

UL 514B

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Conduit, Tubing, and Cable Fittings

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UL Standard for Safety for Conduit, Tubing, and Cable Fittings, UL 514B

Fifth Edition, Dated February 16, 2004

Revisions: This Standard contains revisions through and including April 3, 2006.

SUMMARY OF TOPICS

The revisions dated April 3, 2006 were issued to incorporate the following new and revised requirements and to reflect the April 3, 2006 ANSI recognition of the standard:

1) New Marking And Current Test Requirements Applicable To Specific Types Of Flexible Conduit And Cable

2) New Construction And Marking Requirements For Fittings For Use With Metal Clad (MC) Cable

3) Marking For Grounding Means

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Text that has been changed in any manner is marked with a vertical line in the margin. Changes in requirements are marked with a vertical line in the margin and are followed by an effective date note indicating the date of publication or the date on which the changed requirement becomes effective.

The new and revised requirements are substantially in accordance with UL's Proposal(s) on this subject dated September 9, 2005 and January 6, 2006.

The revisions dated April 3, 2006 include a reprinted title page (page1) for this Standard.

As indicated on the title page (page 1), this UL Standard for Safety is an American National Standard. Attention is directed to the note on the title page of this Standard outlining the procedures to be followed to retain the approved text of this ANSI/UL Standard.

The UL Foreword is no longer located within the UL Standard. For information concerning the use and application of the requirements contained in this Standard, the current version of the UL Foreword is located on ULStandardsInfoNet at: <http://ulstandardsinfo.net/ulforeword.html>

The master for this Standard at UL's Northbrook Office is the official document insofar as it relates to a UL service and the compliance of a product with respect to the requirements for that product and service, or if there are questions regarding the accuracy of this Standard.

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The requirements in this Standard are now in effect, except for those paragraphs, sections, tables, figures, and/or other elements of the Standard having future effective dates as indicated in the note following the affected item. The prior text for requirements that have been revised and that have a future effective date are located after the Standard, and are preceded by a "SUPERSEDED REQUIREMENTS" notice.

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New product submittals made prior to a specified future effective date will be judged under all of the requirements in this Standard including those requirements with a specified future effective date, unless the applicant specifically requests that the product be judged under the current requirements. However, if the applicant elects this option, it should be noted that compliance with all the requirements in this Standard will be required as a condition of continued Listing and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

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National Association of Standardization And Certification
NMX-J-017-ANCE
First Edition



Canadian Standards Association
CSA C22.2 18.3-04
First Edition



Underwriters Laboratories Inc.
UL 514B
Fifth Edition

Conduit, Tubing, and Cable Fittings

February 16, 2004

(Title Page Reprinted: April 3, 2006)



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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.

The most recent designation of ANSI/UL 514B as an American National Standard (ANSI) occurred on April 3, 2006. The ANSI approval for this standard does not include the Cover Page, Transmittal Pages, Title Page, or Preface.

This ANSI/UL Standard for Safety, which consists of the Fifth edition with revisions through April 3, 2006 is under continuous maintenance, whereby each revision is ANSI approved upon publication. Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at <http://csds.ul.com>.

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.

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Preface

This is the common ANCE, CSA, and UL standard for Conduit, Tubing, and Cable Fittings. It is the first edition of NMX-J-017-ANCE, the first edition of CSA C22.2 No. 18.3, and the fifth edition of UL 514B. This edition of CSA C22.2 No. 18.3 supersedes the requirements of CSA C22.2 No. 18, published in 1998, for products covered in this standard, as indicated in the scope of this standard.

This common Standard was prepared by the Association of Standardization and Certification (ANCE), the Canadian Standards Association (CSA), and Underwriters Laboratories Inc. (UL). The efforts and support of the Technical Harmonization Subcommittee, Conduit and Cable Fittings, 23A, of the Council on the Harmonization of Electrotechnical Standards of the Nations of the Americas (CANENA), are gratefully acknowledged.

This Standard was reviewed by the CSA Subcommittee on C22.2 No. 18, under the jurisdiction of the CSA Technical Committee on Wiring Products and the CSA Strategic Steering Committee on Requirements for Electrical Safety, and has been formally approved by the CSA Technical Committee.

This standard will be submitted to the Standards Council of Canada (SCC) for approval as a National Standard of Canada.

This standard has been approved by the American National Standards Institute (ANSI) as an American National Standard.

Where reference is made to a specific number of samples to be tested, the specified number is to be considered a minimum quantity.

Note: Although the intended primary application of this standard is stated in its scope, it is important to note that it remains the responsibility of the users of the standard to judge its suitability for their particular purpose.

Level of harmonization

This standard uses the IEC format but is not based on, nor is it to be considered equivalent to, an IEC standard. This standard is published as an equivalent standard for ANCE, CSA, and UL.

An equivalent standard is a standard that is substantially the same in technical content, except as follows: Technical national differences are allowed for codes and governmental regulations as well as those recognized as being in accordance with NAFTA Article 905, for example, because of fundamental climatic, geographical, technological, or infrastructural factors, scientific justification, or the level of protection that the country considers appropriate. Presentation is word for word except for editorial changes.

Reasons for differences from IEC

The draft trilateral standard is not based on an IEC standard or IEC requirements, but is formatted and organized using the IEC formatting criteria. The Technical Harmonization Committee identified two main reasons the requirements in this standard were not harmonized with IEC requirements. First, there is no corresponding IEC standard covering fittings only. Instead IEC requirements for fittings are included under several separate IEC standards that cover the specific systems in which a fitting is used. The time required to research and identify specific fittings requirements in each of the relevant IEC conduit, tubing, and cable system standards would inhibit the completion of the harmonization project in a reasonable time period, and would negate the benefit of having harmonized North American requirements available presently.

The second reason for not harmonizing with IEC requirements concerns the incompatibility of North American conduit, tubing, and cable systems with European conduit, tubing, and cable systems. The construction and performance requirements for systems covered under the IEC standards are significantly different from the North American requirements because fitting construction and installation techniques are significantly different in North America and Europe. Considerable investigation will be needed to identify these differences and assess safety and system compatibility issues. Such future investigation and potential harmonization of North American electrical conduit, tubing, and cable fitting requirements with present IEC electrical conduit, tubing, and cable fitting requirements may be facilitated by first harmonizing North American requirements for fittings.

Interpretations

The interpretation by the standards development organization of an identical or equivalent standard is based on the literal text to determine compliance with the standard in accordance with the procedural rules of the standards development organization. If more than one interpretation of the literal text has been identified, a revision is to be proposed as soon as possible to each of the standards development organizations to more accurately reflect the intent.

ANCE Effective Date

The effective date for ANCE will be announced through the *Diario Oficial de la Federation* (Official Gazette).

CSA Effective Date

The effective date for CSA will be announced through *CSA Informs* or *CSA Certification Notice*.

UL Effective Date

As of April 3, 2006, all products Listed or Recognized by UL must comply with the requirements in this standard.

A UL effective date is one established by Underwriters Laboratories Inc. and is not part of the ANSI approved standard.

SDO Forewords

The UL Foreword is no longer located within the UL Standard. The CSA Foreword is included as an SDO-specific page in the CSA version of this co-published standard. The current version of the UL Foreword is located on ULStandardsInfoNet at <http://ulstandardsinfo.net/ul.com/ulforeword.htm>.

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Conduit, Tubing, and Cable Fittings

1 Scope

1.1 These requirements cover FITTINGS for use with cable and conduit intended for installation in accordance with the National Electrical Code, ANSI/NFPA 70, the Canadian Electrical Code (CEC), Part I, CSA C22.1, and the Standard for Electrical Installations, NOM-001-SEDE.

1.2 These requirements cover CONDUIT LOCKNUTS, conduit BUSHINGS, metal stud BUSHINGS, CONDUIT BODIES, and entrance ELBOWS; FITTINGS for electrical metallic tubing, flexible metal conduit, intermediate metal conduit, liquid-tight flexible conduit, rigid metal conduit, and SERVICE-ENTRANCE HEADS; FITTINGS for armored cable, metal-clad cable, aluminum-sheathed cable, mineral-insulated cable, nonmetallic-sheathed cable, service-entrance cable, and tray cable, and submersible FITTINGS; FITTINGS for flexible cord, flexible nonmetallic and metallic tubing, INSULATING BUSHINGS, grips, reducing washers, and NIPPLES.

Note: In Canada, fittings for metal-clad (MC) cable, intermediate metal conduit (IMC), flexible metallic tubing, flexible nonmetallic tubing, and CONDUIT BODIES are not recognized. CONDUIT BODIES are considered FITTINGS.

Note: In Canada, armored cable includes Type TECK cable.

Note: In Mexico and the United States, requirements for submersible FITTINGS are provided in NMX-J-235/1-ANCE, NMX-J-235/2-ANCE, or UL 50.

Note: In Mexico, intermediate metal conduit is designated as semi-heavy metal conduit.

1.3 The requirements in Clause 5.7 cover CONDUIT BODIES for rigid polyvinyl chloride (PVC) conduit. These products are intended to be used with both heavy-wall and thin-wall rigid PVC conduit, ELBOWS, and other bends. The products covered by these requirements are intended to be joined to rigid polyvinyl chloride (PVC) conduit and rigid PVC ELBOWS and other bends in the field by means of a cement that is, or contains, a solvent for polyvinyl chloride.

1.4 These requirements do not cover FITTINGS intended for use in hazardous locations as defined in the National Electrical Code, ANSI/NFPA 70, the Canadian Electrical Code (CEC), Part I, CSA C22.1, and the Standard for Electrical Installations, NOM-001-SEDE.

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

1.6 These requirements do not cover conduit NIPPLES, threaded ELBOWS, and threaded COUPLINGS, intended for use with rigid metal conduit, intermediate metal conduit, or electrical metallic tubing.

2 Normative references

2.1 Products covered by this standard shall comply with the reference installation codes and standard as appropriate for the country where the product is to be used. When the product is intended for use in more than one country, the product shall comply with the installation codes and standards for all countries where it is intended to be used.

2.2 For undated reference to standards, such reference shall be considered to refer to the latest edition and all revisions to that edition up to the time when this standard was approved. For dated references to standards, such reference shall be considered to refer to the dated edition and all revisions published to that edition up to the time the standard was approved.

ANCE Standards

NOM-001-SEDE,
Standard for Electrical Installations

NMX-J-023/1-ANCE,
Metallic Outlet Boxes Part 1: Specifications and Test Methods

NMX-J-235/1-ANCE,
Enclosures for Electrical Equipment-Part 1 General Requirements – Specifications and Test Methods

NMX-J-235/2-ANCE,
Enclosures for Electrical Equipment-Part 2 Specific Requirements – Specifications and Test Methods

NMX-J-534-ANCE,
Steel Tubes (Conduit) Heavy Type For Electric Conductors Protections and Fittings – Specifications and Test Method

NMX-J-554-ANCE,
Threads for Conduit and Fittings Specifications and Test Method

CSA Standards

C22.1-02,
Canadian Electrical Code, Part I

C22.2 No. 0.5-1982 (R2003),
Threaded Conduit Entries

C22.2 No. 0.15-01,
Adhesive Labels

CAN/CSA C22.2 No. 0.17-00,
Evaluation of Properties of Polymeric Materials

CAN/CSA C22.2 No. 18-98,
Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware

C22.2 No. 45-M1981 (R1999),
Rigid Metal Conduit

CAN/CSA C22.2 No. 85-M89 (R2001),
Rigid PVC Boxes and Fittings

CAN/CSA C22.2 No. 94-M91 (R 2001),
Special Purpose Enclosures

UL Standards

UL 6

Electrical Rigid Metal Conduit – Steel

UL 6A

Electrical Rigid Metal Conduit – Aluminum, Bronze, and Stainless Steel

UL 50

Enclosures for Electrical Equipment

UL 94

Tests for Flammability for Plastic Materials for Parts in Devices and Appliances

UL 746A

Polymeric Materials – Short Term Property Evaluations

UL 746B

Polymeric Materials – Long Term Property Evaluations

UL 969

*Marking and Labeling Systems***ASME¹ Standards**

ASME B1.20.1-1983 (R2001),

Pipe Threads, General Purpose (Inch)

ASME B94.1M-1993,

*Twist Drills***ASTM² Standards**

ASTM G 152-00a,

Standard Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials

ASTM G 153-00a,

Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials

ASTM G 155-00ae1,

*Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials***ISO³ Standard**

ISO 4892-2:1994,

Plastics – Methods of Exposure to Laboratory Light Source – Part 2: Xenon Arc Sources

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NFPA⁴ Standard

NFPA 70 2002,
National Electrical Code

¹ American Society of Mechanical Engineers

² American Society for Testing and Materials

³ International Organization for Standardization

⁴ National Fire Protection Association

3 Definitions

3.1 The definitions in Clauses 3.2 – 3.25 apply in this standard. Terms used throughout this standard which have been defined in Clause 3 are in SMALL ROMAN CAPITAL type font.

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

3.3 **BUSHING:** A FITTING provided to protect wires from abrasion and intended for use where conductors enter or leave the raceway system.

3.4 **BUSHING, INSULATING:** 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.

3.5 **BUSHING, METAL STUD:** A FITTING provided to protect the outer jacket of a cable from sharp edges in cut or punched holes in metal studs into which cables are fished or supported.

3.6 **CONCRETE-TIGHT FITTING:** A FITTING that excludes concrete aggregate (Portland-type cement and sand).

3.7 **CONDUIT BODY:** In Mexico and the United States, a CONDUIT BODY is a means for providing access to the interior of a conduit or tubing system through one or more removable covers at a junction of two or more conduit or tubing sections or at the terminal point of a conduit or tubing.

In Canada, this term does not apply.

3.8 **CONNECTOR:** A FITTING intended to terminate a cable, cord, or raceway to a box or similar device.

3.9 **COUPLING:** A FITTING intended to connect two lengths of raceway or perform a similar function.

3.10 **COUPLING, REDUCING:** A FITTING intended to join lengths of two different sizes of raceway.

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

3.12 **ELBOW:** A FITTING used to change the direction of a raceway system.

3.13 **FITTING:** A means for securing conduit, cable, or tubing to an enclosure, box, or raceway system.

3.14 **FITTING, EXPANSION:** A FITTING intended to compensate for linear thermal expansion of a span of rigid metal conduit, intermediate metal conduit, or electrical metallic tubing.

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- 3.15 **FITTING, FLEXIBLE CORD:** A **CONNECTOR** used to reduce strain at points of termination for flexible cord.
- 3.16 **FITTING, LIQUID-TIGHT:** A **FITTING** intended for use in wet industrial environments that contain machine oils and coolants.
- 3.17 **GRIP, PULLING:** A means of pulling conductors or cable into a raceway.
- 3.18 **GRIP, STRAIN-RELIEF:** A means of reducing strain at points of termination for cable or flexible conduit.
- 3.19 **GRIP, SUPPORT:** A means of holding the weight and restraining the arc-of-bend of a cable.
- 3.20 **HUB:** A **FITTING** intended for use with threaded conduit for connection to an enclosure.
- 3.21 **LOCKNUT, CONDUIT:** An internally threaded **FITTING** for use on rigid metal conduit or intermediate metal conduit, intended to inhibit turning and to provide a secure joint.
- 3.22 **LOCKNUT, FITTING:** A component of a **CONNECTOR** intended to inhibit turning and to provide a secure joint.
- 3.23 **NIPPLE:** An externally threaded **FITTING** intended primarily to serve as a short raceway between close-spaced enclosures.
- 3.24 **SERVICE-ENTRANCE HEAD:** An enclosed **FITTING** intended for use at service entrances where a service drop is connected to a service-entrance cable or raceway system.
- 3.25 **THREADLESS FITTING:** A **FITTING** intended for use with nonthreaded rigid metal conduit, intermediate metal conduit, or electrical metallic tubing.

4 General requirements

4.1 Except as indicated in Clause 4.2, a component of a product covered by this standard shall comply with the requirements for that component. See Annex A for a list of standards covering components generally used in the products covered by this standard. A component shall comply with the ANCE, CSA, or UL standards as appropriate for the country where the product is to be used.

4.2 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.

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

4.4 The values given in SI (metric) units shall be normative. Any other values given shall be for information purposes only.

5 Construction

5.1 Metallic materials

5.1.1 General

5.1.1.1 Other than as provided in Clause 5.1.2.2, a FITTING shall have a wall thickness not less than that specified in Table 16 when measured not less than 3.2 mm (1/8 in) from the edge of the FITTING. Where a taper is provided to facilitate withdrawal of the part from the die, the thickness shall not be less than that required at the base of threads when measured 0.8 mm (1/32 in) from the edge of the FITTING.

5.1.1.2 FITTINGS intended for use with single conductor cable shall be constructed of nonferrous material. When the FITTING is intended to be secured by a LOCKNUT, the LOCKNUT shall be provided and shall be of nonferrous material.

5.1.2 Zinc die-casting material

5.1.2.1 The part of a zinc die-cast FITTING that is secured to flexible conduit by insertion inside the conduit shall have a minimum thickness of 0.64 mm (0.025 in).

5.1.2.2 The minimum thicknesses specified in Clauses 5.1.1.1 and 5.1.2.1 and Table 16 do not apply to grounding ferrules of zinc die-cast FITTINGS, such as those used for liquid-tight flexible metal conduit and gland rings of compression-type FITTINGS.

5.1.3 Coatings on metallic surfaces

5.1.3.1 A ferrous metal FITTING shall be protected against corrosion with a zinc coating not thinner than as specified in Table 17.

5.2 Nonmetallic materials

5.2.1 Flammability

5.2.1.1 Nonmetallic material of a FITTING shall comply with the nonmetallic materials flammability test described in Clause 8.2.

5.2.1.2 The flammability test shall not be required for a material used in a FITTING, an INSULATING BUSHING, or a throat liner that is installed in a metal BUSHING and rated V-0, V-1, V-2, or 5-VA.

Note 1: In Canada and the United States, materials rated V-2 or higher in accordance with CAN/CSA C22.2 No. 0.17 or UL 94, respectively, comply with this requirement.

Note 2: In Mexico, use of the CAN/CSA C22.2 No. 0.17 or UL 94 standard is recommended.

5.2.1.3 A nonmetallic 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, shall not be required to be tested.

5.2.1.4 In Canada and the United States, the flammability test shall not be required to be performed on a polymeric material that has been investigated at the minimum thickness determined in accordance with Clause 5.2.1.5 and found to resist ignition when subjected to at least 60 arcs in accordance with the high-current arc ignition test, as described in UL 746A or CAN/CSA C22.2 No. 0.17.

In Mexico, this requirement does not apply.

5.2.1.5 The minimum thickness of a polymeric material shall 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 shall be measured from the crest of the thread through the material to the smooth wall surface.

5.2.2 INSULATING BUSHINGS

5.2.2.1 In Canada and the United States, an INSULATING BUSHING shall be assigned one of the temperature ratings specified in Table 18. The relative thermal index of the polymeric material shall be equivalent to or greater than the temperature rating of the BUSHING.

In Mexico, this requirement does not apply.

5.2.3 FITTINGS for flexible cord

5.2.3.1 In Canada and the United States, the polymeric material of a FITTING for flexible cord shall have a relative thermal index of at least 60°C (140°F) as determined in accordance with UL 746B or CAN/CSA C22.2 No. 0.17. A FLEXIBLE CORD FITTING intended for use with flexible cord having a temperature rating higher than 60°C (140°F) shall be molded of a material with a relative thermal index for electrical properties and mechanical properties, with or without impact, not less than that of the cord, and shall be marked as indicated in Clause 7.9.1.

In Mexico, this requirement does not apply.

5.2.3.2 A part of a FITTING for flexible cord made of natural or synthetic ELASTOMER materials, other than a thermoplastic ELASTOMER, shall comply with the hardness test specified in Clause 8.3.

5.2.4 Gaskets

5.2.4.1 A gasket constructed of elastomeric materials shall comply with the accelerated aging test described in Clause 8.16.7.

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5.2.5 Gaskets – expanded closed-cell material

5.2.5.1 A gasket constructed of expanded closed-cell material that is intended for installation between a FITTING and its cover, or between a FITTING and an enclosure, shall comply with the tests in Clause 8.31. A gasket constructed from a material that has previously been investigated in accordance with Clause 8.31 shall not be required to be tested.

5.2.5.2 A gasket constructed of expanded (foam) closed-cell material shall comply with the compression set test described in Clause 8.31.2.

5.2.6 Grips

5.2.6.1 In Canada and the United States, the polymeric material of a grip shall have a relative thermal index of at least 50°C (122°F) or higher, based on the manufacturer's specification.

In Mexico, this requirement does not apply.

5.2.6.2 In Canada and the United States, material having a relative thermal index described in UL 746B or CAN/CSA C22.2 No. 0.17 shall not be required to be investigated to determine the relative thermal index.

In Mexico, this requirement does not apply.

5.3 Mechanical protection

5.3.1 A FITTING shall be constructed to allow assembly to a cable or raceway as intended without damaging the cable or raceway. A part of a FITTING that makes contact with an insulated conductor shall be smooth and rounded.

5.3.2 When a FITTING is intended for more than one trade size of raceway, the internal cross-section area shall comply with the requirements of Clause 5.10.2.1 for the larger size of raceway.

5.4 Throats and end stops for FITTINGS

5.4.1 General

5.4.1.1 Other than a COUPLING or LOCKNUT, a conduit FITTING shall be provided with a positive end stop for the conduit and a smooth, rounded throat to protect against abrasion of insulation on conductors entering the FITTING from the conduit. The throat shall be continuous around the circumference of the FITTING.

5.4.1.2 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 as specified for a BUSHING in Table 1.

5.4.1.3 The throat of a FITTING that is internally threaded for attachment to rigid metal conduit or intermediate metal conduit, other than a COUPLING or a LOCKNUT (see Clause 5.4.1.1), shall have a throat diameter as specified in Table 1 for a BUSHING. The gauges illustrated in Figure 1 and the dimensions specified in Table 2 shall be used to determine whether the FITTING complies.

Note: In Canada, intermediate metal conduit (IMC) is not recognized.

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5.4.1.4 A FITTING shall substantially close the opening with which it is used when the cable or raceway is clamped in place and shall inhibit the passage of a 4.8-mm (3/16-in) diameter probe.

5.4.2 End stops for FITTINGS for armored cable

5.4.2.1 A FITTING for armored cable shall be provided with a smooth, rounded end stop so that the armor does not pass through or protrude beyond the end stop. An armored cable BUSHING shall be held in place and shall be visible after installation without disturbing the wiring. The smooth end stop shall be provided by the body of the FITTING or by a separate part applied to the cut end of the cable.

5.4.3 End stops for FITTINGS for flexible metal conduit

5.4.3.1 A flexible metal conduit FITTING shall be provided with a smooth, rounded end stop. The smooth end stop shall be provided by the body of the FITTING or by a separate part applied to the cut end of the conduit.

5.4.3.2 A flexible metal conduit FITTING for 1/2 (16) trade size and larger conduit, other than an ANGLE FITTING, shall completely encircle the end of the conduit. A FITTING for use with conduit less than 1/2 (16) trade size, other than an ANGLE FITTING, having an end stop which does not completely encircle the end of the conduit when installed in the FITTING, shall be provided with the carton marking specified in Clause 7.19.1.

5.4.3.3 The maximum and minimum inside diameter of the end stop of a flexible metal conduit FITTING shall be as specified in Table 3.

5.4.4 End stops for FITTINGS for metal-clad cable

5.4.4.1 A FITTING for metal-clad cable shall be provided with a smooth, rounded end stop so that the metal sheath of the cable does not pass through, or protrude beyond, the end stop.

Note: In Canada, metal-clad (MC) FITTINGS are not recognized.

5.4.5 End stops for FITTINGS for flexible metallic tubing

5.4.5.1 In Mexico and the United States, a FITTING for flexible metallic tubing shall be provided with a smooth, rounded end stop with maximum and minimum inside diameters as specified in Table 4, and which completely encircles the end of the tubing when installed.

These dimensional requirements do not apply to the shoulder of a FITTING that is secured by insertion inside the tubing. 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 5.

In Canada, this requirement does not apply.

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5.4.6 End stops for FITTINGS for liquid-tight flexible conduit

5.4.6.1 A FITTING for liquid-tight flexible metal conduit shall be provided with a smooth, rounded end stop that completely encircles the end of the conduit. The maximum and minimum inside diameter of the end stop shall be as specified in Table 6. 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.

5.4.6.2 A FITTING for liquid-tight flexible nonmetallic conduit shall comply with Clause 5.4.6.1. The end stop shall not be required to completely encircle the conduit.

5.5 Throats and end stops for THREADLESS FITTINGS

5.5.1 CONNECTORS

5.5.1.1 Other than as specified in Clause 5.5.1.2, a threadless CONNECTOR for use with rigid metal conduit, intermediate metal conduit, or electrical metallic tubing shall have a smooth, rounded end stop with a throat diameter as specified for a BUSHING in Table 1.

Note: In Canada, intermediate metal conduit (IMC) is not recognized.

5.5.1.2 A threadless CONNECTOR for electrical metallic tubing in the 2-1/2 (63), 3 (78), 3-1/2 (91), and 4 (103) trade sizes shall have a smooth, rounded end stop with an internal diameter as specified in Table 7. See Clause 7.3.1.

5.5.1.3 The throat diameter of a threadless CONNECTOR for electrical metallic tubing shall not be less than as specified in Table 10, as determined either by application of the limit gauges illustrated in Figure 1 or by measurement as described in Clauses 5.5.1.4 and 5.5.1.5. The dimensions of the gauges are given in Table 11.

5.5.1.4 The measurements from which the throat diameter of a threadless CONNECTOR shall be determined, for comparison with the minimum specified in Table 1, shall be made by means of a machinist's inside micrometer caliper that is equipped with a ratchet. The calibration of the scale shall facilitate estimation of each measurement to 0.003 mm (0.0001 in).

5.5.1.5 The throat diameter at any point in a THREADLESS FITTING shall be equal to or greater than the applicable value specified in Table 1. Four measurements of the throat diameter of each CONNECTOR shall be made to determine the smallest diameter. Each measurement shall be estimated to the nearest 0.003 mm (0.0001 in) and recorded. The smallest of all of the recorded diameters shall be rounded to the nearest 0.03 mm (0.001 in). When rounding, an even number in the third decimal place shall not change when the number in the fourth decimal place is five and there is no number or zero in the fifth place.

5.5.2 COUPLINGS

5.5.2.1 Other than as specified in Clause 5.5.2.2, a threadless COUPLING for use with rigid metal conduit, intermediate metal conduit, or electrical metallic tubing shall be provided with a centering stop having an effective diameter not less than the minimum throat diameter specified in Table 1 and not greater than the smallest outside diameter of the smallest raceway intended to be accommodated.

Note: In Canada, intermediate metal conduit (IMC) is not recognized.

5.5.2.2 Threadless COUPLINGS for electrical metallic tubing in the 2-1/2 (63), 3 (78), 3-1/2 (91), and 4 (103) trade sizes shall be provided with a centering stop having an effective diameter not less than the minimum throat diameter specified in Table 7. See Clause 7.3.1.

5.5.3 Throats and end stops for BUSHINGS and INSULATING BUSHINGS

5.5.3.1 A BUSHING OR INSULATING BUSHING for rigid metal conduit or intermediate metal conduit shall have a smooth, rounded surface at the throat. The throat diameter shall be as specified in Table 1.

Note: In Canada, intermediate metal conduit (IMC) is not recognized.

5.5.3.2 A BUSHING OR INSULATING BUSHING shall be provided with ribs or the equivalent to facilitate tightening.

5.5.4 Throats and end stops for SERVICE-ENTRANCE HEADS

5.5.4.1 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 as specified in Clause 5.5.4.2, the internal diameter of the end stop shall be as specified for a BUSHING in Table 1.

Note: In Canada, intermediate metal conduit (IMC) is not recognized.

5.5.4.2 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 for a BUSHING in Table 1.

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5.6 Screws

5.6.1 General

5.6.1.1 A FITTING employing a plate or a yoke shall be secured by a screw or screws not smaller than No. 8 and not having more than 32 threads per 25.4 mm (1 in).

5.6.2 Screws for FITTINGS for armored cable and flexible metal conduit

5.6.2.1 When a direct-bearing setscrew is used, it shall not be smaller than No. 10 and shall be of the tangential type. The use of a direct-bearing setscrew of the radial type with the axis of both the screw and the cable or conduit in the same plane shall comply where the angle between the axis of the screw and the axis of the cable or conduit is not more than 60 degrees and is oriented in the direction that forces the cable or conduit into the FITTING.

5.7 CONDUIT BODIES (Mexico and US only)

5.7.1 General

5.7.1.1 In Mexico and the United States, the requirements in Clauses 5.7.1.2 – 5.7.2.7, Tables 8 – 11, Tables 40 – 42, and Figure 12 apply.

In Canada, the requirements of Clauses 5.7.1.2 – 5.7.2.7, Tables 8 – 11, Tables 40 – 42, and Figure 12 do not apply.

5.7.1.2 A CONDUIT BODY shall have a cross-sectional area not less than that specified in Table 40, based on the largest size raceway that is intended to be connected to it.

5.7.1.3 A CONDUIT BODY having provision for the connection of conduit or tubing larger than the 1/2 (16) trade size:

- a) shall have a removable blank cover, and
- b) shall comply with Clauses 5.7.1.4 and 5.7.1.5.

This requirement does not apply to a CONDUIT BODY marked for use only with No. 6 AWG (13.30 mm²) or smaller conductors.

This requirement does not apply to a CONDUIT BODY having an internal length (measured as shown in Figure 12) that is equal to or greater than the dimensions specified in Table 41. See Clause 7.10.4.

5.7.1.4 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 size of the connected largest tubing or conduit. The length shall be measured inside the CONDUIT BODY from the end stop of the conduit HUB, away from the center of the body, to an equivalent point on the conduit HUB on the opposite wall, or for a CONDUIT BODY having a single raceway entry, to the opposite wall. See Figure 12.

Note: Measurements expressed as multiples of trade sizes are to be determined by converting the trade size of the raceway (not the metric designator) to a value expressed in millimeters. Example: 1/2 trade size X 8 = 4 = 4 inches = 101.6 mm.

A shorter CONDUIT BODY complies when it is investigated for installation of a combination of conductors that are less than the specified maximum fill for the largest conduit size that the CONDUIT BODY will accommodate. See Clause 7.10.4.

5.7.1.5 A CONDUIT BODY constructed to enable a change in the direction of the axis of a tubing or conduit system (see Figure 12) 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 a) and b) (see note to Clause 5.7.1.4):

- a) six times the trade size of the largest tubing or conduit for which the body is intended, and
- b) the sum of the diameters of all other tubing or conduit entries in the same wall of the body.

A CONDUIT BODY having smaller dimensions shall be investigated for installation of a combination of conductors, including 4 AWG (21.2 mm²) or larger, that is less than the specified maximum fill for the largest conduit size that the CONDUIT BODY is intended to accommodate. See Clause 7.10.4.

A CONDUIT BODY having a raceway entry in the wall opposite the removable cover specified in Clause 5.7.1.3 a) shall have a distance from the cover to the opposite wall not less than that specified in Table 42.

5.7.1.6 With reference to Clause 5.7.1.5, the distance shall 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. See Figure 12.

5.7.1.7 A CONDUIT BODY shall also comply with Clause 7.10.

5.7.1.8 Mating surfaces of a cover and body shall provide a close fit. A gasket, where required to provide a tight fit, shall be provided with the cover. The gasket shall not be required to be cemented or otherwise secured in place on the cover.

5.7.1.9 A cover shall be attached to the body by No. 6 or larger machine screws not having more than 32 threads per 25.4 mm (1 in). The screws shall thread into metal having at least two full threads.

5.7.1.10 The throat diameter of a CONDUIT BODY shall not be less than as specified in Table 10, as determined either by application of the limit gauges illustrated in Figure 1 or by measurement as described in Clauses 5.7.1.12 and 5.7.1.13. The dimensions of the gauges are given in Table 11.

5.7.1.11 The curved surfaces of the limit gauges illustrated in Figure 1 shall be ground and lapped to the diameters and within the tolerances specified in Table 11. The handles for these gauges are not specified, nor is the means by which the handles are joined to the gauges. Each gauge for an internally threaded adapter shall have the letters FEM or equivalent on the same face on which the size appears.

5.7.1.12 The measurements from which the throat diameter of a finished CONDUIT BODY shall be determined, for comparison with the minimum specified in Table 10, shall be made by means of a machinist's inside micrometer caliper that is equipped with a ratchet. The calibration of the scale shall facilitate estimation of each measurement to 0.003 mm (0.0001 in).

5.7.1.13 The throat diameter at any point in a CONDUIT BODY shall be equal to or greater than the applicable value specified in Table 10. Four measurements of the throat diameter of each CONDUIT BODY shall be made to determine the smallest diameter. Each measurement shall be estimated to the nearest 0.003 mm (0.0001 in) and recorded. The smallest of all of the recorded diameters shall be rounded to the nearest 0.03 mm (0.001 in). When rounding, an even number in the third decimal place shall not change when the number in the fourth decimal place is five and there is no number or zero in the fifth place.

5.7.2 Conduit bodies for use with rigid PVC conduit

5.7.2.1 In addition to compliance with Clause 5.7.1.1, a CONDUIT BODY intended for use with rigid polyvinyl chloride (PVC) conduit shall comply with Clauses 5.7.1.5 – 5.7.2.7 and 8.20.

Note: The products covered by these requirements are rated as inherently resistant to the corrosive influences of common industrial atmospheres, including the vapors and mists of bases, hydrofluoric and chromic acids, and pickling and plating baths.

5.7.2.2 A CONDUIT BODY shall be of an unplasticized PVC material rated for the application.

5.7.2.3 The inner and outer surfaces of a PVC CONDUIT BODY shall not be subject to peeling, scaling, or flaking and shall be smooth and free from blisters, cracks, and other defects. In the case of a molded product, excess flashing shall be removed from the mold line of all interior surfaces so that there are no sharp edges or obstructions to the passage of wiring or mating of parts in the intended use of the product.

5.7.2.4 Inserts used for compliance with Clause 5.7.1.9 shall be molded or assembled into the body of a PVC CONDUIT BODY.

5.7.2.5 A PVC CONDUIT BODY shall be constructed to allow securing to PVC conduit by means of a solvent type of cement without damage to the CONDUIT BODY or conduit.

5.7.2.6 The socket of a PVC CONDUIT BODY shall have a circular cross section. The socket shall be tapered and shall be provided with an end or centering stop:

- a) without burrs, sharp edges, or similar conditions to damage wires being pulled over the stop, and
- b) that restricts the depth of penetration of PVC conduit.

5.7.2.7 The socket dimensions of a CONDUIT BODY shall be as specified in Table 8 or Table 9, and shall enable assembly to PVC conduit in a manner that provides the strength required for both the joint and the assembly, as determined by compliance with the bending test described in Clause 8.20.8, and the pull test described in Clause 8.20.9.

A socket depth greater than the maximum specified in Table 8 or Table 9 complies when the CONDUIT BODY is marked in accordance with Clause 7.10.7.

5.8 Threads for FITTINGS and conduit entries

5.8.1 General

5.8.1.1 The external threads of a FITTING shall be straight or tapered and the thread form shall comply with NMX-J-554-ANCE or ANSI/ASME B1.20.1. Internal threads of a fitting or conduit entry shall be straight or tapered and comply with Clauses 5.8.1.2 and 8.36.

5.8.1.2 Internal threads of a fitting or conduit entry shall comply with NMX-J-554-ANCE, CSA C22.2 No. 0.5, or ANSI/ASME B1.20.1 and use National Standard Straight (NPS) and modified National Standard Pipe Taper (NPT) thread. For NPT threads, the number of turns for disengagement shall be a minimum of $L1 + 1/2$ turn to a maximum of $L1 + 5$ turns, and shall be such that not less than three full threads on the conduit engage with the threaded portion of the fitting.

5.8.1.3 A FITTING that has threads other than as specified in Clause 5.8.1.1 and is intended to be connected to a sheet metal box shall be provided with a LOCKNUT.

5.8.2 Minimum thread projection

5.8.2.1 The thread projection of a FITTING, when measured from the shoulder stop to the end of the thread along the axis of the FITTING, shall not be less than that specified in Table 12.

5.9 Electrical continuity of FITTINGS, enclosures, cables, and raceways

5.9.1 Metallic FITTINGS intended for connection of metallic raceway or metal-sheathed cable to a metal enclosure shall provide a continuous electrical bonding (to ground) connection, and shall comply with the resistance test described in Clause 8.8.

5.9.2 Where the FITTING is intended for use with a raceway or cable sheath that is depended upon to carry a fault current, the FITTING shall comply with the current test described in Clause 8.9. A FITTING determined to be a non-grounding type shall not be required to be subjected to this test.

Note: See respective national installation codes to identify non-grounding type FITTINGS. In Canada, see Section 10 of the Canadian Electrical Code (CEC), Part I.

5.9.3 All metal parts of a FITTING that are capable of becoming energized shall be bonded together to ground unless located so that they are unable to be contacted.

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5.10 Offset and ANGLE FITTINGS

5.10.1 Offset FITTINGS

5.10.1.1 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 when the offset is greater than 25.4 mm (1 in) or when the axis of the offsetting section is at any angle greater than 35 degrees from the axis of the raceway.

5.10.2 ANGLE FITTINGS

5.10.2.1 A FITTING, such as an offset NIPPLE or ELBOW, through which wires 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 1. The shape and area of the FITTING shall not inhibit use of the largest number and size of conductors intended for that trade size FITTING.

5.10.2.2 ANGLE FITTINGS without removable covers, other than CONNECTORS which are secured to the raceway by means other than turning, shall comply with the wire pull test described in Clause 8.4. These requirements do not apply to FITTINGS for a liquid-tight flexible conduit or flexible cord.

5.11 Luminaire studs

5.11.1 A luminaire stud shall be of malleable iron, steel, or other equivalent material and shall have a 3/8 (12) NPS straight pipe thread. The threaded portion shall have no fewer than five full threads.

5.12 FITTINGS and BUSHINGS for armored cable

5.12.1 An armored cable FITTING of the 3/8 (12) trade size shall secure a No. 14 AWG (2.08 mm²), 2-wire cable, unless marked in accordance with Clause 7.12.1 to indicate its use with a cable of another size.

5.12.2 An armored cable BUSHING shall be usable for the purpose intended. The BUSHING size for a given range of armored cable is shown in Table 13.

5.12.3 An armored cable BUSHING shall be of a readily distinguishable bright color such as red, orange, or yellow.

5.12.4 An armored cable BUSHING shall have dimensions as specified in Table 13. For all sizes of BUSHINGS, the maximum percentage of the circumference that contains projections shall be 40 percent of the outside diameter of the BUSHING.

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5.13 FITTINGS for nonmetallic-sheathed cable

5.13.1 A nonmetallic-sheathed cable FITTING shall secure cable in a range between No. 14 AWG (2.1 mm²), 2-wire cable with an uninsulated grounding wire, and the largest oval or round multiconductor cable accommodated by the FITTING, unless marked to indicate its use with a specific range of cable sizes. See Clause 7.4.1.

5.13.2 In Canada and the United States, the polymeric material of a FITTING for nonmetallic-sheathed cable shall have a relative thermal index of at least 90°C (194°F) for mechanical properties without impact and 50°C (122°F) for mechanical properties with impact as determined in accordance with UL 746B or CAN/CSA C22.2 No. 0.17.

In Mexico, this requirement does not apply.

5.13.3 In Canada and the United States, a nonmetallic material having a relative thermal index as described in UL 746B or CAN/CSA C22.2 No. 0.17 shall not be required to be investigated to determine the relative thermal index.

In Mexico, this requirement does not apply.

5.14 FITTINGS for mineral-insulated cable

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

5.14.2 Flexible insulating tubing shall be provided with each FITTING. At least 152 mm (6 in) of tubing shall be provided for each cable conductor. A single piece of tubing with a total length that is equivalent to 152 mm (6 in) times the number of cable conductors complies with the requirement.

5.14.3 The inside diameter of the tubing specified in Clause 5.14.2 shall be such that the tubing is easily slipped over the bared conductors of the cable of the largest conductor size for which the FITTING is intended. The wall thickness of the tubing shall not be less than 0.51 mm (0.020 in).

5.14.4 Insulating materials of different composition used with the same FITTING shall be compatible. See Clause 8.23.9.1.

5.14.5 Other than as specified in Clause 5.14.6, 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 the FITTING shall be usable with a separate sealing FITTING.

5.14.6 A FITTING intended for use in dry locations only, and marked in accordance with Clause 7.4.1, shall not be required to comply with the wet locations (rain-tight) test described in Clause 8.6.

5.15 NIPPLES

5.15.1 A NIPPLE shall have a tightening means that has a maximum diameter not exceeding that of a LOCKNUT OR BUSHING, as specified in Table 1.

5.16 SERVICE-ENTRANCE HEADS

5.16.1 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 unintended use does not occur.

Note: In Canada, intermediate metal conduit (IMC) is not recognized.

5.16.2 A SERVICE-ENTRANCE HEAD shall have provisions for separate entry of each service conductor. Not more than three of the holes shall be opened, and not more than one hole shall be uninsulated.

5.16.3 A SERVICE-ENTRANCE HEAD for use with service-entrance cable shall protect the open end of the jacket or braid from the entrance of rain and shall have a means for mounting and for clamping of the cable.

5.17 Pulling, strain-relief, and mesh grips

5.17.1 A grip shall consist of a mesh (wire, strand, or nonmetallic filament) that surrounds the object to which it is assembled and shall be provided with a means of termination. A grip shall be constructed so that a longitudinally applied force results in the mesh tightening circumferentially about the object in an even manner.

5.17.2 A STRAIN-RELIEF GRIP attached to a FITTING shall not interfere with the intended use of that FITTING.

5.18 Reducing washers

5.18.1 Reducing washers for reducing the size of knockout holes shall be of metal and consist of two pieces with a combined thickness of not less than 1.3 mm (0.052 in) for steel and 2.3 mm (0.091 in) for aluminum. The dimensions of the washers are given in Table 14.

5.18.2 In Mexico and the United States, the combined thickness of steel reducing washers shall not be less than 1.59 mm (0.0625 in).

In Canada, this requirement does not apply.

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5.19 CONDUIT LOCKNUTS

5.19.1 A CONDUIT LOCKNUT shall be provided with notches or the equivalent to facilitate tightening.

5.19.2 A CONDUIT LOCKNUT shall have dimensions as specified in Table 1. CONDUIT LOCKNUTS made of steel or aluminum having a reduced thickness, and all LOCKNUTS made of other metals, are usable when the LOCKNUTS comply with the test specified in Clause 8.12.1.1.

5.19.3 A CONDUIT LOCKNUT shall be threaded throughout its entire length. A CONDUIT LOCKNUT having an incomplete or nonstandard thread shall comply with Clause 8.12.1.2.

5.20 BUSHINGS for metal studs

5.20.1 A BUSHING for a metal stud, constructed of either metallic or nonmetallic material, shall comply with the requirements in Clause 8.34.

6 General conditions for tests

6.1 Method of assembly

6.1.1 Unless otherwise specified, the samples of FITTINGS for all tests shall be assembled in the intended manner and as described in Clauses 6.1.3, 6.2.1, and 6.2.2 as applicable. A FITTING shall not crack or break, and the FITTING or screw threads shall not be stripped. The raceway to which the FITTING is assembled shall not be damaged.

6.1.2 A FITTING shall be investigated for use with cable or conduit of each type, size, wall thickness, and material, as specified by the manufacturer. The cable or conduit used in the investigation shall comply with the applicable ANCE, CSA, or UL Standards.

6.1.3 For a FITTING, other than as specified in Clause 8.10.2, that has an end or centering stop, the conduit, tubing, or cable shall be pushed against the stop before the FITTING is tightened.

6.1.4 In Canada, solvents for assembling PVC parts shall be as specified by the manufacturer or shall comply with CAN/CSA C22.2 No. 85.

In Mexico and the United States, this requirement does not apply.

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6.2 Assembly torque

6.2.1 The tightening torque to be applied to a compression-type FITTING, or similar product, shall be as specified in Table 15. A LOCKNUT shall be hand-tightened and then further tightened 1/4 turn with a hammer and a flat-bladed screwdriver or by an equivalent method.

6.2.2 Other than as indicated in Clauses 8.7.2, 8.10.3.2, and 8.24.1.3, a screw or bolthead screw, other than a No. 8 or No. 6, that is capable of being tightened with a screwdriver shall be tightened to a torque of 3.96 N•m (35 lbf-in). A No. 8 screw shall be tightened to a torque of 2.26 N•m (20 lbf-in), and a No. 6 screw shall be tightened to a torque of 1.36 N•m (12 lbf-in). An unslotted, bolthead screw, direct-bearing or securing a clamp, shall be wrench-tightened to a torque of 18.1 N•m (160 lbf-in).

6.2.3 In Canada, the assembly torque for flexible metal conduit FITTINGS and armored cable FITTINGS shall be 2.3 N•m (20.36 lbf-in) for all screw sizes. The assembly torque for aluminum-sheathed cable FITTINGS shall be 1.7 N•m (15.05 lbf-in).

In Mexico and the United States, this requirement does not apply.

6.3 Environmental conditions

6.3.1 General

6.3.1.1 A FITTING intended for use in a wet location shall comply with the wet locations (rain-tight) test described in Clause 8.6. Such a FITTING is also rain-tight and concrete-tight.

6.3.1.2 A CONCRETE-TIGHT FITTING shall comply with the concrete-tightness test described in Clause 8.7. The following FITTINGS shall not be required to be tested:

- a) a threaded or compression-type FITTING,
- b) a FITTING that complies with Clause 8.6, and
- c) a FITTING marked to indicate that it is to be taped to inhibit the entrance of concrete.

6.3.2 LIQUID-TIGHT FITTINGS

6.3.2.1 A liquid-tight FITTING shall comply with the oil spray test described in Clause 8.16.6 or 8.18.4. A LIQUID-TIGHT FITTING is usable in wet locations and is also rain-tight and concrete-tight.

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6.3.3 Other environments

6.3.3.1 A **FITTING** intended for use with enclosures for environments other than those covered in Clauses 6.3.1.1, 6.3.1.2, and 6.3.2.1, such as those with type ratings that indicate the external conditions for which they are usable, shall comply with the type tests specified in NMX-J-235/1-ANCE, NMX-J-235/2-ANCE, CAN/CSA C22.2 No. 94, or UL 50, and shall be marked in accordance with Clause 7.2.1.

6.3.3.2 In Canada, a **FITTING** marked submersible shall comply with the submersion test described in Clause 8.10.8, and is also rain-tight, concrete-tight, and liquid-tight.

In Mexico and the United States, requirements for submersible **FITTINGS** are provided in NMX-J-235/1-ANCE, NMX-J-235/2-ANCE, or UL 50.

6.4 SERVICE-ENTRANCE HEADS

6.4.1 In Canada and the United States, the polymeric material of a **BUSHING** intended for use in a **SERVICE-ENTRANCE HEAD** shall have a relative thermal index of at least 50°C (122°F).

In Mexico, this requirement does not apply.

7 Marking

Advisory Note: In Canada, there are two official languages, English and French. Markings required by this standard may have to be provided in other languages to conform with the language requirements of the country where the product is to be used.

7.1 General

7.1.1 Units of measure for markings shall be in SI (metric), equivalent units, or both.

7.1.2 All markings shall be legible. All product markings shall be permanent. The following types of markings or the equivalent are permanent:

- a) etched,
- b) molded,
- c) die stamped,
- d) paint stenciled,
- e) in Canada and the United States, indelibly stamped on a pressure sensitive label secured by adhesive and complying with CSA C22.2 No. 0.15 or UL 969, and
- f) in Mexico, indelibly stamped on a pressure-sensitive label in accordance with the permanence of markings test in Clause 8.35.

7.1.3 A **FITTING** shall be marked with the manufacturer's name, trademark, or other descriptive marking identifying the organization responsible for the product. The **FITTING** shall also be marked with a catalog number or an equivalent designation. The marking shall be located where it is readily visible after the **FITTING** has been installed. If the catalog number or its equivalent designation is not marked on the **FITTING**, it shall be marked on the smallest unit shipping carton or other container in which the **FITTING** is packaged.

7.1.4 In the United States, when a manufacturer produces or assembles **FITTINGS** at more than one factory, each finished product shall have a distinctive marking to identify it as a product of a particular factory.

In Canada and Mexico, this requirement does not apply.

7.1.5 A **FITTING** that has been found usable for specific conditions of installation, for use with a specific cable or conduit construction, or for use with certain wiring systems, shall be marked to indicate the condition of installation or the intended use on the smallest unit carton. Table 19 specifies the condition of use and the associated carton marking.

7.1.6 Where specific assembly techniques are required for a **FITTING**, instructions for proper assembly shall be provided with the **FITTING** when shipped from the factory.

7.1.7 Unless specifically required on the product by this standard, required markings shall be incorporated either on the product or on the smallest unit shipping carton. When applicable, the marking specified in Table 19, in the complete or abbreviated form, shall be used.

7.2 Other environments

7.2.1 With reference to Clause 6.3.3.1, a **FITTING** intended for use with enclosures for other environments, requiring type ratings, shall be marked to indicate compliance with NMX-J-235/1-ANCE, NMX-J-235/2-ANCE, CAN/CSA C22.2 No. 94, or UL 50. The **FITTING** or smallest unit shipping carton in which it is packaged shall be marked with a Type number in accordance with the applicable standard, for example, "Type _," indicating the environmental conditions for which it is acceptable. A **FITTING** that complies with the requirements for more than one type shall be allowed to have multiple designations.

7.2.2 In Canada, a **FITTING** intended for submersible applications shall comply with the submersion test described in Clause 8.10.8, and shall be marked with the word "SUBMERSIBLE."

In Mexico and the United States, requirements for submersible **FITTINGS** are provided in NMX-J-235/1-ANCE, NMX-J-235/2-ANCE, or UL 50.

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7.3 FITTINGS for rigid metal conduit, electrical metallic tubing (EMT), and intermediate metal conduit (IMC)

Note: In Canada, intermediate metal conduit (IMC) is not recognized.

7.3.1 A FITTING intended for use with electrical metallic tubing of the 2-1/2 (63), 3 (78), 3-1/2 (91), or 4 (103) trade size shall be plainly and permanently marked "EMT ONLY," unless the FITTING is also intended for use with rigid conduit and IMC or IMC. This marking shall appear on the FITTING. A FITTING for use only with rigid conduit and IMC or IMC shall not be required to be marked.

In Mexico, marking a fitting for use with electrical metallic tubing with "Electrical Metallic Tubing Only" or "EMT ONLY" complies with the requirement.

7.3.2 In Canada, unless the construction is obvious, as illustrated in Figure 2, a THREADLESS FITTING intended for use with EMT for wet-location uses shall be marked to indicate such use. See Clause 6.3.1.

In Mexico and the United States, a THREADLESS FITTING intended for use with EMT for wet location uses shall comply with the wet locations (rain-tight) test described in Clause 8.6, prior to being marked.

7.3.3 In Mexico and the United States, a set-screw fitting for use with EMT, rigid metal conduit, or IMC, and tested as specified in Clause 8.7.4 without vibration, shall be marked "Concrete-tight at depths not greater than 610 mm (2 ft)" or equivalent wording.

In Canada, this requirement does not apply.

7.4 FITTINGS for nonmetallic-sheathed cable

7.4.1 A FITTING intended to secure nonmetallic-sheathed cable of a size or sizes other than 14 AWG (2.08 mm²), 2-wire cable shall be marked to indicate the specific size or range of sizes the FITTING is intended to secure. The range shall include the maximum and minimum size.

7.4.2 A FITTING intended to secure more than one nonmetallic-sheathed cable of the same size shall be marked with the size and number of cables it is intended to secure.

7.5 INSULATING BUSHINGS

7.5.1 Other than as specified in Clauses 7.5.2 and 7.5.3, the temperature rating of an INSULATING BUSHING and a BUSHING having an insulating throat shall be marked in a location that is visible after installation (see Table 18).

7.5.2 With respect to Clause 7.5.1, a black or brown color shall be an alternative means of identifying the temperature rating, if the rating is 150°C (302°F). For a BUSHING having a rating other than 150°C (302°F), the BUSHING shall not be identified by a black or brown color.

7.5.3 An INSULATING BUSHING, and a BUSHING having an insulating throat rated at 90°C (194°F) shall not be required to be marked with a temperature rating.

7.5.4 An unthreaded BUSHING intended for threaded conduit shall be marked, "Unthreaded for threaded conduit." When the BUSHING is also intended for unthreaded conduit it shall be marked "Unthreaded for threaded or unthreaded conduit."

7.6 BUSHINGS for armored cable

7.6.1 Each smallest unit shipping container of armored cable BUSHINGS shall be marked with the number of BUSHINGS, size of BUSHING, and size or sizes of armored cable for which it is to be used.

7.6.2 Each armored cable BUSHING shall be marked with the BUSHING size and the manufacturer's name, trademark, or other symbol of identification. This marking shall appear on the BUSHING.

7.7 Mesh grips

7.7.1 Marking for mesh grips shall be on the grip or attached to the grip.

7.7.2 A grip intended for use in an environment at a temperature greater than 50°C (122°F) shall be marked with the applicable temperature rating.

7.8 Tray-cable FITTINGS

7.8.1 A tray-cable FITTING or the smallest unit shipping carton shall be marked with the diameter of the smallest and largest cable for which the FITTING is rated. For oval cables, the diameter of both the minor and major axis of the smallest and largest cable shall be marked.

7.8.2 FITTINGS that comply with Clauses 8.27.1.1 – 8.27.1.4 shall be marked "Sunlight Resistant" or "Dry Location."

7.8.3 FITTINGS that comply with the oil spray test described in Clause 8.27.5 shall be marked "Oil Resistant I" or "Oil Resistant II."

7.8.4 A FITTING for tray cable shall be marked "for use with tray cable rated ____°C" when the FITTING is rated above 60°C (140°F). The blank shall be filled in with the temperature rating declared by the manufacturer.

7.9 FLEXIBLE CORD FITTINGS

7.9.1 In Canada and the United States, both a liquid-tight FITTING for cord and the gland of a FITTING that is intended for use in an environment requiring a relative thermal index greater than 60°C (140°F) shall be marked with the applicable temperature rating.

In Mexico, this requirement does not apply.

7.9.2 The required outside diameter range of cord for a FLEXIBLE CORD FITTING shall be marked on the FITTING or smallest unit shipping carton.

7.10 CONDUIT BODIES

7.10.1 In Mexico and the United States, the requirements in Clauses 7.10.2 – 7.10.7 and Tables 8 and 9 apply. Metallic CONDUIT BODIES shall comply with the requirements of Clauses 7.10.2 – 7.10.4.

In Canada, the requirements in Clauses 7.10.2 – 7.10.7 and Tables 8 and 9 do not apply.

7.10.2 Additional markings, other than those specified in Clause 7.10, shall not conflict with or be confused with the specified markings.

7.10.3 A CONDUIT BODY that complies with the wire pull test described in Clause 8.4 by using a wire pulling compound shall be marked "For Use With Wire-Pulling Lubricant" or with equivalent wording.

7.10.4 A CONDUIT BODY that has been investigated for a specific combination of conductors shall be marked with the maximum number and maximum size of the conductors for which it is intended. See Clauses 5.7.1.3 – 5.7.1.5.

7.10.5 Each CONDUIT BODY that is intended for use where it is wetted by, or immersed in, one or more specific reagents (see Clauses 5.7.2.1 and 8.20.10 – 8.20.12) shall be marked "Reagent-resistant A" or with an equivalent designation.

7.10.6 Unless all FITTINGS marked "Reagent-resistant" have been found to be usable with the same reagent or the same group of reagents, the manufacturer shall add a different designation to the marking on each product as the means of differentiating between products in the field. For example, "Reagent-resistant A" is marked on one FITTING, and "Reagent-resistant B" is marked on another. A group of reagents is determined to be the same when the physical characteristics of individual reagents, such as concentrations and maximum temperatures, are identical. A FITTING shall be investigated in accordance with Clauses 8.20.10 – 8.20.12 to determine the reagents or group of reagents with which the FITTING is able to be used.

7.10.7 A CONDUIT BODY having a socket depth greater than the maximum specified in Table 8 or Table 9 shall be marked "Extra long sockets – Not for use with standard ELBOWS or bends" or with equivalent wording.

7.11 FITTINGS for threaded HUBS

7.11.1 A FITTING provided without a LOCKNUT and intended for securement to a threaded HUB shall have a marking on the smallest unit shipping carton "For securement to a threaded HUB only" or with equivalent wording.

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7.12 FITTINGS for armored cable, aluminum-sheathed cable, and metal-clad cable

Note: In Canada, metal-clad (MC) FITTINGS are not recognized.

7.12.1 A FITTING for armored cable or aluminum-sheathed cable that is not intended for use with a 14 AWG (2.08 mm²), 2-wire cable shall be marked for the smallest and largest size cable, and the nominal diameter of the smallest size cable, for which the FITTING is intended to be used.

7.12.2 A FITTING for armored cable or aluminum-sheathed cable that is for use with a No. 14 AWG (2.08 mm²), 2-wire cable shall be marked with the diameter of the No. 14 AWG (2.08 mm²), 2-wire cable with which the FITTING has been tested, the size "14/2," and the size of the largest size cable for which it is intended to be used.

7.12.3 The carton for a FITTING for metal-clad cable shall be marked with the type of cable and range of cable diameters, and the largest 2-conductor cable size (e.g., 10/2) for which the fitting is intended to be used. The following markings shall be used:

- a) "Metal-Clad Interlocking Armor Cable Type" or "MCI",
- b) "Metal-Clad Interlocking Armor Ground Cable Type" or "MCI-A",
- c) "Metal-Clad Continuous Smooth Sheath Armor Cable Type" or "MCS",
- d) "Metal-Clad Continuous Corrugated Sheath Armor Cable Type" or "MCC", and
- e) "Metal-Clad Continuous Corrugated Sheath Armor Cable Type Flat" or "FLAT".

7.12.4 A FITTING for metal-clad cable shall be marked "For use in dry locations only" or with equivalent wording.

A FITTING that complies with Clause 8.21.7.1 is not required to be marked.

7.12.5 When a FITTING assembly has insufficient space for all markings to be placed on the body of the FITTING, the markings shall be provided on the smallest unit shipping carton.

7.13 FITTINGS for service-entrance cable

7.13.1 A service-entrance cable FITTING shall be marked with the diameter or diameter range of the cable with which the FITTING is intended to be used.

7.13.2 A service-entrance cable FITTING intended for wet locations shall be marked with the shape and the diameter or diameter range of the cable with which the FITTING is intended to be used.

7.14 FITTINGS for liquid-tight flexible metal conduit

7.14.1 In Mexico and the United States, a LIQUID-TIGHT FITTING of the 1-1/2 (41) or larger trade size for use with liquid-tight flexible metal conduit of the grounding type shall comply with the current test described in Clause 8.9 and be marked "Grounding Type" or "GRND" or with the symbol for grounding ($\equiv$) (IEC 60417, Symbol 5019(a), when the carton or other container in which the FITTING is packaged is marked "Grounding Type."

In Canada, this requirement does not apply.

7.15 FITTINGS for flexible metal conduit

7.15.1 Deleted April 3, 2006.

7.16 FITTINGS for liquid-tight flexible nonmetallic conduit

7.16.1 When intended for use with liquid-tight flexible nonmetallic conduit:

a) a FITTING for Type A conduit only shall be marked "Liquid-Tight Flexible Nonmetallic Conduit Type A Only" or "LFNC-A only" or "FNMC-A only."

b) a metallic FITTING for Type B shall be marked "Liquid-Tight Flexible Nonmetallic Conduit Type B Only" or "LFNC-B" or "FNMC-B" or with equivalent wording.

When a metallic FITTING that physically is unable to be connected to any type of conduit other than liquid-tight flexible metallic or nonmetallic Type B conduit, the marking shall be allowed on the smallest unit shipping carton in which the FITTING is packed.

c) a nonmetallic FITTING for Type B conduit only shall be marked "Liquid-Tight Flexible Nonmetallic Conduit Type B Only" or "LFNC-B only" or "FNMC-B only."

d) a nonmetallic FITTING for Type C conduit only shall be marked "Liquid-Tight Flexible Nonmetallic Conduit Type C Only" or "LFNC-C only" or "FNMC-C only."

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7.17 FITTINGS for mineral-insulated cable

7.17.1 A mineral-insulated cable FITTING intended for use in dry locations only (see Clause 5.14.6) shall be marked "Dry location use" or with equivalent wording in a location where it is visible after installation.

7.18 EXPANSION FITTINGS

7.18.1 The smallest unit shipping carton of outdoor EXPANSION FITTINGS intended for use with external bonding jumpers shall be marked "Intended for use with external bonding jumpers."

7.19 BUSHINGS for flexible metal conduit FITTINGS

7.19.1 For a FITTING for flexible metal conduit, as described in Clause 5.4.3.2, the carton shall be marked "Armored Cable BUSHING Required on Flexible Metal Conduit" or with equivalent wording.

8 Performance

8.1 General notes on tests

8.1.1 Unless otherwise stated, the requirements in Clauses 6.1, 8.4 – 8.9, 8.16.7, and 8.31.2 apply to all products that are covered by this standard. They are supplemented or modified in subsequent clauses by requirements applying to specific products. Where a test is described, and criteria are not given, the requirements are stated in subsequent clauses for specific products.

8.1.2 Unless otherwise stated, samples shall not be additionally tightened, serviced, or conditioned between the tests of a sequence.

8.1.3 A FITTING intended to be installed in a knockout in a sheet-metal surface with or without the use of a LOCKNUT shall provide a mechanical connection to the various thicknesses of metal to which it is intended to be installed.

In Mexico and the United States, the thickness range shall be 1.59 – 1.64 mm (0.0625 – 0.0645 in).

In Canada, the thickness range shall be 1.3 – 1.4 mm (0.051 – 0.055 in).

In addition, all products in the 3/8 to 1-1/4 (12 to 35) trade sizes shall be assembled in accordance with Clause 6.1 and shall comply with the resistance test described in Clause 8.8, while assembled to sheet metal having a thickness of 0.66 – 0.71 mm (0.026 – 0.028 in).

8.1.4 Where the potential exists for the performance of a FITTING to be affected by the thickness of the material to which it is mounted, the FITTING shall comply with all testing after it has been assembled to metal with the thicknesses specified in Clause 8.1.3.

8.1.5 Unless otherwise noted, the samples of FITTINGS for all tests shall be assembled in the intended manner and as described in Clauses 6.1 and 6.2. When a line of a minimum of four trade sizes of a particular construction is being investigated, three samples of each trade size shall be tested.

8.1.6 A LOCKNUT provided as part of a FITTING shall be tested as part of the FITTING and shall comply with the applicable requirements for that FITTING in this standard.

8.2 Nonmetallic materials flammability test

8.2.1 When a plaque sample or a finished product sample are tested as described in Clauses 8.2.2 – 8.2.9, they shall comply with the following:

- a) the plaque material shall not flame for more than 30 seconds after any of the first four applications or more than 1 minute after the fifth application of the test flame.
- b) the finished product material shall not:
 - 1) openly flame for more than one minute after the final application of the test flame, or
 - 2) be consumed.
- c) there shall not be an opening in the material such that a 6.4 mm (1/4 in) diameter rod passes through after the material has returned to ambient temperature. The rod shall be applied without force.
- d) there shall not be a visible flame on the surface of the plaque or sample opposite the surface to which the test flame has been applied.
- e) there shall not be glowing or burning particles during the test.

8.2.2 In Mexico and United States, with reference to Clause 8.2.1 b) 2), a polymeric throat or throat liner located in a FITTING of the 1/2 (16) or 3/4 (21) trade size that is consumed during the test complies with the requirement.

In Canada, this requirement does not apply.

8.2.3 Six plaque samples or finished product samples shall be tested. Three shall be tested as received, and three shall be tested after being conditioned for 168 hours at a temperature of $90 \pm 1^\circ\text{C}$ ($194 \pm 2^\circ\text{F}$) in a full-draft air-circulating oven that has been preheated at full draft.

8.2.4 The apparatus for this test shall consist of a test chamber of sheet metal 305 mm wide x 356 mm deep x 610 mm high (12.0 in wide x 14.02 in deep x 24.02 in high) open at the top and front. When the FITTING is too large to be tested in this chamber, a chamber with proportionately larger dimensions shall be used.

8.2.5 When plaque samples are tested, the plaques shall be molded composition, in 102 mm (4 in) square sheet form, having a thickness equal to the minimum thickness used for a part. Each plaque or finished sample shall be secured with its vertical axis in the center of the enclosure and with both axes parallel to the back of the enclosure. See Figure 3.