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UL 331C

Outline of Investigation for Fuel Filtration Units

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Summary of Topics

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INTRODUCTION

1 Scope

1.1 This outline covers fuel filtration units rated 600 V or less. These units are intended for use with one or more of the following:

- a) Diesel fuel and diesel fuel/biodiesel blends with nominal biodiesel concentrations up to 5 percent (B0 – B5) formulated in accordance with the Standard Specification for Diesel Fuel Oils, ASTM D975.
- b) Kerosene formulated in accordance with the Standard Specification for Kerosene, ANSI/ASTM D3699.
- c) Fuel oil (heating oil) formulated in accordance with the Standard Specification for Fuel Oils, ASTM D396.

1.2 These devices are intended to be installed in accordance with the National Electrical Code, ANSI/NFPA 70.

1.3 This outline does not cover fuel filtration units for use with fuels other than as mentioned in 1.1.

1.4 This outline does not cover filters or strainers themselves. These devices are covered under the Standard for Strainers for Flammable Fluids and Anhydrous Ammonia, UL 331, or the Outline of Investigation for Strainers for Diesel Fuel, Biodiesel Fuel, Diesel/Biodiesel Blends with Nominal Biodiesel Concentrations Up to 20 Percent (B20), Kerosene, and Fuel Oil, UL 331B.

2 Components

2.1 Except as indicated in 2.2, a component of a product covered by this outline shall comply with the requirements for that component.

2.2 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 outline, or
- b) Is superseded by a requirement in this outline.

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

2.4 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.

3 Units of Measurement

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

3.2 Values of voltage and current are rms values, unless otherwise indicated.

4 Undated References

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

5 Glossary

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

5.2 GASOLINE/ETHANOL BLENDS – Blended fuels composed of a gasoline component and an ethanol component. The numerical value corresponding to the ethanol component determines the blend rating (such as E85 for 85% ethanol, 15% gasoline).

5.3 HAZARDOUS LOCATIONS – Locations in which flammable gases or vapors are or may be present in the air in quantities sufficient to produce explosive or ignitable mixture

5.4 SECONDARY CIRCUIT – A circuit supplied from a secondary winding of an isolating transformer.

CONSTRUCTION

6 General

6.1 A product shall employ materials found by investigation to be acceptable for the intended application.

6.2 A product shall be assembled so that it will not be adversely affected by the vibration of normal operation.

6.3 The construction shall be such that parts can be replaced or reassembled to function as intended after being dismantled.

6.4 The device shall incorporate provisions for support independent of piping, tubing, or conduit that may be connected thereto.

6.5 The frame or chassis of the device shall not be used to carry current during intended operation.

6.6 Products shall be suitable for an intended ambient temperature range of minus 31 to 104°F (minus 35 to 40°C).

7 Enclosure

7.1 A product shall be formed and assembled so that it will have the strength and rigidity necessary to resist the abuses to which it is likely to be subjected, without resulting in a risk of fire, electric shock, or injury to persons due to total or partial collapse with resulting reduction of spacings, loosening or displacement of parts, or other defects.

7.2 Cast and sheet-metal portions of an enclosure shall not be thinner than the applicable values specified in Table 7.1.

Table 7.1
Thickness of enclosure metal

Metal	Minimum thickness, in (mm)				
	At a small flat unreinforced surface and at a surface of a shape or size to provide mechanical strength		At a surface to which a wiring system is to be connected in the field		At a relatively large unreinforced flat surface
Die-cast metal	3/64	(1.2)	—		5/64 (2.0)
Cast malleable iron	1/16	(1.6)	—		3/32 (2.4)
Other cast metal	3/32	(2.4)	—		1/8 (3.2)
Uncoated sheet steel	0.026	(0.66)	0.032	(0.81)	0.026 (0.66)
Galvanized sheet steel	0.029	(0.74)	0.034	(0.86)	0.029 (0.74)
Nonferrous sheet metal	0.036	(0.91)	0.045	(1.14)	0.036 (0.91)

7.3 Among other factors that should be considered when judging the acceptability of a nonmetallic enclosure are:

- a) Mechanical Strength;
- b) Resistance to impact;
- c) Moisture absorptive properties;
- d) Flammability; and
- e) Resistance to distortion at temperatures to which the material may be subjected under conditions of normal or abnormal usage.

7.4 An enclosure of polymeric material shall comply with the applicable requirements for products that are not categorized as household use only as contained in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

7.5 An enclosure of polymeric material shall be subjected to the Resistance to Impact Test described in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C before and after cold conditioning at minus 31°F (minus 35°C) for 3 hours. After each test, the enclosure shall comply with 7.1.

7.6 The enclosure of a product shall prevent molten metal, burning insulation, flaming particles, or the like from falling on flammable materials, including the surface upon which the product is supported.

7.7 The requirement in 7.6 will necessitate that a switch, a relay, a solenoid, or the like, be individually and completely enclosed, except for terminals, unless it can be shown that malfunction of the component would not result in a risk of fire, or there are no openings in the bottom of the product enclosure. It will also necessitate the use of a barrier of nonflammable material:

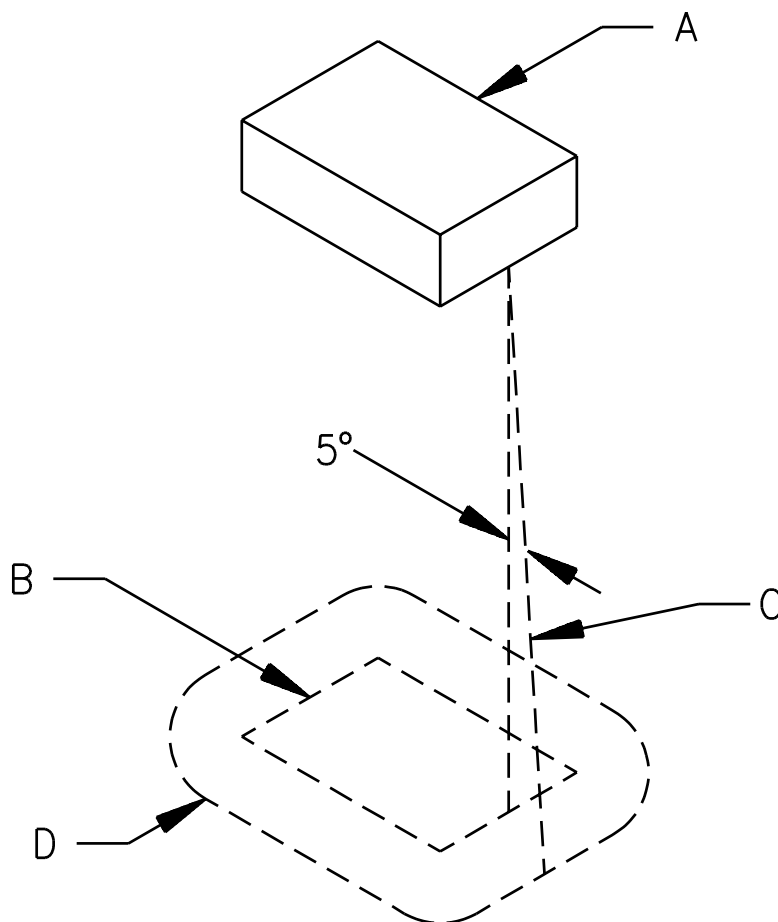
a) Under a motor unless:

- 1) The structural parts of the motor or of the product provide the equivalent of such a barrier;
- 2) The protection provided with the motor is such that no burning insulation or molten material falls to the surface that supports the product when the motor is energized under each of the following fault conditions:
 - i) Open main winding,
 - ii) Open starting winding,
 - iii) Starting switch short-circuited, and
 - iv) Capacitor of permanent-split capacitor motor short circuited - the short-circuit is to be applied before the motor is energized, and the rotor is to be locked;
- 3) The motor is provided with a thermal motor protector - a protective device that is sensitive to temperature and current - that will prevent the temperature of the motor windings from exceeding 257°F (125°C) under the maximum load under which the motor will run without causing the protector to cycle and from exceeding 302°F(150°C) with the rotor of the motor locked;
- 4) The motor complies with the requirements for impedance-protected motors in either the Standard for Overheating Protection for Motors, UL 2111, or the Standard for Impedance Protected Motors, UL 1004-2, and the temperature of the motor winding will not exceed 302°F(150°C) during the first 72 hours of operation with the rotor of the motor locked; or
- 5) A vertically mounted motor is supplied with a metal screen on the end bell having a mesh with nominal openings not greater than 0.079 inch (2 mm) between center lines and with wire diameters of not less than 0.018 inch (0.45 mm) or if the motor complies with the Hot Flaming Oil Test in the Standard for Information Technology Equipment - Safety - Part 1: General Requirements, UL 60950-1.

b) Under wiring, unless the wire is marked VW-1.

7.8 The barrier mentioned in 7.7 shall be horizontal, shall be located as indicated in Figure 7.1, and shall not have an area less than that described in that illustration. Openings for drainage, ventilation, and the like may be employed in the barrier, provided such openings would not permit molten metal, burning insulation, or the like to fall on flammable material.

Figure 7.1
Location and extent of barrier



SA0604-1

NOTES –

A – Region to be shielded by barrier. This will consist of the entire component if it is not otherwise shielded and will consist of the unshielded portion of a component that is partially shielded by the component enclosure or equivalent.

B – Projection of outline of component on horizontal plane.

C – Inclined line that traces out minimum area of barrier. The line is always

- 1) Tangent to the component,
- 2) 5 degrees from the vertical, and
- 3) Oriented so that the area traced out on a horizontal plane is maximum.

D – Location (horizontal) and minimum area for barrier. The area is that included inside the line of intersection traced out by the inclined line C and the horizontal plane of the barrier.

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7.9 A door or a cover of an enclosure that provides access to any overload-protective device that requires resetting or renewal shall be hinged or otherwise attached in an equivalent manner.

7.10 Means shall be provided for holding the door or cover over a fuseholder in a closed position, and the door or cover shall be tight-fitting.

7.11 An enclosure of a unit shall be considered suitable for outdoor use and shall comply with the Rain Test, Section 49.

8 Accessibility of Uninsulated Live Parts and Film-Coated Wire

8.1 To reduce the likelihood of unintentional contact that may involve a risk of electric shock from an uninsulated live part or film-coated wire, an opening in an enclosure shall comply with either (a) or (b).

- a) For an opening that has a minor or dimension (see 8.5) less than 1 inch (25.4 mm), such a part or wire shall not be contacted by the probe illustrated in Figure 8.1.
- b) For an opening that has a minor dimension of 1 inch (25.4 mm) or more, such a part or wire shall be spaced from the opening as specified in Table 8.1.

Exception: A motor other than one used in either a hand-held product or a hand-supported portion of a product need not comply with these requirements if it complies with the requirements in 8.2.

Table 8.1
Minimum acceptable distance from an opening to a part that may involve a risk of electric shock

Minor dimension ^a of opening,		Minimum distance from opening to part	
inches	(mm) ^b	inches	(mm) ^b
3/4 ^c	(19.1)	4-1/2	(114.0)
1 ^c	(25.4)	6-1/2	(165.0)
1-1/4	(31.8)	7-1/2	(190.0)
1-1/2	(38.1)	12-1/2	(318.0)
1-7/8	(47.6)	15-1/2	(394.0)
2-1/8	(54.0)	17-1/2	(440.0)
d		30	(762.0)

^a See 8.5.
^b Between 3/4 inch and 2-1/8 inches (19 and 54 mm) interpolation is to be used to determine a value between values specified in the table.
^c Any dimension less than 1 inch (25 mm) applies to a motor only.
^d More than 2-1/8 inches (54 mm), but not more than 6 inches (152.0 mm).

8.2 With respect to a part or wire as mentioned in 8.1 in an integral enclosure of a motor as mentioned in the Exception to 8.1:

- a) An opening that has a minor dimension (see 8.5) less than 3/4 inch (19.1 mm) is acceptable if:

- 1) Film-coated wire cannot be contacted by the probe illustrated in Figure 8.3;
- 2) In a directly accessible motor (see 8.6), an uninsulated live part cannot be contacted by the probe illustrated in Figure 8.4; and

3) In an indirectly accessible motor (see 8.6), an uninsulated live part cannot be contacted by the probe illustrated in Figure 8.2.

b) An opening that has a minor dimension of 3/4 inch or more is acceptable if a part of wire is spaced from the opening as specified in Table 8.1.

Figure 8.2
Probe for uninsulated live parts

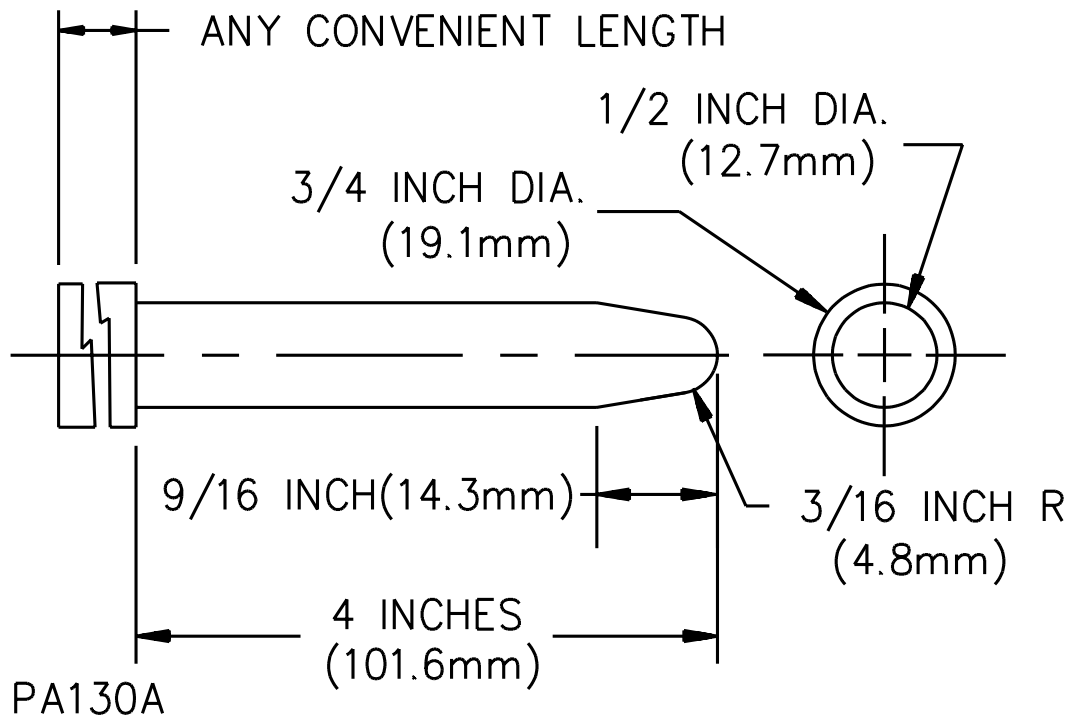
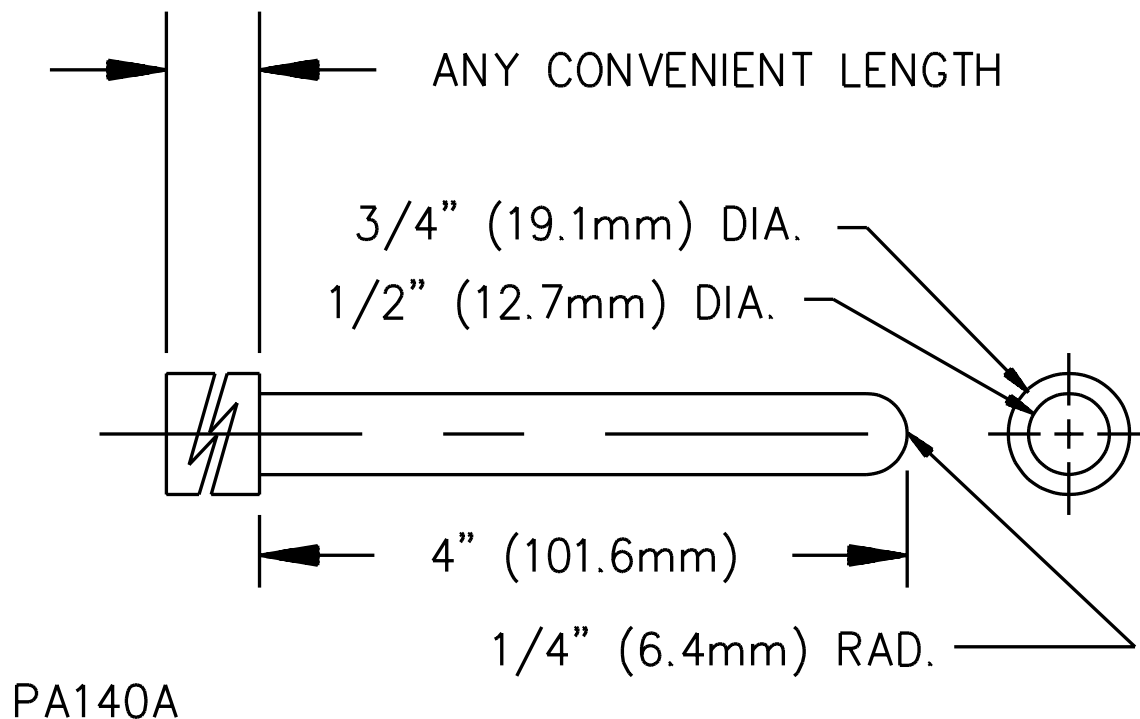


Figure 8.3
Probe for film-coated wire

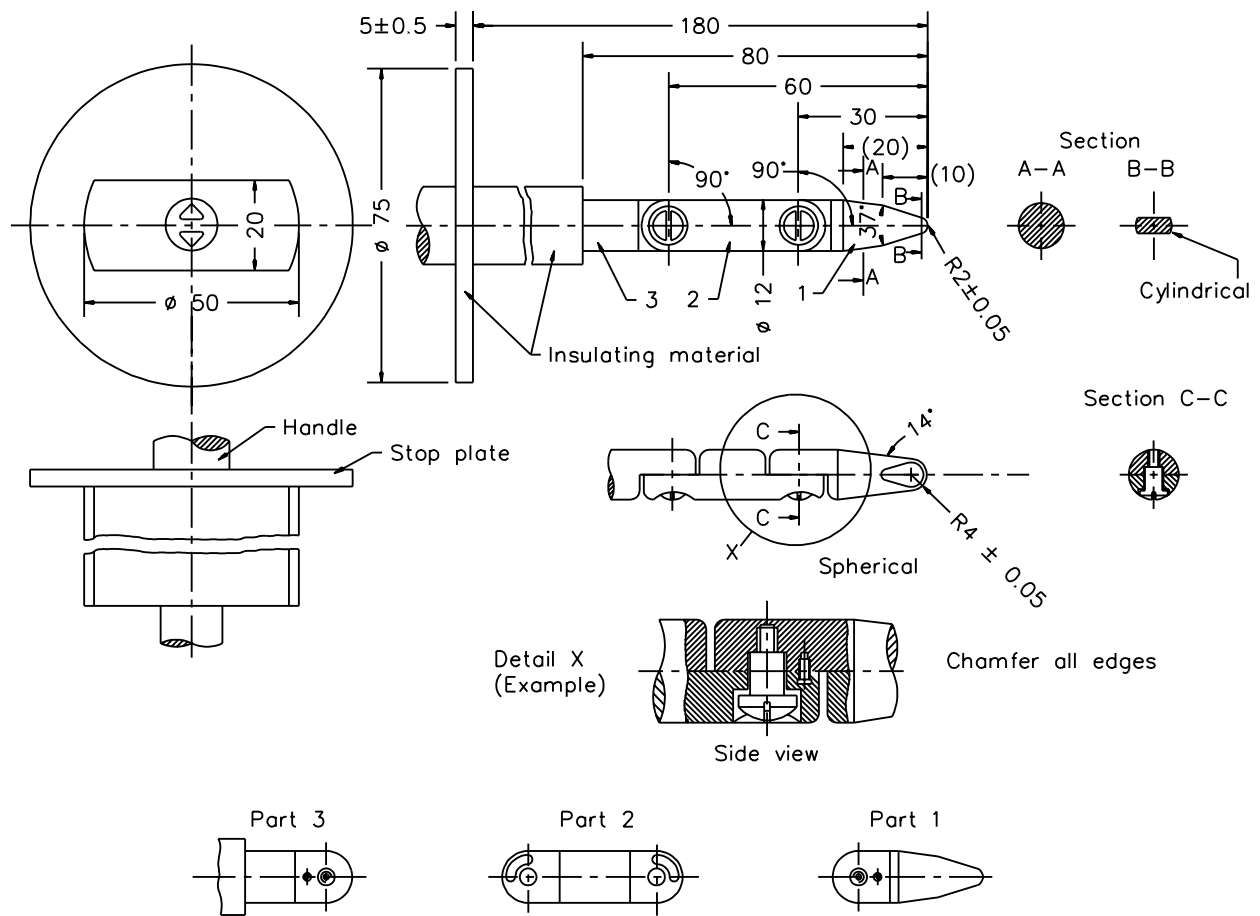


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Figure 8.4
International Electrotechnical Commission (IEC) articulate accessibility probe with stop plate



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8.3 The probes mentioned in 8.1 and 8.2 and illustrated in Figures 8.1 – 8.4 shall be applied to any depth that the opening will permit, and shall be rotated or angled before, during, and after insertion through the opening to any position that is necessary to examine the enclosure. The probes illustrated in Figures 8.1 and 8.4 shall be applied in any possible configuration; and if necessary, the configuration shall be changed after insertion through the opening.

8.4 The probes illustrated in Figures 8.1 – 8.4 shall be used as measuring instruments to judge the accessibility provided by an opening, and not as instruments to judge the strength of a material; they shall be applied with the minimum force necessary to determine accessibility.

8.5 With reference to the requirements in 8.1 and 8.2, the minor dimension of an opening is the diameter of the largest cylindrical probe having a hemispherical tip that can be inserted through the opening.

8.6 With reference to the requirements in 8.2,

a) An indirectly accessible motor is a motor:

- 1) That is accessible only by opening or removing a part of the outer enclosure, such as a guard or panel, that can be opened or removed without using a tool, or
- 2) That is located at such a height or is otherwise guarded or enclosed so that it is unlikely to be contacted.

b) A directly accessible motor is a motor:

- 1) That can be contacted without opening or removing any part, or
- 2) That is located so as to be accessible to contact.

8.7 During the examination of a product to determine whether it complies with the requirements in 8.1 or 8.2, a part of the enclosure that may be opened or removed by the user without using a tool (to attach an accessory, to make an operating adjustment, or for other reasons) is to be opened or removed.

9 Protection Against Corrosion

9.1 Iron and steel parts shall be protected against corrosion by enameling, galvanizing, plating, or other equivalent means, if corrosion of such unprotected parts would be likely to 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 may not be required to be protected against corrosion if the oxidation of the metal due to the exposure to air and moisture is not likely to be appreciable. 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.

9.2 If deterioration of a liquid container provided as a part of a product would result in a risk of fire or electric shock, the container shall be of a material that is resistant to corrosion by the liquid intended to be used therein.

10 Supply Connections

10.1 Cord-connected products

10.1.1 A product intended to be connected to the power-supply circuit by means of a flexible cord shall be provided with a flexible cord and an attachment plug for connection to the supply circuit.

10.1.2 The flexible cord shall have a voltage rating not less than the rated voltage of the product, and shall have an ampacity that is not less than the current rating of the product.

10.1.3 A flexible cord shall be type SJOW, SJEOW, SJTOW, SOW, or SEOW flexible cord, or a type at least equally serviceable for the application.

10.1.4 The flexible cord may be attached permanently to a product or may be in the form of a separate cord set with means for connection to the product.

10.1.5 An attached flexible cord provided with the product shall be at least 6 feet (1.8 m) long including the attachment plug.

10.1.6 The attachment plug shall have an ampacity not less than the rated current of the product and a voltage rating equal to the rated voltage of the product. If a product is adaptable for use on two or more different values of voltage by field alteration of internal connections, the attachment plug provided with the product shall be acceptable for the voltage for which the product is connected when shipped from the factory.

10.1.7 The power-supply cord of a product shall exit the enclosure in an area that is not in close proximity to a hot spot or moving part.

10.2 Strain relief

10.2.1 Strain relief shall be provided so that mechanical stress on a flexible cord, flexible conduit, or armored cable will not be transmitted to terminals, splices, or interior wiring. See Pull relief test, 47.1.

10.2.2 Means shall be provided to prevent a flexible cord from being pushed into a product through a cord-entry hole if such displacement may subject the cord to mechanical damage or exposure to a temperature higher than that for which the cord is acceptable, or may reduce a spacing, such as to a metal strain-relief clamp, below the minimum acceptable value, or damage to the internal connections or components. Compliance is to be checked by the Push back relief test, 47.2.

10.2.3 A knot in a flexible cord shall not serve as a strain relief means.

10.3 Bushings

10.3.1 At a point where a flexible cord passes through an opening in a wall, barrier, or enclosure, there shall be a bushing or the equivalent that shall be substantial, reliably secured in place, and shall have a smooth, well-rounded surface against which the cord may bear. The bushing or equivalent may be of metal provided that a suitable insulating material is placed between the metal bushing and the cord.

10.3.2 A cord hole in wood, porcelain, phenolic composition, or other nonconducting material and having a smooth, rounded surface is considered to be equivalent to a bushing.

10.3.3 Ceramic materials and some molded compositions are generally acceptable for insulating bushings.

10.3.4 A vulcanized fiber bushing shall not be less than 3/64 inch (1.2 mm) thick and so formed and secured in place that it will not be adversely affected by conditions of ordinary moisture.

10.3.5 A separate soft-rubber, neoprene or polyvinyl chloride bushing may be employed in the frame of a motor or in the enclosure of a capacitor attached to a motor provided that the bushing is:

- a) Not less than 3/64 inch (1.2 mm) thick, and
- b) Located so that it will not be exposed to oil, grease, oily vapor, or other substances having a deleterious effect on the compound employed.

10.3.6 At any point in a product, a bushing of the same material as, and molded integrally with, the supply cord is acceptable if the built-up section is not less than 1/16 inch (1.6 mm) thick at the point where the cord passes through the enclosure.

10.3.7 An insulated metal grommet may be acceptable instead of an insulating bushing if the insulating material used is not less than 1/32 inch (0.8 mm) thick and completely fills the space between the grommet and the metal in which it is mounted.

10.4 Permanently connected products

10.4.1 A permanently connected product shall have provision for connection to a wiring system.

10.4.2 A terminal box or compartment in which power-supply connections to a permanently connected product are to be made shall be located so that the connections may be inspected after the product is installed as intended.

10.4.3 A terminal compartment intended for connection of a supply raceway shall be attached to the product so as to be prevented from turning.

10.4.4 If it is intended that supply connections be made directly to a motor, the terminal compartment on the motor shall comply with the requirements for terminal compartments in the Standard for Rotating Electrical Machines - General Requirements, UL 1004-1.