UL 514B

STANDARD FOR SAFETY

Conduit, Tubing, and Cable Fittings

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

Sixth Edition, Dated July 13, 2012

Summary of Topics

This revision of ANSI/UL 514B dated May 22, 2020 includes the following changes in requirements:

– Addition Of Requirements Specific To 'Heavy-duty' Liquid-Tight Flexible Metal Fittings; 3.22A, 7.14.2, Table 19, Annex D

– Armored Cable (AC) Tolerances for Assembly Test; 8.15.2.2

– Metal-Clad (MC) Cable, Type ACG90 Cable, and Type ACGWU90 Cable Tolerances for Assembly Test; 8.22.2.4

– Flexible Cord Tolerances for Assembly Test; 8.27.2.2

– Tray Cable Tolerances for Assembly Test; 8.28.2.2, 8.28.2.3, 8.28.2.5

– Cross-Sectional Area of Conduit Bodies; Table 39

– Editorial Correction; 7.10.5

– Removing XRW Fittings; 5.6.2.2, Table 19

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

The new and revised requirements are substantially in accordance with Proposal(s) on this subject dated January 18, 2019 and December 6, 2019.

No Text on This Page

Association of Standardization and Certification
NMX-J-017-ANCE
Third Edition

CSA Group
CSA-C22.2 No. 18.3-12
Second Edition

Underwriters Laboratories Inc.
UL 514B
Sixth Edition

Conduit, Tubing, and Cable Fittings

July 13, 2012

(Title Page Reprinted: May 22, 2020)

ANSI/UL 514B-2020

Commitment for Amendments

This standard is issued jointly by the Association of Standardization and Certification (ANCE), Canadian Standards Association (operating as "CSA Group"), and Underwriters Laboratories Inc. (UL). Comments or proposals for revisions on any part of the standard may be submitted to ANCE, CSA Group, or UL at anytime. Revisions to this standard will be made only after processing according to the standards development procedures of ANCE, CSA Group, and UL. CSA Group and UL will issue revisions to this Standard by means of a new edition or revised or additional pages bearing their date of issue. ANCE will incorporate the same revisions into a new edition of the standard bearing the same date of issue as the CSA Group and UL pages.

ISBN 978-1-55491-745-7 © 2014 Canadian Standards Association

This Standard is subject to review within five years from the date of publication, and suggestions for its improvement will be referred to the appropriate committee. To submit a proposal for change, please send the following information to inquiries@csagroup. org and include "Proposal for change" in the subject line: Standard designation (number); relevant clause, table, and/or figure number; wording of the proposed change; and rationale for the change.

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This ANSI/UL Standard for Safety consists of the Sixth Edition including revisions through May 22, 2020. The most recent designation of ANSI/UL 514B as an American National Standard (ANSI) occurred on May 22, 2020. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

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 harmonized ANCE, CSA Group, and UL standard for Conduit, Tubing, and Cable Fittings. It is the Third edition of NMX-J-017-ANCE, the Second edition of CSA C22.2 No. 18.3, and the Sixth edition of UL 514B. This edition of CSA-C22.2 No. 18.3 supersedes the previous edition(s) published in 2004. This edition of UL 514B supersedes the previous edition(s) published in 2004. This harmonized standard has been jointly revised on May 22, 2020. For this purpose, CSA Group and UL are issuing revision pages dated May 22, 2020, and ANCE is issuing a new edition dated May 22, 2020.

This harmonized standard was prepared by the Association of Standardization and Certification (ANCE), CSA Group 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 is considered suitable for use for conformity assessment within the stated scope of the standard.

The present Mexican standard was developed by the CT 23, Electrical Accessories from the Comite de Normalizacion de la Asociacion de Normalizacion y Certificacion, A.C., CONANCE, with the collaboration of the conduit, tubing and cable fittings manufacturers and users.

This Standard was reviewed by the CSA Integrated Committee on Fittings, Hardware, and Positioning Devices, 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.

Application of 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 Group, 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 trinational 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.

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 (CE Code), 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 or box clamps referenced from other standards 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 1: 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 2: In Canada, armored cable includes Type TECK cable.

Note 3: In Canada, tray cable includes any "TC rated" cable.

Note 4: In Mexico and the United States, requirements for submersible FITTINGS are provided in NMX-J-235/2-ANCE or UL 50E.

Note 5: In Mexico, intermediate metal conduit is designated as semi-heavy metal conduit.

1.3 In Mexico and the United States, these requirements cover CONDUIT BODIES for rigid polyvinyl chloride (PVC) conduit. These products are intended to be used with Schedule 40, Type EB, Type A and Schedule 80 PVC conduit, ELBOWS, and other bends.

In Canada, requirements for fittings intended for use with rigid PVC conduit are addressed in CSA C22.2 No. 85.

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 (CE Code), 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 or intermediate metal conduit.

2 Normative References

2.1 Products covered by this standard shall comply with the reference installation codes and standards 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-2005
Standard for Electrical Installations

NMX-J-010-ANCE-2011
Thermoplastic-insulated wires and cables

NMX-D-122-ANCE-1973
Test Method for Corrosion Resistance of Coated Metal Parts Used in Motor Vehicles – Salt Spray (Fog)

NMX-J-023/1-ANCE-2007
Metallic Outlet Boxes Part 1: Specifications and Test Methods

NMX-J-235/2-ANCE-2000
Enclosures for Electrical Equipment-Part 2 Specific Requirements – Specifications and Test Methods

NMX-J-451-ANCE-2011
Thermoset-insulated wires and cables

NMX-J-534-ANCE-2008
Steel Tubes (Conduit) Heavy Type For Electric Conductors Protections and Fittings – Specifications and Test Method

NMX-J-554-ANCE-2004
Threads for Conduit and Fittings Specifications and Test Method

NMX-J-565/3-ANCE-2006
Safety Requirements – Flammability of Plastic Materials for Parts in Devices and Appliances – Test Method

NMX-J-565/7-ANCE-2007
Safety Requirements – High Current Arc Resistance to Ignition – Test Method

NMX-T-152-SCFI-2004
Rubber Industry – Raw Materials – Specific Gravity – Displacement – Test Method

CSA Standards

C22.1-12
Canadian Electrical Code, Part I

C22.2 No. 0.5-1982 (R2008)
Threaded Conduit Entries

C22.2 No. 0.15-01 (R2006)
Adhesive Labels

CAN/CSA C22.2 No. 0.17-00 (R2009)
Evaluation of Properties of Polymeric Materials

C22.2 No. 45.1-07
Electrical Rigid Metal Conduit – Steel

CAN/CSA C22.2 No. 85-M89 (R2010)
Rigid PVC Boxes and Fittings

CAN/CSA C22.2 No. 94.2-07
Enclosures for Electrical Equipment, Environmental Considerations

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, Non-Environmental Considerations

UL 50E
Enclosures for Electrical Equipment, Environmental Considerations

UL 44
Thermoset-insulated wires and cables

UL 83
Thermoplastic-insulated wires and cables

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

ASME[1] Standards

ASME B1.20.1-1983 (R2001)
Pipe Threads, General Purpose (Inch)

ASME B94.1M-1993
Twist Drills

ASTM[2] Standards

ASTM D 792-08
Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement

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

ISO[3] Standards

ISO 868:2003
Plastics and Ebonite – Determination of Indentation Hardness by Means of a Durometer (Shore Hardness)

ISO 4287:1997 (R2005)
Geometrical Product Specifications (GPS) – Surface texture: Profile method – Terms, Definitions and Surface Texture Parameters

ISO 4892-1:1999
Plastics – Methods of Exposure to Laboratory Light Sources – Part 1: General Guidance

ISO 4892-2:1994
Plastics – Methods of Exposure to Laboratory Light Source – Part 2: Xenon-Arc Sources

ISO 9227
Corrosion Test in Artificial Atmospheres – Salt Spray Tests

NFPA[4] Standard

NFPA 70-2011
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 – 3.29 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. A FITTING for the connection of two cables or conduits into one knockout or into a coupling is not considered to be an ANGLE FITTING.

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 only for linear thermal expansion of a span of rigid metal conduit, intermediate metal conduit, or electrical metallic tubing.

3.15 FITTING, EXPANSION-DEFLECTION: An expansion FITTING that compensates for linear expansion and compensates for lateral or angular deflection in a span of rigid metal conduit, intermediate metallic conduit, or electrical metallic tubing.

3.16 FITTING, DEFLECTION: A FITTING intended to compensate only for lateral or angular deflection in a span of rigid metal conduit, intermediate metallic conduit, or electrical metallic tubing.

3.17 FITTING, FLEXIBLE CORD: A CONNECTOR used to reduce strain at points of termination for flexible cord.

3.18 FITTING, LIQUID-TIGHT: A FITTING intended for use in wet industrial environments that contain machine oils and coolants.

3.19 FITTING, SEALING: A FITTING used with conduit or tubing that includes provision for preventing the circulation of air inside of the conduit or tubing.

3.20 GRIP, PULLING: A means of pulling conductors or cable into a raceway.

3.21 GRIP, STRAIN-RELIEF: A means of reducing strain at points of termination for cable or flexible conduit.

3.22 GRIP, SUPPORT: A means of holding the weight and restraining the arc-of-bend of a cable.

3.22A HEAVY DUTY FITTING FOR LIQUID-TIGHT FLEXIBLE METAL CONDUIT: A fitting for liquid-tight flexible metal conduit fitting showing a higher level of pull force.

3.23 HUB: A FITTING, or part of a fitting intended for use with threaded conduit for connection to an enclosure.

3.24 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.

3.25 LOCKNUT, FITTING: A component of a CONNECTOR intended to inhibit turning and to provide a secure joint.

3.26 NIPPLE: An externally threaded FITTING intended primarily to serve as a short raceway between close-spaced enclosures.

3.26A SEALING RING: A fitting used in conjunction with a liquid-tight fitting or a fitting or conduit locknuts to provide a seal at a knockout in a box or enclosure.

3.27 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.

3.28 THREADLESS FITTING: A FITTING intended for use with nonthreaded rigid metal conduit, intermediate metal conduit, or electrical metallic tubing.

3.29 TRANSITION COUPLING: A FITTING intended to attach one or more metal sheathed cables or flexible metal conduit to one non-flexible metallic raceway.

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 or with an alternate corrosion-resistant coating. The alternate coating shall comply with the tests specified in Clause 8.6.

5.1.3.2 A ferrous metal fitting having an alternate corrosion-resistant coating other than zinc shall be marked as specified in Clauses 7.19.1 and 7.19.2.

5.1.3.3 In Mexico and the United States, a fitting of ferrous metal construction intended for use with liquid-tight flexible metal conduit or liquid-tight flexible nonmetallic conduit and intended for direct burial in earth shall be subjected to a neutral salt spray (NSS) in accordance with ISO 9227 for 600 h. After the test, there shall be no visible red rust when examined with normal or corrected normal vision. The test shall not be required for a fitting constructed of stainless steel having a minimum of 16% chromium. In Mexico, compliance shall be determined in accordance with NMX-D-122-ANCE.

In Canada, this requirement does not apply.

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: Materials rated V-2 or higher in accordance with CAN/CSA-C22.2 No. 0.17, UL 94, or NMX-J-565/3-ANCE comply with this requirement.

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 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 NMX-J-565/7-ANCE, CAN/CSA-C22.2 No. 0.17, or UL 746A.

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 FLEXIBLE CORD 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 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 impact (RTI-Impact) or without impact (RTI-Strength) not less than the temperature rating 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 8.17.7.

5.2.5 Gaskets – expanded closed-cell material

5.2.5.1 A gasket constructed of expanded closed-cell material, other than an expanded closed-cell (foam) 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 8.32.1. A gasket constructed from a material that has previously been investigated in accordance with Clause 8.32.1 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 8.32.2.

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 opening. 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.

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 7.18.1.

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, Type ACG90 or ACGWU90, 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. A TRANSITION COUPLING having an end stop which does not completely encircle the end of the cable when installed in the FITTING shall be provided with the carton marking specified in Clause 7.18.2.

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.

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.

5.4.7 End stops for TRANSITION COUPLINGS

5.4.7.1 A TRANSITION COUPLING shall be provided with end stops as applicable for the cable and/or conduit for which the coupling is intended.

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 1, 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 2.

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 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 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.

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.

5.6.2.2 *Deleted*

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 – 5.7.1.9 and 5.7.2, Table 39 – Table 41, and Figure 12 and the applicable requirements in Clause 7.10 apply to CONDUIT BODIES for use with rigid metal conduit (RMC), electrical metallic tubing (EMT), and intermediate metal conduit (IMC).

In Canada, the requirements of Clauses 5.7.1.2 – 5.7.1.9 and 5.7.2, Table 39 – Table 41, Figure 12 and the applicable requirements in Clause 7.10 do not apply.

5.7.1.1A In Mexico and the United States, the requirements in Clauses 5.7.1.2 – 5.7.1.9 and Clause 5.7.3, Table 8 – Table 11, Table 39 – Table 41, and Figure 12 apply to conduit bodies for use with rigid PVC conduit.

In Canada, the requirements in Clauses 5.7.1.2 – 5.7.1.9 and Clause 5.7.3, Table 8 – Table 11, Table 39 – Table 41, and Figure 12 do not apply.

5.7.1.2 A CONDUIT BODY shall have an internal cross-sectional area not less than that specified in Table 39, 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 6 AWG (13.30 mm^2) 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 40. 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.

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.

5.7.1.6 A CONDUIT BODY having smaller dimensions than as specified in Clause 5.7.1.5 shall:

a) comply with the wire pull test in Clause 8.4 for installation of a combination of conductors, including 4 AWG (21.2 mm^2) 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, or

b) have a radius to the curve of its centerline not less than the radius to the center of the tube as indicated for an elbow in UL 6, C22.2 No. 45.1 or NMX-J-534-ANCE. See Clause 7.10.4A.

5.7.1.7 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 41.

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. Alternatively, the screw attachment shall comply with the torque requirements in Clause 6.2.2.

5.7.1.10 Deleted November 21, 2014

5.7.1.11 Deleted November 21, 2014

5.7.1.12 Deleted November 21, 2014

5.7.1.13 Deleted November 21, 2014

5.7.2 CONDUIT BODIES for use with rigid metal conduit (RMC), electrical metallic tubing (EMT), or intermediate metallic conduit (IMC)

5.7.2.1 The throat diameter of a CONDUIT BODY intended for use with rigid metal conduit (RMC), electrical metallic tubing (EMT), or intermediate metal conduit (IMC), shall comply with Clause 5.4.1.3.

5.7.3 Conduit bodies for use with rigid polyvinyl chloride (PVC) conduit

5.7.3.1 A CONDUIT BODY intended for use with rigid PVC conduit shall comply with Clauses 5.7.1.5 – 5.7.1.13, Clauses 5.7.3.2 – 5.7.3.11, Clause 8.21, and Table 8 – Table 11.

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.

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

5.7.3.3 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.

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

5.7.3.5 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.

5.7.3.6 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.

5.7.3.7 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 8.21.8, and the pull test described in Clause 8.21.9.

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.

5.7.3.8 The throat diameter of a CONDUIT BODY for use with rigid PVC conduit 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 5.7.3.10 and 5.7.3.11. The dimensions of the gauges are specified in Table 11.

5.7.3.9 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.

5.7.3.10 The measurements from which the throat diameter of a finished CONDUIT BODY is 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).

5.7.3.11 The throat diameter at any point in a CONDUIT BODY for use with rigid PVC conduit 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.

5.8 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, ***5.8.1.3***, 5.8.1.4, and 8.37.

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) or modified National Standard Pipe Taper (NPT) thread. For NPT threads, the entries shall be threaded to a gauging tolerance of L1 + 1/2 to L1 + 5 on a working NPT plug gauge.

5.8.1.3 Deleted November 21, 2014

5.8.1.4 Threaded openings of a fitting for the connection of conduit shall be smooth and rounded to provide protection to the conductors. The throat diameter of an opening shall be within the limits specified in Table 1. For NPT threaded entries, the minimum depth to an integral bushing or end stop shall be in accordance with Table 42.

5.8.1.5 A FITTING that has external 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 external 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 8.9.

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 8.10. A FITTING determined to be a non-grounding type shall not be required to be subjected to this test.