UL 635

STANDARD FOR SAFETY

Insulating Bushings

UL Standard for Safety for Insulating Bushings, UL 635

Third Edition, Dated March 8, 2012

Summary of Topics

This reaffirmation of ANSI/UL 635 dated April 24, 2025 is being issued to update the title page to reflect the most recent designation as a Reaffirmed American National Standard (ANS). No technical changes have been made.

Text that has been changed in any manner or impacted by ULSE's electronic publishing system is marked with a vertical line in the margin.

The requirements are substantially in accordance with Proposal(s) on this subject dated March 7, 2025.

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UL 635

Standard for Insulating Bushings

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Second Edition – October, 2001

Third Edition

March 8, 2012

This ANSI/UL Standard for Safety consists of the Third Edition including revisions through April 24, 2025.

The most recent designation of ANSI/UL 635 as a Reaffirmed American National Standard (ANS) occurred on April 24, 2025. 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 ULSE at any time. Proposals should be submitted via a Proposal Request in the Collaborative Standards Development System (CSDS) at https://csds.ul.com.

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INTRODUCTION

1 Scope

1.1 This Standard covers insulating bushings and accessories for insulating bushings used for the following purposes in electrical equipment:

a) Insulating bushings used for the protection of cables, flexible cords, and insulated wires, where routed through internal or external walls of electrical equipment.

b) Insulating bushings used to provide strain-relief for flexible cord and single conductor insulated wiring and to protect such cords or wiring.

c) Accessories to insulating bushings used to supplement the characteristics of the bushing.

1.2 This Standard does not cover bushings used in the following applications:

a) Bushings for the protection of uninsulated conductors.

b) Strain-relief insulating bushings used to hold more than one cable, wire, or cord.

c) Bushings that are an integral part of a flexible cord.

d) Bushings used at the end of a raceway at the point of connection to open wiring and bushings used in conjunction with rigid or flexible conduit, conduit fittings, electrical metallic tubing, armored cable, or non-metallic sheathed cable.

e) Bushings for power circuit breakers, transformers, or similar power apparatus rated more than 600 volts.

f) Bushings intended for outdoor use.

g) Bushings used on armored cable between the conductors and the outer armor.

h) Insulating bushings provided either separately or as part of a conduit fitting.

i) Rainproof or liquid tight bushings.

j) Bushings for use on the ends of rigid or flexible conduit.

k) Closures of the type used to plug holes in outlet boxes or outlet box covers:

1) Covered by the Standard for Metallic Outlet Boxes, UL 514A and by the Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers, UL 514C; or

2) Of the type used to plug holes in enclosures.

l) The following items covered by the Standard for Conduit, Tubing, and Cable Fittings, UL 514B:

1) Cord grips;

2) Insulating bushings;

3) Liquid-tight flexible cord fittings;

4) Mesh grips;

5) Strain relief grips;

6) Strain relief grips for bus drop cables;

7) Strain relief grips for flexible cords; and

8) Strain relief with wire mesh cord grips.

1.3 In this standard, a requirement which applies to one type of bushing is to be identified by a specific reference in that requirement to the type of bushing involved. In the absence of such specific reference or when the general terms "bushing" or "insulating bushing" are used, it is to be understood that the requirement applies to all other types of bushings covered by this standard.

2 Units of Measurement

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

3 Undated References

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.

4 Glossary

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

4.2 CORD GUARD – A cord guard is an accessory device used to provide a smooth bend of the cord exiting from a bushing.

4.3 INSULATING BUSHING ACCESSORY – A subordinate part of an assembly used to complete the function of a bushing.

4.4 INSULATING FEED-THROUGH BUSHING – A device which physically and electrically separates cables, flexible cord, or insulated wires from metal edges of openings through which they pass. A feed-through bushing is not intended to provide any strain relief.

4.5 INSULATING STRAIN-RELIEF BUSHING – A device which physically and electrically separates cables, flexible cord, or insulated wires from metal edges of openings through which they pass and prevents a mechanical force (push, pull) imposed on the conductors from being transmitted to internal electrical connections through the plane of the bushing opening.

CONSTRUCTION

5 General

5.1 A bushing shall be constructed so that it has the strength and rigidity required to resist the abuses to which it is subjected, without increasing the fire, shock or casualty hazards due to total or partial collapse with resulting reduction in spacings, loosening or displacement of parts, or other serious defects.

5.2 A bushing shall be provided with a means to reliably secure it in place.

5.3 The surfaces against which the cable, flexible cord or insulated wire bear shall be smooth and rounded.

5.4 A strain-relief bushing shall be constructed so that it performs its intended function without damage to the flexible cord or insulated wire. An anti-rotation feature shall be provided. See 13.4(d).

5.5 A bushing that is intended to be used with a cord that is in motion during normal use shall provide sharp bend protection as indicated in the Sharp Bend Protection Test, Section 12.

6 Materials

6.1 General

6.1.1 Ceramic materials and some molded compositions such as phenolic and urea formaldehyde are capable of being used as materials for a separate insulating bushing. Vulcanized fiber is not prohibited from being used when the bushing is not less than 3/64 inch (1.2 mm) thick, and when it is formed and secured in place so that it is not adversely affected by conditions of typical moisture. Other materials, such as nylon, are capable of being used after a suitable investigation.

6.1.2 Wood, hot-molded shellac, tar compositions, or rubber shall not to be used as materials for a separate insulating bushing.

6.1.3 The wall thickness of an insulating bushing shall not be less than 3/64 inch (1.2 mm) unless a thickness has been determined to be capable of being used as a result of an investigation. See reference to vulcanized fiber in 6.1.1. This requirement does not preclude the use of narrow slots or openings in the wall of an insulating bushing when the intended cable, flexible cord, or insulated wire is not capable of being pressed into such slots or openings.

6.2 Flammability

6.2.1 Materials employed in the construction of insulating bushings shall be classified with a flammability rating of at least HB as determined by the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94 or IEC 60695-11-10, Test Flames – 50 W Horizontal and Vertical Flame Test Methods.

6.3 Temperature rating

6.3.1 The temperature rating of a bushing is to be based on the mechanical-without-impact relative thermal index (RTI – Strength) of the material used in the insulating bushing. The relative thermal index shall be determined in accordance with the Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B.

Note: The relative thermal index of a material is an indication of the material's ability to retain a particular property (such as physical or electrical) when exposed to an elevated temperature for an extended period of time. For each material, a number of relative thermal indices are established, each related to a specific property, and specific thickness of the material.

6.3.2 The temperature rating of an insulating bushing shall not exceed the mechanical-without-impact relative thermal index of the material that is selected for the insulating bushing device, in the bushing's minimum critical thickness. When a bushing model number is evaluated with alternate or substitute materials (see Substitution of materials, Section 6.4) the temperature rating for that specific model number can not exceed the lowest mechanical-without-impact relative thermal index of the materials authorized for that model.

6.4 Substitution of materials

6.4.1 Another polymeric material shall be allowed to be substituted in a device having met the requirements of this Standard only when all of the following conditions are met and compliance is determined through an appropriate investigation:

a) The substitute material has an identical generic description (for example: Type 66, 30 percent glass filled, FR type, polyamide).

b) The tensile strength of the substitute and the originally evaluated material, determined in accordance with the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A or ISO 527-1, Plastics – Determination of Tensile Properties – Part 1: General Principles, and ISO 527-2, Plastics – Determination of Tensile Properties – Part 2: Test Conditions for Moulding and Extrusion Plastics, shall be compared, and shall indicate that the substitute material has a strength of at least 95 percent of that of the original material. The tensile strengths used in this comparison shall be generated by either:

1) A previous investigation or

2) Side-by-side testing of both materials.

c) The substitute material's mechanical-without-impact relative thermal index shall be equal to or higher than the originally evaluated material.

6.5 Molding considerations

6.5.1 Except as indicated in (a) and (b), polymeric materials used to mold or fabricate devices covered by this Standard shall be made from materials that are 100 percent virgin and unmodified by the molder:

a) Devices made from thermoplastic materials are limited to 25 percent regrind by weight of the same material, unless the results of a separate investigation indicate acceptable performance for the material or the specific device. The Standard for Polymeric Materials – Fabricated Parts, UL 746D, includes guidelines to be considered in such a separate investigation.

b) Devices covered by this Standard shall be allowed to employ colorants, flame retardants, fillers, mold-release lubricants, color concentrates, dyestuff, chemical blowing agents or reinforcements in conjunction with the polymeric material, when the additive or concentrate is tested and found not to adversely affect the critical properties of the material. An additive or concentrate of unknown performance shall not be used. The Standard for Polymeric Materials – Fabricated Parts, UL 746D, provides guidance for the use of specific additives that may be used in the molding process without need for separate investigation.

6.5.2 Devices shall not employ materials that have been blended together unless one of the following conditions have been met:

a) When two materials have already been individually considered acceptable for an application, and are both found to be generically similar, are both produced by the same manufacturer, and are both designated HB in the minimum part thickness when tested in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94 or IEC 60695-11-10, Test Flames – 50 W Horizontal and Vertical Flame Test Methods, these materials may be dry blended in any proportion by the manufacturer without further testing.

b) When two materials have already been individually considered acceptable for an application and are both found to be generically similar, are both produced by the same manufacturer, each is designated V-0, V-1, or V-2 in the minimum part thickness when tested in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94 or IEC 60695-11-10, Test Flames – 50 W Horizontal and Vertical Flame Test Methods, and when

the results of a separate investigation indicate performance meeting the requirements for the material or the specific device, these materials may be dry blended in any proportion by the manufacturer without further testing. The Standard for Polymeric Materials – Fabricated Parts, UL 746D, includes guidelines for a separate investigation.

A device made from blended material described in (a) or (b) shall be considered to have flammability, mechanical, and thermal properties that are no better than the performance of the weaker of the individual constituents on a property-to-property basis.

7 Accessories for Insulating Bushings

7.1 When a cord guard is provided, it is not prohibited from being a helical wire spring or an equivalent protective device. The guard shall provide a smooth wireway and shall be held securely in place when the bushing is installed in the intended manner.

7.2 The guard shall extend a minimum of 1-1/2 inches (38 mm) from the exit of the bushing (other dimensions are not specified). The diameter of the wireway in the guard shall accommodate the cord without restriction or unnecessary looseness. A smooth metal grommet or a suitable bushing is capable of being used at the free end of a spring guard.

7.3 The cord guard supplied with a bushing shall be flexible enough to conform to the motion of the cord in normal use without producing a sharp bend at or near the point of attachment to the bushing. See Sharp Bend Protection Test, Section 12.

Exception: A rigid guard is capable of being used when, upon investigation, it is determined to provide protection equivalent to that of a flexible cord guard. See Sharp Bend Protection Test, Section 12.

8 Corrosion Protection

8.1 Iron or steel other than washers, screws, bolts, nuts and stainless steel parts shall be protected against corrosion. Cadmium or zinc provides suitable corrosion protection.

PERFORMANCE

9 General

9.1 A bushing shall be capable of performing its intended functions after exposure to conditions of normal and reasonably foreseeable abnormal use.

9.2 To determine when a bushing complies with the requirement in 9.1, representative samples of that bushing are to be subjected to the tests in Sections 10 – 13.

9.3 When any type of bushing uses a bell-mouth construction having a radius not less than 1.5 times the overall diameter of the largest cable or cord it is intended to accommodate, the construction is not prohibited from being used where the flexible cable or cord is in motion during use, when it is determined to provide protection from sharp bends as indicated in the Sharp Bend Protection Test, Section 12.

10 Feed-Through Test

10.1 Three samples of each feed-through bushing shall be capable of performing their intended functions when tested as indicated in 10.2 and 10.3 without damaging the insulation of the conductors and without displacing the bushing.

10.2 The feed-through bushing are to be assembled in the intended manner in a suitable, vertical metal plate in the largest size opening intended to accommodate the bushing. From the side of the bushing having the smallest flange diameter, the test conductors are to be inserted. The test conductors are to be 36 inches (0.9 m) long, laid parallel to each other, and amount to 40 percent of the maximum fill (cross-sectional capacity) of the bushing. The test conductors are to extend 6 inches (152 mm) from the side of the bushing having the largest flange diameter.

10.3 Grasping the 6-inch (15-mm) side of the conductors, a pull is to be applied. This force is to pull the remainder of the entire bundle of conductors through the bushing in one smooth motion, in not less than 1.5 seconds. The bushing and conductors shall comply with the requirements in 10.1.

11 Strain-Relief Test

11.1 Three samples of a strain-relief bushing are to be assembled in a metal plate in accordance with 11.2. When tested in accordance with 11.2, the samples are to have the force applied perpendicular to the metal plate. See Figure 11.1 and Figure 11.2 .

Figure 11.1

Strain-relief test (straight-through bushing)

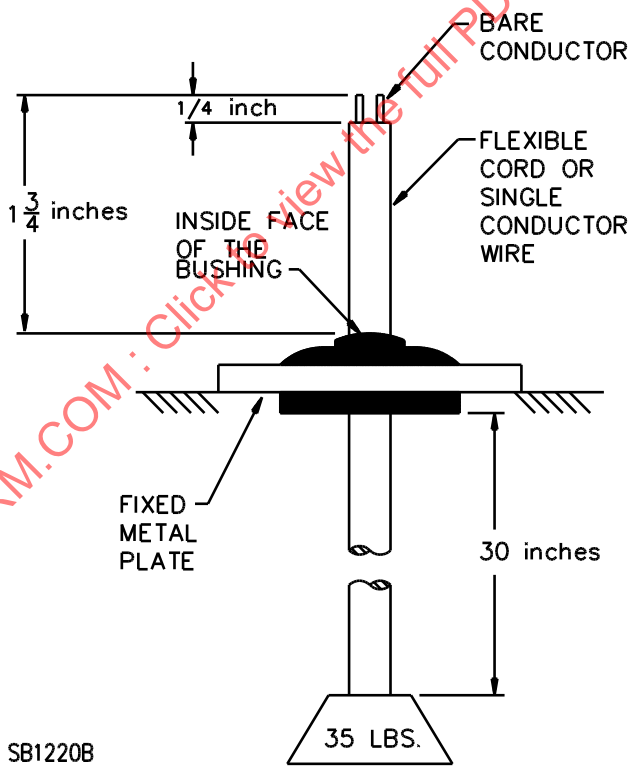
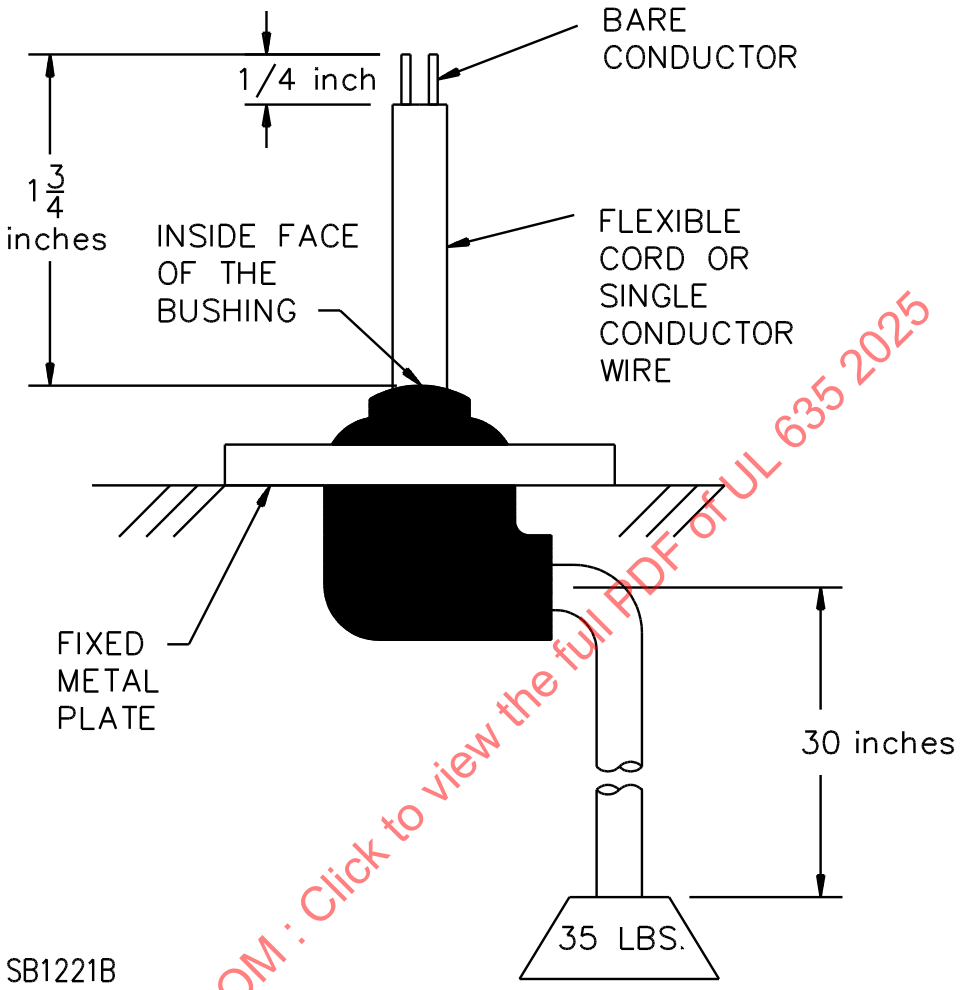


Figure 11.2

Strain-relief test (right-angle bushing)



11.2 Each sample is to be assembled to a metal plate in accordance with the recommendations of the manufacturer in regards to:

a) The flexible cable or cord size and type;

b) Mounting means or hole size and shape; and

c) Minimum panel thickness.

The flexible cord or single insulated wire is to be 30 inches (0.7 m) in length, and is to extend 1-3/4 inches (44 mm) from the inside face of the bushing. The last 1/4 inch (6.4 mm) of the cord or wire is to be a bare conductor. The plate is to be firmly supported in a horizontal plane. A gradual pull of the force of 35 pounds is to be applied to the length of cord exiting the outside face of the bushing hanging beneath the plate. The force is to be applied for a period of one minute.

11.3 Upon completion of the test, the insulating strain-relief bushing shall not be displaced from the mounting plate. The 1-3/4 inch (44 mm) section of the cord or wire shall not be less than 1-5/8 inches (41 mm) when measured from the inside face of the bushing, with the weight removed. The flexible cord or the single conductor insulated wire shall not show any sign of damage.

11.4 When the strain-relief bushing is intended to be used with various cord sizes and types, mounting openings of various dimensions, or mounting plates of various thicknesses, additional tests are to be conducted. The test data shall permit, where possible, the determination of compliance with the requirements by all assemblies falling within the ranges and variables mentioned above without testing each combination.

12 Sharp Bend Protection Test

12.1 To determine that the cord guard complies with the requirement in 7.3, the guard is to be tested with a 3-pound (1.4 kg) weight attached to a length of flexible cord or insulated wire extending at least 12 inches (305 mm) beyond the cord guard that is installed in the appropriate bushing and assembled to a fixed metal plate.

12.2 The bushing is to be mounted as illustrated in Figure 12.1 . Dimension X is to be measured while the axis of the cord and the cord guard coincide with the axis of the bushing. No weight is to be applied to the cord during this measurement.