperatures under either normal or abnormal service conditions.

7 Ventilating Openings

7.1 When mounted as intended, an enclosure shall not have ventilating openings that vent into concealed spaces of a building structure or that are covered by combustible material.

7.2 Openings in the sides of the enclosure shall be located and sized to prevent entry of a foreign object and to reduce the risk of injury to persons contacting internal parts. Louvers shall not be used unless they are shaped to deflect external falling objects outward. See Figure 7.1 for examples of louver constructions that have been determined to be acceptable. See also 7.8.

7.3 Openings shall not be used in the bottom of an enclosure unless the enclosure is under areas containing only materials classified as minimum V-1 and the openings are not larger than 1/4 inch (6.4 mm) square. Openings that are not square shall not be used unless they have an area not greater than 1/16 square inch (40 mm²).

7.4 An enclosure top opening or an opening directly over an uninsulated live part involving a risk of fire, electric shock, or electrical energy involving high-current levels shall not exceed 0.19 inch (4.8 mm) 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 7.2 for top enclosure constructions that have been determined to be acceptable.

7.5 All combustible material used within an enclosure shall be rated V, HF-2, or better.

Exception: Motors, relays, capacitors, semiconductors, transformers, switches, insulating tubing or tape, and other electrical elements are exempt from this requirement when they comply with the flame test applicable to the component. Meter faces and cases (when investigated and determined to be acceptable for mounting live parts) and indicator lamps or jewels, or both, are exempt from flammability requirements. The following requirements apply to parts that are isolated either by at least 0.5 inch of air or by a solid barrier of V-1 or less-flammable material from uninsulated electrical parts that involve a risk of electrical energy involving high current levels:

- a) Gears, cams, belts, bearings, strain-relief bushings applied over PVC-jacketed cords, and other small parts that contribute negligible fuel to a fire are not required to be investigated.
- b) Tubing for air or fluid systems, and foamed plastics, shall not be more flammable than HB. Foamed plastics classed HBF in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, are in compliance with this requirement.

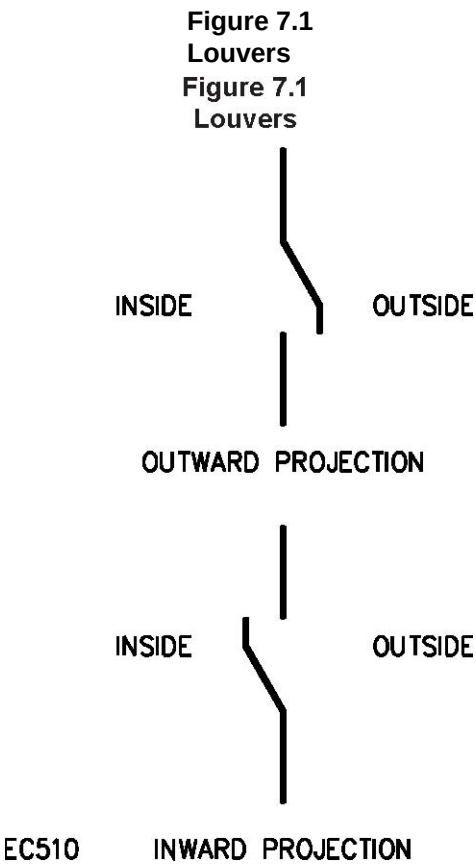
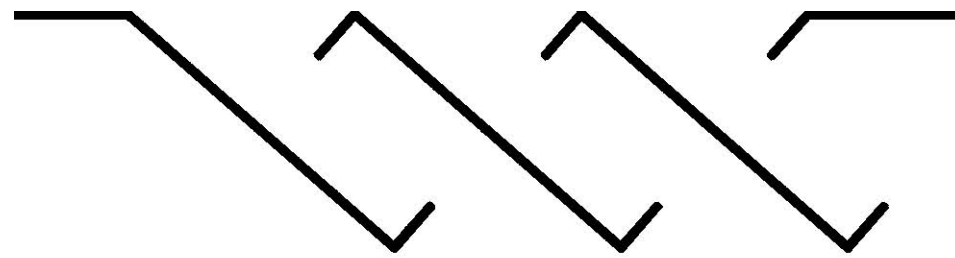
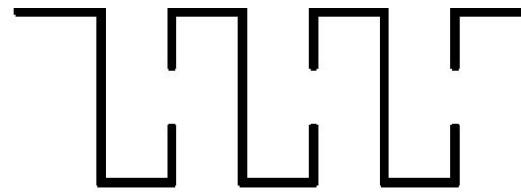


Figure 7.2 Cross sections of top-cover constructions



SLANTED OPENINGS



VERTICAL OPENINGS

EC500

**Figure 7.3 Articulated
accessibility probe**

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NOTE – The probe is to be used only as a gauge and inserted with minimal force. The probe is to be rotated with the moveable sections straight or in any possible position resulting from bending one or more sections in the same direction.

7.6 There are no limitations on the size or number of openings in areas that contain:

- a) PVC, TFE, CTFE, FEP, and neoprene-insulated wire cables and
- b) Plugs and receptacles.

7.7 Openings in the enclosure shall not give access to any relays, terminals, controls, or related components that might be subject to tampering.

7.8 An opening shall not permit entrance of a 3/4-inch (19.1-mm) diameter rod and shall be sized and arranged so that a probe, as illustrated in Figure 7.3, cannot be made to contact any uninsulated live electrical part (other than a low-voltage part) or film-coated wire when inserted through the opening in a straight or articulated position.

8 Corrosion Protection

8.1 Ferrous metal parts, except bearings and the like where such protection is impracticable, shall be protected against corrosion by enameling, galvanizing, sherardizing, plating, or other equivalent means.

8.2 The requirement in 8.1 applies to all enclosing cases whether of sheet steel or cast iron, and to all springs and other parts upon which mechanical operations depend. It does not apply to minor parts such as washers, screws, bolts, and the like if the deterioration of such unprotected parts will not result in a risk of fire or in impairment of product operation. Parts made of stainless steel, polished or treated if necessary do not require additional protection against corrosion. Bearing surfaces shall be of such materials and construction that the risk of binding due to corrosion is reduced.

9 Insulating Materials

9.1 Uninsulated live parts involving a risk of fire, electric shock, or electrical energy involving high-current levels shall be mounted on porcelain, phenolic composition, or other material that has been determined to be acceptable for the application. The thickness of flat sheets of insulating materials shall be in accordance with Table 9.1.

Table 9.1 Thickness of flat sheets of insulating material

Maximum dimensions				Minimum thickness, inch (mm)		Area, inch
Length or width, inches (mm)						
24 61 48 122 48 122 Over 48 Over 122				360 1152 1728 Over 1728	2323 7432 11148 Over 11148	3/8a 1/2 5/8 3/4 9.5a 12.7 15.9 19.1
a Material less than 3/8 inch (9.5 mm) but not less than 1/8 inch (3.2 mm) thick shall not be used for a panel unless the panel is supported or reinforced to provide rigidity not less than that of a 3/8 inch (9.5 mm) thick sheet. Material used for subassemblies, such as supports for terminal for internal wiring, resistors, and other components is not required to be a minimum of 1/8 inch (3.2 mm) thick.						

9.2 Vulcanized fiber shall not be used as the sole support for uninsulated live parts if shrinkage, current leakage, or warpage introduces a risk of fire or electric shock. Thermoplastic materials used for the direct or indirect support of uninsulated live parts involving a risk of fire, electric shock, or electrical energy involving high-current levels shall comply with the requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

Exception: This requirement does not apply to insulating bushings, washers, separators, and barriers not used as sole support for uninsulated live parts.

9.3 Molded parts shall have the mechanical strength and rigidity to withstand the stresses of actual service.

9.4 An insulating liner shall be determined to be acceptable for its intended purpose. 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 shall not be used where a sharp edge or point is involved.

9.5 A countersunk, sealed part shall be covered with a waterproof insulating compound that will not melt at a temperature 15° C (27° F) higher than the maximum intended operating temperature of the assembly, nor shall it melt at any temperature less than 65° C (149° F). The depth or thickness of sealing compound shall not be less than 1/8 inch (3.2 mm).

10 Mounting of Parts

10.1 All parts of a product shall be mounted in position and prevented from loosening or turning if such motion adversely affects the performance of the product, or presents the risk of fire or injury to persons incident to the operation of the product.

10.2 A switch, lampholder, attachment-plug receptacle, or plug connector shall be mounted as intended and, except as noted in 10.3 and 10.4, shall be prevented from turning.

10.3 A switch is not required to be prevented from turning when all the following conditions are met:

- a) The switch is of a plunger or other type that does not rotate when operated. A toggle switch is considered to be subject to forces that turn the switch during operation of the switch.
- b) The switch is mounted in such a manner that operation of the switch will not loosen the switch.
- c) The spacings are not reduced below the minimum required values if the switch does rotate.

10.4 A lampholder of a type in which the lamp is irreplaceable, such as a neon pilot or indicator light in which the lamp is sealed in by a nonremoveable jewel, need not be prevented from turning if rotation cannot reduce spacings below the minimum required values.

10.5 The means for preventing the turning mentioned in 10.2 shall consist of more than friction between surfaces, but a lock washer is acceptable as a means for preventing a small stem-mounted switch or other device having a single-hole mounting means from turning.

10.6 Uninsulated live parts, including terminals, shall be secured to their supporting surfaces by methods other than friction between surfaces so that they will be prevented from turning or shifting in position if such motion results in reduction of spacings to less than those required. The security of contact assemblies shall be such as to provide the continued alignment of contacts.

11 Operating Mechanisms

11.1 Operating parts, such as gear mechanisms, light-duty relays, and similar devices shall be protected against fouling by dust or by other material that adversely affects their intended operation by individual protection or dust-tight cabinets. A relay using contacts having a wiping action does not require any special protection against fouling by dust.

11.2 Gears shall have uniformly formed teeth with smooth engaging surfaces, and shall be reliably secured in place.

11.3 The assembly of an operating mechanism included as a part of a product shall be such that it will not be adversely affected by any condition of intended operation.

11.4 Cams and similar parts shall be fastened to prevent independent turning or loosening by methods other than friction between surfaces.

11.5 Moving parts shall have sufficient play at bearing surfaces to prevent binding.

11.6 Provision shall be made to prevent adjusting screws and similar adjustable parts from loosening under the conditions of actual use.

12 Field-Wiring Connections – Permanently-Connected Products

12.1 General

12.1.1 A wiring terminal or lead shall be investigated and determined to be acceptable for the connection of conductors of the minimum size required by the National Electrical Code, ANSI/NFPA 70, corresponding to the electrical rating of the unit.

12.1.2 Duplicate terminals or leads, or equivalent means to achieve electrical supervision, shall be provided for each incoming and outgoing connection. A common terminal shall not be used for connection of both incoming and outgoing wires, unless the construction of the terminal does not permit an uninsulated section of a single conductor to be looped around the terminal and serve as two separate connections, thereby precluding supervision of the connection in the event that the wire becomes dislodged from under the terminal. A notched clamping plate under a single securing screw, in which separate conductors of an initiating circuit are intended to be inserted in each notch, shall not be used unless this arrangement is supplemented by additional marking in the wiring area or on the installation wiring diagram specifying the intended connections to the terminals.

12.2 Field-wiring terminal connections

12.2.1 The location of a terminal box or compartment in which branch-circuit connections to a permanently wired product are to be made shall be such that the connections are capable of being readily inspected without disturbing the wiring or the product after the product has been installed as intended.

12.2.2 A terminal compartment intended for connection of a supply raceway shall be attached to the product so that it cannot turn.

12.3 Field-wiring terminals and leads

12.3.1 A permanently connected product shall be provided with wiring terminals or leads for the connection of conductors having an ampacity not less than 125 percent of the current input of the product.

12.3.2 The free length of a lead inside a terminal box or compartment shall be a minimum of 6 inches (152 mm) if the lead is intended for field connection to an external circuit.

Exception: The lead may be less than 6 inches long if it is evident that the use of a longer lead might result in a risk of fire or electric shock.

12.3.3 A field-wiring terminal shall be kept from turning or shifting in position by means other than friction between surfaces. This shall be accomplished by two screws or rivets; by square shoulders or mortises; by a dowel pin, lug, or offset; by a connecting strap or clip fitted into an adjacent part; or by other equivalent means.

12.3.4 A field-wiring terminal shall be provided with a soldering lug or pressure terminal connector firmly bolted or held by a screw, except that a wire-binding screw shall not be used at a wiring terminal intended to accommodate a No. 10 AWG (5.3 mm²) or smaller conductor unless upturned lugs, cupped washers, or the equivalent are provided to hold the wire in position.

12.3.5 Upturned lugs or cupped washers shall be capable of retaining a supply conductor of the size indicated in 12.3.1 under the head of the screw or washer.

12.3.6 A wire-binding screw at a wiring terminal shall not be smaller than No. 10 (4.8 mm diameter).

Exception No. 1: A No. 8 (4.2 mm diameter) screw may be used at a terminal intended only for the connection of a No. 14 AWG (2.1 mm²) conductor.

Exception No. 2: A No. 6 (3.5 mm diameter) screw may be used for the connection of a No. 16 or 18 AWG (1.3 or 0.8 mm²) conductor.

12.3.7 As specified in the National Electrical Code, ANSI/NFPA 70, No. 14 AWG (2.1 mm²) is the smallest conductor that is to be used for branch-circuit wiring and thus is the smallest conductor that shall be used at a terminal for connection of a branch-circuit conductor.

12.3.8 A wire-binding screw shall thread into metal for not less than two full threads.