

UL 514B

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Fittings for Cable and Conduit

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The revisions are substantially in accordance with UL's Bulletin(s) on this subject dated November 21, 2001.

The revisions dated February 7, 2002 include a reprinted title page (page1) for this Standard.

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UL 514B

Standard for Fittings for Cable and Conduit

Prior to the First edition, the requirements for the products covered by this standard were included in the Standard for Outlet Boxes and Fittings, UL 514.

The Third and previous editions were titled Fittings for Conduit and Outlet Boxes.

First Edition – July, 1982

Second Edition – March, 1989

Third Edition – December, 1996

Fourth Edition

November 3, 1997

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The Department of Defense (DoD) has adopted UL 514B on June 11, 1992 . The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

Revisions of this Standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest set of revised requirements.

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FOREWORD

A. This Standard contains basic requirements for products covered by Underwriters Laboratories Inc. (UL) under its Follow-Up Service for this category within the limitations given below and in the Scope section of this Standard. These requirements are based upon sound engineering principles, research, records of tests and field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, inspection authorities, and others having specialized experience. They are subject to revision as further experience and investigation may show is necessary or desirable.

B. The observance of the requirements of this Standard by a manufacturer is one of the conditions of the continued coverage of the manufacturer's product.

C. A product which complies with the text of this Standard will not necessarily be judged to comply with the Standard if, when examined and tested, it is found to have other features which impair the level of safety contemplated by these requirements.

D. A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this standard, and that involves a risk of fire or of electric shock or injury to persons shall be evaluated using appropriate additional component and end-product requirements to maintain the level of safety as originally anticipated by the intent of this standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this standard does not comply with this standard. Revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this standard.

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F. Many tests required by the Standards of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

INTRODUCTION

1 Scope

1.1 These requirements cover fittings for use with conduit and outlet boxes to be employed in accordance with the National Electrical Code, NFPA 70.

1.2 The requirements in Sections 1 – 85 cover conduit locknuts, conduit bushings, conduit bodies, entrance elbows; fittings for electrical metallic tubing, flexible metal conduit, intermediate metal conduit, liquid-tight flexible conduit, rigid metal conduit, rigid nonmetallic conduit; service-entrance heads; threadless fittings; fittings for armored cable, metal clad cable, mineral-insulated cable, nonmetallic sheathed cable, service-entrance cable; and fittings for flexible cord, flexible nonmetallic tubing, insulating bushings, and nipples.

1.3 The requirements in Sections 86 – 103 cover fittings for rigid polyvinyl chloride (PVC) conduit. See Scope, Section 86, for additional details.

1.4 These requirements do not cover fittings for use in hazardous locations as defined in the National Electric Code, NFPA 70.

1.5 These requirements do not cover fittings intended for use with surface raceway systems.

1.6 These requirements do not cover conduit nipples, elbows and threaded couplings intended for use with intermediate metal conduit or rigid metal conduit, or elbows intended for use with intermediate metal conduit, rigid metal conduit, or electrical metallic tubing are not covered by these requirements.

1.7 *Deleted February 7, 2002*

2 Terminology

2.1 In the following text, a requirement that applies only to one or more types of fitting is so identified by a specific reference in that requirement to the type or types of fittings involved. Absence of such reference indicates that the requirement applies to all of these types of fittings unless the context indicates otherwise.

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 **ANGLE FITTING** – A fitting with or without a removable cover (or cap) intended to change the direction of the raceway.

4.3 **BUSHING** – A fitting provided to protect wires from abrasion and intended for use where conductors enter or leave the raceway system.

4.4 **CONCRETE-TIGHT FITTING** – A fitting that excludes concrete aggregate (portland-type cement and sand).

4.5 **CONDUIT BODY** – A means for providing access to the interior of the system through one or more removable covers at a junction of two or more sections or at a terminal point.

4.6 **CONDUIT BODY, SHORT RADIUS** – A capped elbow or service entrance elbow.

4.7 **CONNECTOR** – A fitting intended to terminate a cable, cord, or raceway to a box or similar device.

4.8 **COUPLING** – A fitting intended to connect two lengths of raceway or perform a similar function.

4.9 **ELASTOMER** – Rubber or any polymer other than a thermoplastic elastomer that has properties similar to those of rubber.

4.10 **ELBOW** – A fitting used to change the direction of a raceway system.

4.11 **EXPANSION JOINT** – A fitting intended to compensate for linear thermal expansion of a span of intermediate metal, rigid metal, or nonmetallic conduit.

4.12 **FITTING** – A means for securing conduit, cable, or electrical metallic tubing to an enclosure, box, or raceway system.

4.13 **FLEXIBLE CORD FITTING** – A cord grip without mesh support used to reduce strain at points of termination for flexible cord.

4.14 **FLEXIBLE CORD FITTING, LIQUID-TIGHT** – A cord grip without mesh support used to reduce strain at points of termination for flexible cord intended for liquid-tight and outdoor applications.

4.15 **GRIP, PULLING** – A mesh grip used to pull conductors or cable into a raceway.

4.16 **GRIP, STRAIN RELIEF** – A mesh grip used to reduce strain at points of termination for cable or flexible conduit.

4.17 **GRIP, SUPPORT** – A mesh grip used to hold the weight and restrain the arc-of-bend of a cable.

4.18 HUB – A fitting intended for use with threaded conduit for connection to an enclosure.

4.19 INSULATING BUSHING – A fitting, consisting of a polymeric insulator provided to protect wires from abrasion and intended for use where conductors enter or leave the raceway system. Included are metal bushings or fittings having a polymeric throat, throat liner, or insert.

4.20 LOCKNUT – An internally threaded fitting for use on intermediate metal or rigid metal conduit or fittings to prevent turning and to provide a secure joint.

4.21 NIPPLE – An externally threaded fitting intended primarily to serve as a short raceway between close-spaced enclosures.

4.22 REDUCING COUPLING – A fitting intended to join lengths of two different sizes of raceway.

4.23 SERVICE-ENTRANCE HEAD – An enclosed fitting intended for use at service entrances where open wiring is connected to a service-entrance cable or raceway system.

4.24 THREADLESS FITTING – A fitting intended for use with electrical metallic tubing, intermediate metal conduit, or rigid metal conduit.

5 Units of Measurement

5.1 If a value for measurement is followed by a value in other units in parentheses, the second value may be only approximate. The first stated value is the requirement. Where there is a trade size shown followed by a number in parentheses, the second number is the metric designator.

CONSTRUCTION

ALL FITTINGS

6 General

6.1 The requirements in Sections 7 – 12 apply to all fittings except those for use with rigid nonmetallic conduit. They are supplemented or modified in subsequent sections with requirements applying exclusively to threadless fittings, wet-location fittings, and concrete-tight fittings and the like.

6.2 A part of a fitting that may contact an insulated conductor shall be smooth and rounded.

6.3 A fitting that will accommodate more than one trade size of raceway shall comply with 6.2 with each size of raceway installed as intended.

6.4 Other than a coupling or locknut, a fitting that is internally threaded for attachment to intermediate metal conduit or rigid metal conduit shall be provided with a positive end stop for the conduit and a smooth, rounded throat to prevent abrasion of insulation on conductors entering the fitting from the conduit. The throat shall be continuous around the circumference.

6.5 A fitting for the connection of conduit shall have a smooth rounded inlet hole. Unless otherwise indicated, the throat diameter of the inlet hole shall be within the limits specified for a bushing in Table 30.1, and compliance shall be determined by applying the limit gauges illustrated in Figure 90.1 and having the dimensions specified in Table 90.5.

6.6 A fitting shall substantially close the opening with which it is used when the cable or raceway is clamped in place and shall not permit the passage of a 3/16-inch (4.8-mm) diameter probe.

6.7 All metal parts of a fitting that can become energized shall be grounded unless located so that they cannot be contacted.

7 Materials

7.1 A material intended for installation between a fitting or the cover of a fitting and an enclosure that is depended upon to exclude water or moisture shall be made of:

- a) Material that complies with the requirements for use as gasket material in accordance with the Standard for Gaskets and Seals, UL 157,
- b) An elastomer that complies with Elastomeric Materials Test, Section 44, or
- c) Expanded (foam) closed-cell material that complies with Compression/Set Test, Section 43.

7.2 A polymeric fitting shall comply with Flammability Test, Section 36.

Exception No. 1: A fitting or insulating bushing of a material Classed V-0, V-1, V-2, or 5VA in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, does not require flammability tests.

Exception No. 2: A polymeric component that is located so that it is unable to propagate flame from one area to another or bridge between a possible ignition source and a combustible material, does not require flammability tests.

7.2 revised October 21, 1998

7.3 A polymeric throat or throat liner installed in a metal fitting shall:

- a) Comply with the requirements for fittings in Flammability Test, Section 36.

Exception: A polymeric throat or throat liner that has been evaluated at the minimum thickness in accordance with 7.4 and found to comply with the High-Current-Arc-Ignition Test in the Standard for Polymeric Materials – Short-Term Property Evaluations, UL 746A, when subjected to a minimum of 60 arcs, need not comply with Flammability Test, Section 36.

- b) Comply with Insulating Bushings, Section 63.

7.4 The minimum thickness of a polymeric material is to be determined by measuring the thickness of the material at any point other than at the base of a groove used to assemble a polymeric throat to a bushing. The thickness at threads is to be measured from the crest of the thread through the material to the smooth wall surface.

7.5 An insulating bushing shall be assigned one of the temperature ratings specified in Table 63.1. See 81.1.

8 Protection Against Corrosion

8.1 A ferrous metal fitting shall be protected against corrosion with a zinc or cadmium coating not thinner than specified in Table 8.1.

Exception No. 1: A fitting of stainless steel and a bar hanger formed of steel bar stock need not be so protected.

Exception No. 2: A cut edge, a punched hole, and the threaded surface of a tapped hole, need not be so protected.

Exception No. 3: Other types of coatings may be employed provided they are investigated and found to be acceptable for the purpose.

Table 8.1
Thickness of coating

Table 8.1 revised October 21, 1998

Type of fitting and material	Thickness of coating, inch (mm)	
	Average ^a	Minimum
A fitting part, lock-nut or clamp intended for assembly inside a box	0.00015 (0.0038)	0.0001 (0.0025)
Outside of a sheet-steel or a machined-steel coupling, connector, bushing, reducing washer, or conduit locknut (other than one intended for assembly inside a box)	0.0005 (0.0127)	0.0004 (0.0102)
Inside of a sheet-steel or machined-steel fitting	b	b
Malleable or cast-iron fittings	b	b
Screws	b	b
^a The average thickness is to be determined by averaging at least three measurements. Each measurement is to be taken on a different surface, if possible. If multiple measurements are taken on a single surface, they are to be spaced equally over that surface. ^b The minimum thickness of the coating on these fittings and components is not specified. Evidence of corrosion protection provided is to be verified by visual inspection.		

9 Wall Thickness

9.1 Other than as provided in 9.2 and 9.4, a fitting shall have a wall thickness not less than that specified in Table 9.1 when measured not less than 1/8 inch (3.2 mm) from the edge of the fitting. If a taper is provided to permit easy withdrawal of the part from the die, the thickness shall not be less than that required at the base of threads when measured 1/32 inch (0.8 mm) from the edge of the fitting.

9.2 Thickness at the base of threads is to be measured with a conical-nosed micrometer having points with a 1/64-inch (0.4-mm) flat surface at the ends, and with the sides of the cone forming an angle of 60 degrees with the planes of the flat surfaces.

9.3 The part of a die-cast fitting that is secured to flexible conduit by insertion inside the conduit shall not be less than 0.025 inch (0.64 mm) thick.

Table 9.1
Wall thickness of fittings

Table 9.1 revised October 21, 1998

Material of fittings	Minimum wall thickness of unthreaded parts,		Minimum thickness at base of threads,	
	inch	(mm)	inch	(mm)
Sheet steel or machine steel	0.0250 ^e	(0.635)	0.0250 ^a 0.0200 ^b	(0.635) (0.508)
Sheet aluminum or machine aluminum	0.031	(0.79)	0.031	(0.79)
Die-cast aluminum, die-cast zinc, or malleable iron	1/16	(1.6)	1/32	(0.8)
Die-cast zinc – ribbed or otherwise reinforced	3/64	(1.2)	1/32	(0.8)
Sand-cast aluminum, steel, bronze, or cast iron	1/8	(3.2)	3/32 ^c 1/16 ^d	(2.4) (1.6)
^a At the base of cut threads. ^b At the base of rolled threads. ^c At the base of internal threads and at the base of external threads in fittings of the 1 (27) and larger trade sizes. ^d At the base of external threads in fittings of the 3/4 (21) and smaller trade sizes. ^e A flexible-conduit or armored-cable connector less than 0.0250 inch (0.635 mm) but not less than 0.0160 inch (0.406 mm) thick is acceptable if it is manufactured from heat-treated steel with a Rockwell hardness on the C scale of 40–50.				

9.4 Grounding ferrules of fittings for liquid-tight flexible metal conduit and gland rings of compression-type fittings having a minimum thickness less than that specified in 9.1, 9.3, or Table 9.1, are acceptable if the fittings comply with all other applicable tests in this Standard.

10 Internal Dimensions

10.1 The throat of a fitting that is internally threaded for attachment to intermediate metal conduit or rigid metal conduit, other than a coupling or a locknut (see 6.4), shall have a throat diameter as specified in Table 30.1 for a bushing. The limit gauges illustrated in Figure 90.1 and having the dimensions specified in Table 90.5 shall be used to determine whether the fitting complies.

10.2 A fitting, such as an offset nipple or elbow, through which wires are to pass shall have an internal cross-sectional area at all points not less than 80 percent of that of a bushing having a minimum throat diameter in accordance with Table 30.1. The shape and area of the fitting shall be such as to permit use of the largest number and size of conductors permitted for that trade size fitting.

10.3 For a fitting that will accommodate more than one trade size of raceway, the internal cross-sectional area shall comply with 10.2 with each size of raceway installed as intended.

10.4 A coupling intended to connect a metal sheathed cable to conduit or two different types of conduit shall have a smooth, rounded, centering stop having an effective diameter not less than the minimum throat diameter specified for the fitting for each cable or conduit. Neither cable or conduit shall be able to pass through the coupling.

10.4 effective February 1, 1999

11 Means of Assembly

11.1 A fitting utilizing a plate or yoke shall be secured by a screw or screws not smaller than No. 8 and having no more than 32 threads per inch.

11.2 A fitting shall be constructed so that it can be assembled to a cable or raceway as intended without damaging the cable or raceway.

11.3 A fitting shall be investigated for use with conduit or cable of each type, size, wall thickness, and material for which the manufacturer recommends its use.

11.4 A fitting intended for a specific condition of installation, for use with a specific conduit or cable construction, or for use with a specific wiring system shall be marked in accordance with 84.1.

11.5 A fitting that has a nonstandard thread shall be provided with a locknut.

Exception: This requirement does not apply to a fitting that is intended to be connected to a sheet-metal box without the use of a locknut.

11.6 A metal fitting intended to be installed in a knockout in a sheet-metal surface with or without the use of a locknut shall provide a reliable mechanical and electrical connection to the various thicknesses of metal to which it is likely to be installed.

11.7 The various thicknesses mentioned in 11.6 include 0.026 – 0.075 inches (0.66 – 1.91 mm) thick for steel, and 0.032 – 0.091 inch (0.81 – 2.31 mm) thick for aluminum.

11.8 The thread projection of a fitting, when measured from the shoulder stop to the end of the thread along the major axis of the fitting, shall not be less than that specified in Table 11.1. The construction shall be such that a 1-1/4 (35) or smaller trade-size fitting can be securely mounted in 0.026-inch (0.66-mm) thick metal.

Table 11.1
Minimum thread projection of fitting

Table 11.1 revised October 21, 1998

Trade size of fitting	(metric designator)	Minimum thread projection,	
		in	(mm)
3/8	(12)	0.299	(7.59)
1/2	(16)	0.323	(8.20)
3/4	(21)	0.338	(8.59)
1	(27)	0.391	(9.93)
1-1/4	(35)	0.391	(9.93)
1-1/2	(41)	0.391	(9.93)
2	(53)	0.408	(10.36)
2-1/2	(63)	0.654	(16.61)
3	(78)	0.654	(16.61)
3-1/2	(91)	0.717	(18.21)
4	(103)	0.717	(18.21)
5	(129)	0.779	(19.79)
6	(155)	0.841	(21.36)

12 Angle Fittings

12.1 A fitting intended to change the direction of a raceway system, and having a radius of bend less than that specified in Table 12.1 shall:

- a) Have a removable cap or cover to facilitate the installation of wires; or
- b) Comply with Wire Pull Test, Section 37.

Exception No. 1: This requirement does not apply to:

- a) A liquid-tight flexible conduit fitting, or*
- b) A flexible cord fitting.*

Exception No. 2: This requirement does not apply to an elbow, intended to be used as a connector, that

- a) Changes the direction of the wires entering it not more than 90 degrees, and*
- b) Is secured to the raceway system by means other than turning.*

12.2 An offset fitting intended to change the position of the axis of a raceway system shall have a removable cap or cover to facilitate the installation of wires if the offset is greater than 1 inch (25.4 mm) or if the axis of the offsetting section is at any angle greater than 35 degrees from the axis of the raceway.

Table 12.1
Radius of bend of angle fittings

Trade size of conduit	(metric designator)	Minimum radius to center of fitting,	
		in	(mm)
1/2	(16)	4	(102)
3/4	(21)	4-1/2	(114)
1	(27)	5-3/4	(146)
1-1/4	(35)	7-1/4	(184)
1-1/2	(41)	8-1/4	(210)
2	(53)	9-1/2	(241)
2-1/2	(63)	10-1/2	(267)
3	(78)	13	(330)
3-1/2	(91)	15	(381)
4	(103)	16	(406)
5	(129)	24	(610)
6	(155)	30	(762)

13 Wet-Location and Concrete-Tight Fittings

13.1 A fitting intended for use in a wet location shall comply with Wet-Locations Test, Section 39.

13.2 A concrete-tight fitting shall be tested in accordance with Concrete-Tightness Test, Section 40.

Exception No. 1: A fitting of the threaded or compression type need not be tested.

Exception No. 2: A fitting marked to indicate that it is to be taped against the entrance of concrete, in accordance with 84.1, need not be tested.

Exception No. 3: A fitting that complies with Wet-Locations Test, Section 39, need not be tested.

SPECIFIC FITTINGS

14 Studs

14.1 A fixture stud shall have available no fewer than five full threads and shall be made of malleable iron, steel, or other acceptable material.

15 Conduit Bodies

15.1 A conduit body intended for use with rigid polyvinyl chloride (PVC) conduit shall also comply with requirements in Section 89.

15.2 A conduit body shall have a cross-sectional area not less than that specified in Table 15.1, based on the largest size raceway that is intended to be connected to it.

Table 15.1
Cross-sectional area of conduit bodies

Trade size of raceway	(metric designator)	Cross section,		Trade size of raceway,	(metric designator)	Cross section,	
		in ²	(cm ²)			in ²	(cm ²)
1/2	(16)	0.605	(3.92)	3	(78)	14.785	(95.39)
3/4	(21)	1.067	(6.88)	3-1/2	(91)	19.774	(127.57)
1	(27)	1.729	(11.15)	4	(103)	25.461	(164.26)
1-1/4	(35)	2.991	(19.30)	5	(129)	40.012	(258.14)
2	(53)	6.711	(43.30)	6	(155)	57.781	(372.78)
2-1/2	(63)	9.576	(61.78)	—	—	—	—

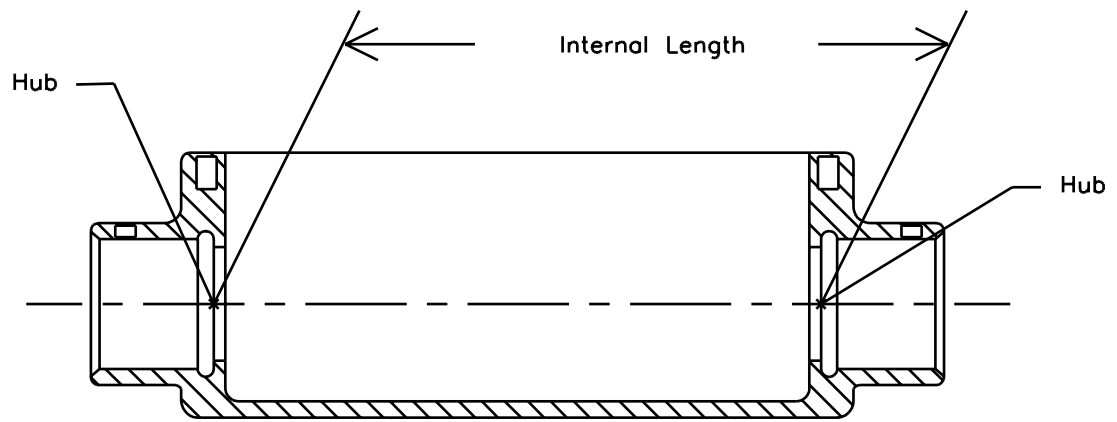
15.3 A conduit body having provision for the connection of conduit or tubing larger than the 1/2 (16) trade size shall:

- a) Have a removable cover, and
- b) Comply with in 15.4 and 15.5.

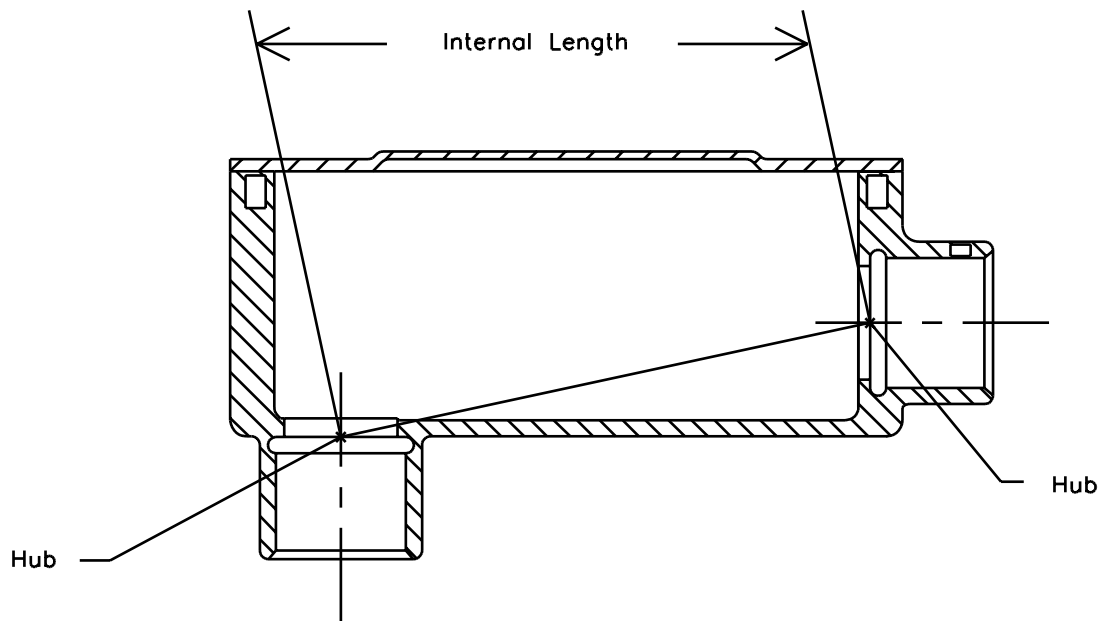
Exception No. 1: This requirement does not apply to a conduit body marked for use only with No. 6 AWG (13.3 mm²) or smaller conductors.

Exception No. 2: This requirement does not apply to a conduit body having an internal length (measured as shown in Figure 15.1) that is equal to or greater than the dimensions specified in Table 15.2. See 70.1.

Figure 15.1
Conduit body internal length measurement



Straight Pull Conduit Body



Angle Pull Conduit Body

SM1198

Table 15.2
Minimum distance between conduit body hubs for three-conductor installation with no investigation

Wire size, AWG or kcmil (mm ²)	Minimum distance, in								Minimum distance, mm
	Conduit body hub trade size (metric designator)								
	1 (21)	1-1/4 (35)	1-1/2 (41)	2 (53)	2-1/2 (63)	3 (78)	3-1/2 (91)	4 (103)	
4 (21.2)	4.50 ^a	4.50 ^a	4.50 ^a	4.50 ^a	4.50 ^a	4.50 ^a	4.50 ^a	4.50 ^a	114.30 ^a
	2.25 ^b	2.25 ^b	2.25 ^b	2.25 ^b	2.25 ^b	2.25 ^b	2.25 ^b	2.25 ^b	57.15 ^b
	4.00 ^c	4.00 ^c	4.00 ^c	4.00 ^c	4.00 ^c	4.00 ^c	4.00 ^c	4.00 ^c	101.60 ^c
3 (26.7)	—	4.98 ^a	4.98 ^a	4.98 ^a	4.98 ^a	4.98 ^a	4.98 ^a	4.98 ^a	126.49 ^a
	—	2.55 ^b	2.55 ^b	2.55 ^b	2.55 ^b	2.55 ^b	2.55 ^b	2.55 ^b	64.77 ^b
	—	4.25 ^c	4.25 ^c	4.25 ^c	4.25 ^c	4.25 ^c	4.25 ^c	4.25 ^c	107.95 ^c
2 (33.6)	—	5.44 ^a	5.44 ^a	5.44 ^a	5.44 ^a	5.44 ^a	5.44 ^a	5.44 ^a	138.18 ^a
	—	2.72 ^b	2.72 ^b	2.72 ^b	2.72 ^b	2.72 ^b	2.72 ^b	2.72 ^b	69.09 ^b
	—	4.50 ^c	4.50 ^c	4.50 ^c	4.50 ^c	4.50 ^c	4.50 ^c	4.50 ^c	114.30 ^c
1 (42.4)	—	—	5.82 ^a	5.82 ^a	5.82 ^a	5.82 ^a	5.82 ^a	5.82 ^a	147.83 ^a
	—	—	4.00 ^b	4.00 ^b	4.00 ^b	4.00 ^b	4.00 ^b	4.00 ^b	101.60 ^b
	—	—	4.80 ^c	4.80 ^c	4.80 ^c	4.80 ^c	4.80 ^c	4.80 ^c	121.92 ^c
0 (53.5)	—	—	6.06 ^a	6.06 ^a	6.06 ^a	6.06 ^a	6.06 ^a	6.06 ^a	153.92 ^a
	—	—	4.48 ^b	4.48 ^b	4.48 ^b	4.48 ^b	4.48 ^b	4.48 ^b	113.79 ^b
	—	—	5.00 ^c	5.00 ^c	5.00 ^c	5.00 ^c	5.00 ^c	5.00 ^c	127.00 ^c
00 (67.4)	—	—	—	7.53 ^a	7.53 ^a	7.53 ^a	7.53 ^a	7.53 ^a	191.26 ^a
	—	—	—	5.00 ^b	5.00 ^b	5.00 ^b	5.00 ^b	5.00 ^b	127.00 ^b
	—	—	—	5.88 ^c	5.88 ^c	5.88 ^c	5.88 ^c	5.88 ^c	149.35 ^c
000 (85.0)	—	—	—	9.25 ^a	9.25 ^a	9.25 ^a	9.25 ^a	9.25 ^a	234.95 ^a
	—	—	—	5.38 ^b	5.38 ^b	5.38 ^b	5.38 ^b	5.38 ^b	136.65 ^b
	—	—	—	6.87 ^c	6.87 ^c	6.87 ^c	6.87 ^c	6.87 ^c	174.50 ^c
0000 (107.2)	—	—	—	9.68 ^a	9.68 ^a	9.68 ^a	9.68 ^a	9.68 ^a	245.87 ^a
	—	—	—	5.75 ^b	5.75 ^b	5.75 ^b	5.75 ^b	5.75 ^b	146.05 ^b
	—	—	—	8.00 ^c	8.00 ^c	8.00 ^c	8.00 ^c	8.00 ^c	203.20 ^c
250 (127.0)	—	—	—	—	10.20 ^a	10.20 ^a	10.20 ^a	10.20 ^a	259.08 ^a
	—	—	—	—	6.71 ^b	6.71 ^b	6.71 ^b	6.71 ^b	170.43 ^b
	—	—	—	—	8.40 ^c	8.40 ^c	8.40 ^c	8.40 ^c	213.36 ^c
300 (152.0)	—	—	—	—	12.64 ^a	12.64 ^a	12.64 ^a	12.64 ^a	321.06 ^a
	—	—	—	—	7.42 ^b	7.42 ^b	7.42 ^b	7.42 ^b	188.47 ^b
	—	—	—	—	8.72 ^c	8.72 ^c	8.72 ^c	8.72 ^c	221.49 ^c
350 (177.0)	—	—	—	—	—	14.87 ^a	14.87 ^a	14.87 ^a	377.70 ^a
	—	—	—	—	—	7.94 ^b	7.94 ^b	7.94 ^b	201.68 ^b
	—	—	—	—	—	8.94 ^c	8.94 ^c	8.94 ^c	227.08 ^c

Table 15.2 Continued on Next Page

Table 15.2 Continued

Wire size, AWG or kcmil (mm ²)	Minimum distance, in								Minimum distance, mm
	Conduit body hub trade size (metric designator)								
	1 (21)	1-1/4 (35)	1-1/2 (41)	2 (53)	2-1/2 (63)	3 (78)	3-1/2 (91)	4 (103)	
400 (203.0)	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	10.30 ^c	10.30 ^c	10.30 ^c	261.62 ^c
500 (253.0)	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	12.43 ^c	12.43 ^c	12.43 ^c	12.43 ^c
Note – Where values are not specified, an investigation shall be performed to determine acceptability of the intended installation.									
^a Applies to straight pull conduit body.									
^b Applies to conduit body with hub in side.									
^c Applies to conduit body with hub in back.									

15.4 A conduit body that does not change the direction of wiring passing through it shall have a length not less than eight times the trade diameter of the largest tubing or conduit that may be connected to it. The length is to be measured inside the conduit body from the end stop of the conduit hub away from the center of the body to a like point on the conduit hub on the opposite wall, or for a conduit body having a single raceway entry, to the opposite wall.

Exception: A shorter conduit body shall be investigated for installation of a combination of conductors less than the maximum fill permitted in accordance with the National Electrical Code, ANSI/NFPA 70-1993. See 70.1.

15.5 A conduit body constructed to permit a change in the direction of the axis of a tubing or conduit system shall have a distance inside the body between each tubing or conduit entry and the entry hub on the opposite wall of the body intended to enclose a common conductor not less than that specified in (a) or between each tubing or conduit entry and the opposite wall not less than the sum of and (a) and (b):

- a) Six times the trade diameter of the largest tubing or conduit for which the body is intended.
- b) The sum of the diameters of all other tubing or conduit entries in the same wall of the body.

Exception No. 1: A conduit body having smaller dimensions shall be investigated for installation of a combination of conductors, including No. 4 AWG (21.2 mm²) or larger, that is less than the maximum fill permitted in accordance with the National Electrical Code, ANSI/NFPA 70-1993. See 70.1.

Exception No. 2: A conduit body having a raceway entry in the wall opposite the removable cover shall have a distance from the cover to the opposite wall not less than that specified in Table 15.3.

Table 15.3
Space inside a conduit body

Maximum size of wire, AWG or kcmil (mm ²)		Minimum distance to cover,	
		in	(mm)
14 – 10	(2.1 – 5.3)	Not Specified	
8 – 6	(8.4 – 13.3)	1-1/2	(38.1)
4 – 3	(21.2 – 26.7)	2	(50.8)
2	(33.6)	2-1/2	(63.5)
1	(42.4)	3	(76.2)
0,2/0	(53.5,67.4)	3-1/2	(88.9)
3/0,4/0	(85.0,107.2)	4	(102)
250	(127)	4-1/2	(114)
300 – 350	(152 – 177)	5	(127)
400 – 500	(203 – 253)	6	(152)
600 – 700	(304 – 355)	8	(203)
750 – 900	(380 – 456)	8	(203)
1000 – 1250	(507 – 633)	10	(254)
1500 – 2000	(760 – 1013)	12	(305)

15.6 With reference to 15.5, the distance is to be measured from points located at each of the raceway entries where the axis of the raceway passes through the plane of the end stop of the conduit hub to the inside surface of the cover.

16 Short Radius Conduit Bodies

16.1 A capped elbow or service-entrance elbow for rigid metal or nonmetallic conduit, intermediate metal conduit, or electrical metallic tubing shall have an integral end stop that provides a smooth, rounded opening. The internal diameter of the end stop shall be within the limits specified in Table 30.1 for a bushing, as determined by the application of the limit gauges illustrated in Figure 90.1 and having the dimensions specified in Table 90.5.

16.1 effective February 1, 1999

17 Flexible Cord Fittings

17.1 The polymeric material of a flexible cord fitting shall have a relative thermal index of at least 60°C (140°F) as determined in accordance with the Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B. A flexible cord fitting intended for use with flexible cord having a temperature rating higher than 60°C shall be molded of a material with a relative thermal index not less than that of the cord, and shall be marked in accordance with in 70.1.

18 Hubs

18.1 A fitting intended to be assembled in a conventional knockout or opening in a sheet metal enclosure to provide an internally threaded connection for threaded rigid or intermediate metal conduit shall comply with Hubs, Section 47.

19 Armored Cable Fittings

19.1 A fitting for armored cable shall be provided with a smooth, rounded end stop so that the armor will not pass through. The armored cable bushing shall be held in place and shall be visible after installation without disturbing the wiring.

19.2 A direct-bearing setscrew used in an armored cable fitting shall not be smaller than No. 10 and shall be of the tangential type.

Exception: A direct-bearing setscrew of the radial type with the axis of both the screw and the cable in the same plane is acceptable for use in an armored cable fitting if the angle between the axis of the screw and the axis of the cable is not more than 60 degrees and in the direction that will force the cable into the fitting.

19.3 An armored cable fitting of the 3/8 (12) trade size shall secure a No. 14 AWG (2.1 mm²), 2-wire cable, unless marked in accordance with 73.1 to indicate its use with a cable of another size.

20 Armored Cable Bushings

20.1 An armored cable bushing shall be of a readily distinguishable bright color such as red, orange, or yellow. The polymeric material of the bushing shall have a relative thermal index of at least 50°C (122°F).

20.2 An armored cable bushing shall have dimensions as specified in Table 20.1.

Table 20.1
Armored cable bushing dimensions

Bushing size No.	Wall thickness,		Tolerance (+/-),	
	in	(mm)	in	(mm)
0	0.025	(0.64)	0.010	(0.25)
1	0.029	(0.74)	0.011	(0.28)
2	0.033	(0.84)	0.012	(0.30)
3	0.034	(0.86)	0.012	(0.30)
4	0.034	(0.86)	0.012	(0.30)
5	0.038	(0.97)	0.013	(0.33)
6	0.043	(1.09)	0.014	(0.36)
7	0.050	(1.27)	0.015	(0.38)
8	0.070	(1.78)	0.015	(0.38)

20.3 The bushing size for a given range of armored cable is shown in Table 20.2.

Table 20.2
Bushing size for a range of armored cable

Bushing size, No.	Diameter, in (mm)			
	Minimum		Maximum	
0	0.210	(5.33)	0.350	(8.89)
1	0.306	(7.78)	0.460	(11.68)
2	0.430	(10.92)	0.590	(14.99)
3	0.560	(14.22)	0.740	(18.80)
4	0.710	(18.03)	0.960	(24.38)
5	0.900	(22.86)	1.200	(30.48)
6	1.120	(28.45)	1.510	(38.35)
7	1.420	(36.07)	1.860	(47.24)
8	1.730	(43.94)	2.330	(59.18)

21 Flexible Metal Conduit Fittings

21.1 A flexible metal conduit fitting shall be provided with a smooth, rounded end stop so that the conduit will not pass through.

21.2 The end stop of a flexible metal conduit fitting, other than an angle fitting, shall completely encircle the end of the conduit when installed in the fitting, and the throat of the fitting shall be smooth and rounded.

21.3 The maximum and minimum inside diameter of the end stop of a flexible metal conduit fitting shall be within the limits specified in Table 21.1.

Exception: These dimensional requirements do not apply to the shoulder of a fitting that is secured to flexible metal conduit by insertion inside the conduit.

Table 21.1
Internal diameter of end stop of flexible-metal-conduit fitting

Table 21.1 revised October 21, 1998

Trade size of conduit	(metric designator)	Maximum internal diameter,		Minimum internal diameter,	
		in	(mm)	in	(mm)
5/16	(11)	0.313	(7.95)	0.266	(6.76)
3/8	(12)	0.375	(9.35)	0.319	(8.10)
1/2	(16)	0.625	(15.88)	0.531	(13.49)
3/4	(21)	0.813	(20.65)	0.691	(17.55)
1	(27)	1.000	(25.40)	0.850	(21.59)
1-1/4	(35)	1.250	(31.75)	1.063	(27.00)
1-1/2	(41)	1.500	(38.10)	1.275	(32.39)
2	(53)	2.000	(50.80)	1.700	(43.18)
2-1/2	(63)	2.500	(63.50)	2.125	(53.98)
3	(78)	3.000	(76.20)	2.550	(64.77)
3-1/2	(91)	3.500	(88.90)	2.975	(75.57)
4	(103)	4.000	(101.60)	3.400	(86.36)

21.4 A direct-bearing setscrew used in a flexible metal conduit fitting shall not be smaller than No. 10 and shall be of the tangential type.

Exception: A direct-bearing setscrew of the radial type with the axis of both the screw and the conduit in the same plane is acceptable for use in a flexible metal conduit fitting if the angle between the axis of the screw and the axis of the conduit is not more than 60 degrees and in the direction that will force the conduit into the fitting.

22 Metal-Clad Cable Fittings

22.1 A fitting for metal-clad cable shall be provided with a smooth, rounded end stop so that the metal sheath of the cable will not pass through and the wires will not be damaged in passing over the end stop.

23 Nonmetallic-Sheathed Cable Fittings

23.1 A nonmetallic-sheathed cable fitting of the 3/8 (12) or larger trade size shall secure cable in a range between No. 14 AWG (2.1 mm²), two-wire cable with an uninsulated grounding wire, and the largest oval or round multiconductor cable that is to be accommodated by the fitting, unless marked to indicate its use with a specific range of cable sizes. See Nonmetallic-Sheathed Cable Fittings, Section 52, and 74.1 and 74.2.

23.1 revised October 21, 1998

23.2 The polymeric material of a fitting for nonmetallic sheathed cable shall have a relative thermal index of at least 90°C (194°F) for electrical properties, 90°C for mechanical without impact properties, and 50°C (122°F) for mechanical with impact properties as determined in accordance with the Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B.

Exception: Material having a relative thermal index – based upon historical record – described in UL 746B need not be investigated to determine the relative thermal index.

23.3 Polymeric parts, such as a gland or bushing, of a metal or polymeric fitting shall have the relative thermal index specified in 23.2.

24 Service-Entrance Cable Fittings

24.1 The external threads of a service-entrance cable fitting for wet location use shall have a taper of 3/4 inch per foot (1 mm per 16 mm).

24.2 A service-entrance cable fitting shall be tested in accordance with Service-Entrance Cable Fittings, Section 53.

25 Flexible Metallic Tubing Fittings

25.1 A fitting for flexible metallic tubing shall be provided with a smooth, rounded end stop so that the tubing will not pass through.

25.2 The end stop of a flexible metallic tubing fitting shall completely encircle the end of the tubing when installed.

25.3 The maximum and minimum inside diameters of the end stop of a flexible metallic tubing fitting shall be within the limits specified in Table 25.1.

Exception: These dimensional requirements do not apply to the shoulder of a fitting that is secured by insertion inside the tubing.

Table 25.1
Internal diameter of end stop of flexible metallic tubing fittings

Table 25.1 revised October 21, 1998

Trade size of tubing	(metric designator)	Maximum internal diameter,		Minimum internal diameter,	
		in	(mm)	in	(mm)
3/8	(12)	0.400	(10.16)	0.319	(8.10)
1/2	(16)	0.625	(15.88)	0.531	(13.49)
3/4	(21)	0.813	(20.65)	0.691	(17.55)

25.4 The maximum external diameter of a flexible metallic tubing fitting that fits inside a raceway (screw-in type) shall not exceed the diameter specified in Table 25.2.

Table 25.2
External diameter of flexible metallic tubing fittings

Table 25.2 revised October 21, 1998

Trade size of tubing	(metric designator)	Maximum external diameter of barrel,	
		in	(mm)
3/8	(12)	0.485	(12.30)
1/2	(16)	0.634	(16.10)
3/4	(21)	0.825	(20.96)

26 Liquid-Tight Flexible Metal Conduit Fittings

26.1 A fitting for liquid-tight flexible metal conduit shall be provided with a smooth, rounded end stop that will completely encircle the end of the conduit. The minimum and maximum inside diameter of the end stop shall be within the limits specified in Table 26.1.

26.2 The smooth end stop shall be provided by the body of the fitting or by a separate part applied over the cut end of the conduit.

Table 26.1
Diameter of end stop of liquid-tight flexible conduit fittings

Table 26.1 revised October 21, 1998

Trade size of fitting	(metric designator)	Throat diameter of end stop, in (mm)			
		Minimum		Maximum	
3/8	(12)	0.411	(10.44)	0.484	(12.29)
1/2	(16)	0.529	(13.44)	0.622	(15.80)
3/4	(21)	0.697	(17.70)	0.820	(20.83)
1	(27)	0.885	(22.48)	1.041	(26.44)
1-1/4	(35)	1.173	(29.79)	1.380	(35.05)
1-1/2	(41)	1.339	(34.01)	1.575	(40.01)
2	(53)	1.717	(43.61)	2.020	(51.31)
2-1/2	(63)	2.108	(53.54)	2.480	(62.99)
3	(78)	2.609	(66.27)	3.070	(77.98)
3-1/2	(91)	2.975	(75.57)	3.500	(88.90)
4	(103)	3.400	(86.36)	4.000	(101.60)

26.3 Any part of a fitting inserted into the conduit to assist in providing a smooth throat, a bond between fitting and conduit, or an assembly to the conduit shall not reduce the diameter below the minimum value specified in Table 26.1.

27 Liquid-Tight Flexible Nonmetallic Conduit Fittings

27.1 A fitting for liquid-tight flexible nonmetallic conduit shall comply with Liquid-Tight Flexible Metal Conduit Fittings, Section 26, and Liquid-Tight Flexible Nonmetallic Conduit Fittings, Section 57.

Exception: An end stop need not completely encircle the end of the conduit.

28 Threadless Fittings

28.1 Other than noted in 28.2, a threadless connector shall have a smooth, rounded end stop with a throat diameter within the limits specified for a bushing in Table 30.1. Compliance shall be determined by application of limit gauges illustrated in Figure 90.1 and having the dimensions specified in Table 90.5.

28.2 A threadless connector for electrical metallic tubing in the 2-1/2, 3, 3-1/2, and 4 (63, 78, 91, and 103) trade sizes shall have a smooth, rounded end stop with an internal diameter within the limits specified in Table 28.1. See 79.1.

28.3 Other than noted in 28.4, a threadless coupling shall be provided with a centering stop having an effective diameter not less than the minimum throat diameter specified in Table 30.1 for the smallest trade size of raceway intended to be accommodated.

28.4 A threadless coupling for electrical metallic tubing in the 2-1/2, 3, 3-1/2, and 4 (63, 78, 91, and 103) trade sizes shall have an effective center stop diameter not less than the maximum throat diameter at end stop specified in Table 28.1.

Table 28.1
Diameter of end stop

Trade size of fitting	(metric designator)	Throat diameter at end stop, in (mm)				Minimum throat diameter under threaded section,	
		Minimum		Maximum		in ^a	(mm)
2-1/2	(63)	2.594	(65.89)	2.731	(69.37)	2.222	(56.44)
3	(78)	3.189	(81.00)	3.356	(85.24)	2.761	(70.13)
3-1/2	(91)	3.642	(92.51)	3.834	(97.38)	3.193	(81.10)
4	(103)	4.117	(104.57)	4.334	(110.08)	3.623	(92.02)

^a A reduced diameter under the threaded section is not to result in a sudden reduction in the inside diameter of the raceway.

29 Mineral-Insulated Cable Fittings

29.1 A fitting for mineral-insulated cable shall be provided with means for separation of the cable conductors.

29.2 Flexible insulating tubing shall be provided with each fitting. At least 6 inches (152 mm) of tubing shall be provided for each cable conductor.

Exception: A single piece of tubing of sufficient length is acceptable in lieu of a separate piece for each conductor.

29.3 The inside diameter of the tubing mentioned in 29.2 shall be such that the tubing can be slipped easily over the bared conductors of the cable of the largest AWG size for which the fitting is intended. The wall thickness of the tubing shall not be less than 0.020 inch (0.51 mm).

29.4 Insulating materials of different composition used with the same fitting shall be compatible. See 61.8.1.

29.4 revised October 21, 1998

29.5 Other than noted in 29.6, a fitting shall be provided with a means, as a part of the fitting, for sealing the end of the cable against the entrance of moisture or it shall be acceptable for use with a separate sealing fitting.

29.6 A fitting intended for use in dry locations only and marked in accordance with 80.1 is not required to comply with 61.7.1. See 29.7.

29.6 revised October 21, 1998

29.7 A fitting not marked in accordance with in 80.1 shall comply with 61.7.1.

29.7 revised October 21, 1998

30 Locknuts, Bushings, and Nipples

30.1 A conduit locknut for intermediate metal conduit or rigid metal conduit shall be provided with notches or the equivalent to facilitate tightening and shall have dimensions as specified in Table 30.1.

Exception: A locknut thinner than specified shall comply with 62.3.

30.1 revised October 21, 1998

Table 30.1
Thickness and diameters of locknuts and bushings

Table 30.1 revised October 21, 1998

Trade size of fitting	(metric designator)	Minimum thickness of conduit locknut,		Maximum diameter of locknut or bushing,		Throat diameter of bushing, in (mm)			
		in	(mm)	in	(mm)	Minimum		Maximum	
3/8	(12)	0.125	(3.18)	0.970	(24.64)	0.444	(11.28)	0.493	(12.52)
1/2	(16)	0.125	(3.18)	1.140	(28.96)	0.560	(14.22)	0.622	(15.80)
3/4	(21)	0.140	(3.56)	1.420	(36.07)	0.742	(18.85)	0.824	(20.93)
1	(27)	0.170	(4.32)	1.770	(44.96)	0.944	(23.98)	1.049	(26.64)
1-1/4	(35)	0.170	(4.32)	2.281	(57.94)	1.242	(31.55)	1.380	(35.05)
1-1/2	(41)	0.170	(4.32)	2.598	(65.99)	1.449	(36.80)	1.610	(40.89)
2	(53)	0.187	(4.75)	3.175	(80.65)	1.860	(47.24)	2.067	(52.50)
2-1/2	(63)	0.375	(9.53)	3.562	(90.47)	2.222	(56.44)	2.469	(62.71)
3	(78)	0.375	(9.53)	4.250	(107.95)	2.761	(70.13)	3.068	(77.92)
3-1/2	(91)	0.438	(11.13)	4.803	(122.00)	3.193	(81.10)	3.548	(90.12)
4	(103)	0.438	(11.13)	5.402	(137.21)	3.623	(92.02)	4.026	(102.26)
5	(129)	0.500	(12.70)	6.674	(169.52)	4.542	(115.37)	5.047	(128.19)
6	(155)	0.562	(14.27)	7.934	(201.52)	5.458	(138.63)	6.065	(154.05)

30.2 A fitting locknut shall not have a maximum diameter exceeding that specified in Table 30.1.

30.3 A conduit locknut shall be threaded throughout its entire thickness.

Exception: A conduit locknut having an incomplete or nonstandard thread shall comply with 62.4.

30.4 A bushing or insulating bushing for intermediate metal conduit or rigid metal conduit shall have a smooth, rounded surface at the throat. The throat diameter shall be within the limits specified in Table 30.1 as determined by the application of the limit gauges illustrated in Figure 90.1 and having the dimensions specified in Table 90.5.

30.5 A bushing or insulating bushing shall be provided with ribs or the equivalent to facilitate easy tightening.

30.6 The polymeric material of an insulating bushing rated:

- a) 90°C (194°F) shall have a relative thermal index of at least 90°C.
- b) 105°C (221°F) shall have a relative thermal index of at least 105°C.
- c) 150°C (302°F) shall have a relative thermal index of at least 150°C.
- d) 200°C (392°F) shall have a relative thermal index of at least 200°C.

30.7 A nipple shall not have a tightening means that has a maximum diameter exceeding that specified in the third column of Table 30.1.

30.7 effective February 1, 1999

31 Service-Entrance Heads

31.1 A service-entrance head for rigid metal conduit, intermediate metal conduit, or electrical metallic tubing shall have an integral end stop for the conduit or tubing. The end stop shall have a smooth, rounded opening. Other than noted in 31.3, the opening shall have an internal diameter equivalent to that provided by the throat of a standard conduit bushing. The internal diameter of the end stop shall be within the limits specified for a bushing in Table 30.1. Compliance shall be determined by the application of the limit gauges illustrated in Figure 90.1 and having the dimensions specified in Table 90.5. A service-entrance head for rigid nonmetallic conduit shall comply with Section 89.

31.1 revised October 21, 1998

31.2 A metal service-entrance head shall comply with Service-Entrance Heads, Section 64. A nonmetallic service-entrance head shall comply with Tests for Nonmetallic Service-Entrance Heads, Section 101.

31.3 A service-entrance head for use with conduit of a size larger than that corresponding in size to the other parts of the head shall have an end stop with an internal diameter no greater than the maximum size throat diameter specified in Table 30.1. No minimum internal diameter of the end stop is specified for such a head.

31.4 A removable part on a service-entrance head intended for use on rigid metal conduit, intermediate metal conduit, or electrical metallic tubing that is intended to be discarded after the head is assembled to the conduit or tubing shall be secured so that separation from the head during shipping or handling and improper use does not occur.

31.5 A service-entrance head shall have provision for the separate entry of each conductor through a bushed hole. Not more than three of the holes shall be open and not more than one hole shall be uninsulated. The polymeric material of the bushing shall have a relative thermal index of at least 50°C (122°F).

31.6 A service-entrance head for service-entrance cable shall protect the open end of the jacket or braid from the entrance of rain and shall have means for mounting and for clamping of the cable.

32 Pulling, Strain Relief, and Support Grips

32.1 A grip shall be made of a mesh material (wire, strand, or polymeric filament). The material of a polymeric grip shall have a relative thermal index rating of at least 50°C (122°F) or higher based on the temperature of the environment in which it is intended to be used. See 83.1.

Revised 32.1 effective February 1, 1999

32.2 A strain relief grip attached to a fitting shall be able to be assembled in accordance with Method of Assembly, Section 35.

32.2 effective February 1, 1999