UL 514B

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Conduit, Tubing, and Cable Fittings

Underwriters Laboratories Inc. (UL)
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Northbrook, IL 60062-2096

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

Fifth Edition, Dated February 16, 2004

SUMMARY OF TOPICS

This new edition of the Standard for Conduit, Tubing, and Cable Fittings, UL 514B, is harmonized with ANCE and CSA as a result of UL's Bulletins on this subject dated March 15, 2002, June 13, 2003, and December 26, 2003. The title page reflects the January 30, 2004 ANSI recognition of this new edition of the Standard.

The following table lists the future effective dates with the corresponding item.

Future Effective Date	References
February 16, 2006	5.4.3.1, 5.4.3.2, 5.8, 5.20.1, 7.10.3, 7.10.7, 7.19, 8.34, 8.36

The new requirements are substantially in accordance with UL's Bulletin(s) on this subject dated March 15, 2002, June 13, 2003, and December 26, 2003. The bulletin(s) is now obsolete and may be discarded.

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 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.

Revisions of UL Standards for Safety are issued from time to time. A UL Standard for Safety is current only if it incorporates the most recently adopted revisions.

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An employee of an organization purchasing a UL Standard can make a copy of the page or pages being viewed for their own fair and/or practical internal use.

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that have been revised and that have a future effective date are located after the Standard, and are preceded by a ″SUPERSEDED REQUIREMENTS″ notice.

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.

This Standard consists of pages dated as shown in the following checklist:

Page	Date
1-132	February 16, 2004

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

ANSI/UL 514B-2004

Commitment for Amendments

This standard is issued jointly by the Association of Standardization and Certification (ANCE), Canadian Standards Association (CSA), and Underwriters Laboratories Incorporated (UL). Comments or proposals for revisions on any part of the standard may be submitted to ANCE, CSA, or UL at any time. Revisions to this standard will be made only after processing according to the standards development procedures of ANCE, CSA, and UL. CSA 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 and UL pages.

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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 January 30, 2004. The ANSI approval for this standard does not include the Cover Page, Transmittal Pages, Title Page, Preface, Forewords, or Annex A.

This ANSI/UL Standard for Safety, which consists of the Fifth edition 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. Written comments are to be sent to the UL Northbrook Standards Department, 333 Pfingsten Road, Northbrook, IL 60062.

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.

CONTENTS

Annex A (Normative) Component Standards (See Clause 4.1.)

Annex B (Normative) Ultraviolet Light and Water Test (See Clause 8.26.7.4.)

Annex C (Informative) Armored Cable Bushing Dimensions (See Table 13.)

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 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.

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 February 16, 2004, all products Listed or Recognized by UL must comply with the requirements in this standard except for clauses in the following list which are effective February 16, 2006.

Clauses 5.20.1, 5.4.3.1, 5.4.3.2, 5.8, 7.10.3, 7.10.7, 7.19, 8.34, and 8.36.

Between February 16, 2004 and February 16, 2006, new product submittals to UL may be evaluated under all requirements in this Standard or, if requested in writing, evaluated under presently effective requirements only.

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

Foreword (ANCE)

The present Mexican Standard was developed by the Technical Committee Products and Accessories for Electrical Installations from the Committee of Normalization of the Association of Normalization and Certification A.C., CONANCE, with the collaboration of the fittings for conduit manufacturers and users.

ANCE is an Organization for Standardization (ONN) registered by the DGN (Dirección General de Normas) in the electrical sector and household appliances and electrical installations, raceway systems and cable tray systems. ANCE develops Mexican Standards (NMX) and collaborates in the development of Mexican Official Standards (NOM); these are voluntary and normative standards, respectively.

Conformity assessment in accordance with ANCE Mexican Standards is the responsibility of ANCE's Product Certification Division.

ANCE's Product Certification Division is accredited by the EMA (Entidad Mexicana de Acreditación) to certify a variety of products. Certification is carried out following the relevant procedures established and developed by the Technical Committee on Certification in connection with the test reports produced in test labs accredited by the EMA.

The conformity assessment activities developed by ANCE cover quality systems, test labs, and product verification.

Foreword (CSA)

The Canadian Standards Association (CSA) develops standards under the name Canadian Standards Association, and provides certification and testing under the name CSA International. CSA International provides certification services for manufacturers who, under license from CSA, wish to use the appropriate registered CSA Marks on certain products of their manufacture to indicate conformity with CSA Standards.

CSA Certification for a number of products is provided in the interest of maintaining agreed-upon standards of quality, performance, interchangeability and/or safety, as appropriate. Where applicable, certification may form the basis for acceptance by inspection authorities responsible for enforcement of regulations. Where feasible, programs will be developed for additional products for which certification is desired by producers, consumers, or other interests. In performing its functions in accordance with its objectives, CSA does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of the Association represent its professional judgement given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed.

Products in substantial accord with this Standard but which exhibit a minor difference or a new feature may be deemed to meet the Standard providing the feature or difference is found acceptable utilizing appropriate CSA International Operating Procedures. Products that comply with this Standard shall not be certified if they are found to have additional features which are inconsistent with the intent of this Standard. Products shall not be certifiable if they are discovered to contravene applicable laws or regulations.

Testing techniques, test procedures, and instrumentation frequently must be prescribed by CSA International in addition to the technical requirements contained in Standards of CSA. In addition to markings specified in the Standard, CSA International may require special cautions, markings, and instructions that are not specified by the Standard.

Some tests required by CSA Standards may be inherently hazardous. The Association neither assumes nor accepts any responsibility for any injury or damage that may occur during or as the result of tests, wherever performed, whether performed in whole or in part by the manufacturer or the Association, and whether or not any equipment, facility, or personnel for or in connection with the test is furnished by the manufacturer or the Association.

Manufacturers should note that, in the event of the failure of CSA International to resolve an issue arising from the interpretation of requirements, there is an appeal procedure: the complainant should submit the matter, in writing, to the Secretary of the Canadian Standards Association.

If this Standard is to be used in obtaining CSA Certification please remember, when making application for certification, to request all current Amendments, Bulletins, Notices, and Technical Information Letters that may be applicable and for which there may be a nominal charge. For such information or for further information concerning CSA Certification, please address your inquiry to Applications and Customer Service, CSA International, 178 Rexdale Boulevard, Toronto, Ontario, Canada M9W 1R3.

Foreword (UL)

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

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

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

D. A product employing materials or having forms of construction which conflict with specific requirements of the Standard cannot be judged to comply with the Standard. A product employing materials or having forms of construction not addressed by this Standard may be examined and tested according to the intent of the requirements and, if found to meet the intent of this Standard, may be judged to comply with the Standard.

E. UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of UL represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed. UL shall not be responsible to anyone for the use of or reliance upon this Standard by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of, or reliance upon this Standard.

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

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

ASME[1] Standards

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

ASME B94.1M-1993,
Twist Drills

ASTM[2] 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

ISO[3] Standard

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

NFPA[4] 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.

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.

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.

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.

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.

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 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 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 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.

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.

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 mm^2), 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.

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 mm^2), 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 7.17, 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.

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.

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.

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.

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 mm^2), 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.

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 mm^2), 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 mm^2), 2-wire cable shall be marked with the diameter of the No. 14 AWG (2.08 mm^2), 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 for which it is intended to be used. The following markings shall be used:

a) ″Metal-Clad Interlocking Armor Cable Type″ or ″MCI″,

b) ″Metal-Clad Continuous Smooth Sheath Armor Cable Type″ or ″MCS″,

c) ″Metal-Clad Continuous Corrugated Sheath Armor Cable Type″ or ″MCC″, and

d) ″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 (⏚) (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 In Mexico and the United States, a FITTING for use with flexible metal conduit in the 1 (27) or larger trade size shall comply with the current test described in Clause 8.9 and shall be marked ″Grounding Type″ or ″GRND″ or with the symbol for grounding (⏚) (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.

7.16 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.″

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 ±1°C (194 ±2°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.

8.2.6 A Tirrill gas burner to which a gas pilot light is attached shall supply the test flame. The barrel of the burner shall extend 102 mm (4 in) above the air inlets and its inside diameter shall be 9.5 mm (3/8 in). While the barrel is vertical, the overall height of the flame shall be adjusted to 127 mm (5 in). The blue inner cone shall be 38 mm (1-1/2 in) high. Without disturbing the adjustments for the height of the flame, the valves supplying gas to the burner and pilot flames shall be closed.

8.2.7 A wedge to which the base of the burner is secured shall be provided for tilting the barrel 20 degrees from the vertical, while the longitudinal axis of the barrel remains in a vertical plane. The burner shall be secured to the wedge and the assembly shall be placed in an adjustable jig that is attached to the floor of the enclosure. The jig shall be adjusted laterally (see Figure 3) to place the longitudinal axis of the barrel in the same vertical plane as the vertical axis of the sample. The plane shall be parallel to the sides of the enclosure.

8.2.8 The jig shall also be adjusted toward the rear or front of the enclosure (see Figure 3) to position point A 38.1 mm (1-1/2 in) from point B at which the extended longitudinal axis of the barrel meets the front surface of the sample. Point A is the intersection of the longitudinal axis of the barrel with the plane of the tip of the barrel. Point B is the point at which the tip of the inner blue cone touches the plaque or finished sample. The plaque or finished sample shall be adjusted vertically to place point B at the center of the plaque or finished sample.

8.2.9 The gas shall be 37 Mj/m^3 (993.04 Btu/ft^3) at normal pressure (76 – 127 mm (3 – 5 in) of water). The valve supplying gas to the pilot shall be opened and the pilot flame lit. The valve supplying gas to the burner shall be opened to apply the flame to the sample automatically. This valve shall be held open for 15 seconds and then closed for 15 seconds. This procedure shall be repeated four times for a total of five applications of flame to the plaque or finished sample.

8.3 Elastomeric materials hardness test

8.3.1 Six samples of each elastomeric material, other than a thermoplastic ELASTOMER, shall be conditioned as described in Clause 8.3.2. As a result of the conditioning, the material shall not crack or show a change in hardness of more than ten numbers.

8.3.2 The hardness of the unaged material shall be determined as the average of five readings using a gauge such as the Rex hardness gauge or the Shore durometer. The samples shall be conditioned for 70 hours at a temperature of 100 ±1°C (212 ±2°F) in a full-draft air-circulating oven that has been preheated at full draft. After conditioning, the component shall be cooled to room temperature for not less than 4 hours, and the hardness shall then be determined again as the average of five readings.

8.4 Wire pull test

8.4.1 Conductors shall be pulled through one sample of each trade size of an ANGLE FITTING, CONDUIT BODY, or short radius CONDUIT BODY as described in Clauses 8.4.2 – 8.4.7. After the pull, the insulation of the conductors:

a) shall not show visible damage, and

b) shall comply with Clauses 8.4.6 and 8.4.7.

8.4.2 Three 1.8 m (6 ft) conductors shall be pulled, as a group, through the FITTING. The conductors shall be:

a) type THHN or T90 Nylon for a FITTING for use with 1/2 or 3/4 (16 or 21) trade size conduit or tubing, and

b) type XHHW or RW90 XLPE for a FITTING for use with 1 – 4 (27 – 103) trade size conduit or tubing.

If wire pulling compound is used, the product or smallest unit shipping carton shall be marked in accordance with Clause 7.10.3. The conductors used for the test shall be of the most rigid type.

Note: The most rigid types are as indicated in item a) for the 1/2 (16) and 3/4 (21) trade sizes of conduit or tubing, and as indicated in item b) for the 1 (27) – 4 (103) trade size conduit or tubing.

8.4.3 The size of conductor used shall be as specified in the respective national installation codes for the trade size of conduit or tubing with which the FITTING is intended to be used.

8.4.4 An ANGLE FITTING shall be secured with a LOCKNUT as intended to an outlet box or an equivalent steel plate. A 457 mm (18 in) section of the conduit or tubing that the FITTING is intended to be used with shall be secured to the FITTING. The open end of the conduit or tubing shall be protected by a BUSHING. The wires shall be pulled through the conduit or tubing and the FITTING into the outlet box. The use of blunt tools to direct the wires complies with this requirement.

8.4.5 In Mexico and the United States, a 457 mm (18 in) section of conduit shall be secured to each of two conduit openings of a FITTING, such as a CONDUIT BODY. The conductors shall be pulled through the bottom or side conduit and out through the CONDUIT BODY cover opening. Additionally, the conductors shall be rigidly secured to the open end of the first conduit, to inhibit the conductors from exiting back through the first conduit during the pull through the second conduit. Before pulling through the second conduit, a training loop shall be formed. The conductors shall then be pulled through the second conduit. When the starting end of the conductor bundle begins to exit the second conduit, the training loop shall be removed. The conductors shall then be pulled one conductor at a time to remove the remaining length of the conductor.

In Canada, this requirement does not apply.

8.4.6 After being pulled, the insulation on the wires shall withstand for 5 minutes without breakdown the application of a 60-hertz, sinusoidal potential of 2500 volts rms.

8.4.7 Compliance with Clause 8.4.6 shall be determined by applying the test potential between the conductor and:

a) aluminum foil that is wrapped around, and in contact with, the insulation, or

b) a volume of water containing the wire, FITTING, and conduit section.

8.5 Metallic-coating thickness test

8.5.1 Other than as specified in Clause 8.5.2, the metallic-coating thickness test described in Clauses 8.5.3 – 8.5.10 shall be used to determine the thickness of a zinc coating. Three samples in a series of trade sizes having the same coating shall be tested. The test shall only be performed when a required coating thickness is specified.

8.5.2 Use of a nondestructive test method to determine the thickness of a zinc coating complies with the intent of the requirement in Clause 8.5.1.

Whenever referee measurements are required, the test described in Clauses 8.5.3 – 8.5.10 shall be used.

8.5.3 A solution of distilled water containing 200 grams per liter of reagent grade chromic acid (C_rO_3) and 50 grams per liter of reagent grade concentrated sulfuric acid (H_2SO_4) shall be used for the test. The latter is equivalent to 27 milliliters per liter of reagent grade concentrated sulfuric acid, specific gravity 1.84, containing 96 percent of H_2SO_4.

8.5.4 The test solution shall be contained in a glass vessel such as a separatory funnel with the outlet equipped with a stopcock and a capillary tube having an inside bore of 0.64 mm (0.025 in) and a length of 140 mm (5.5 in). The lower end of the capillary tube shall be tapered to form a tip, the drops from which are about 0.05 ml (0.0018 fl oz) each. As an alternate means, to preserve an effectively constant level, a small glass tube shall be inserted in the top of the funnel through a rubber stopper, and its position shall be adjusted to control the rate of dropping.

8.5.5 The sample and the test solution shall be kept in the test room long enough to acquire the temperature of the room, which shall be recorded. The test shall be performed at a room temperature of 21.1 – 32.2°C (70 – 90°F).

8.5.6 Each sample shall be thoroughly cleaned before testing. All grease, lacquer, paint, and other nonmetallic coatings shall be removed completely by means of solvents. Samples shall then be thoroughly rinsed in water and dried with clean cheesecloth. The cleaned surface shall not be contacted by hands or any foreign material.

8.5.7 The sample to be tested shall be supported 18 – 25 mm (0.7 – 1.0 in) below the orifice, so that the drops of solution strike the point to be tested and run off quickly. The surface to be tested shall be inclined 45 degrees from horizontal.

8.5.8 After cleaning, the sample to be tested shall be put in place under the orifice. The stopcock shall be opened and the time in seconds shall be measured with a stopwatch until the dropping solution dissolves the protective metallic coating, exposing the base metal. The end point shall be the first appearance of the base metal, recognizable by the change in color at that point.

8.5.9 Each sample of a test lot shall be subjected to the test at three or more points, excluding cut, stenciled, and threaded surfaces, and the inside surface, and the test shall be performed at an equal number of points on the outside surface.

8.5.10 The thickness in mm (in) of the coating being tested shall be calculated by multiplying 0.0003 mm (0.00001 in) by the thickness factor from Table 20 that corresponds to the temperature at which the test is being performed. The product of these two factors shall then be multiplied by the time in seconds required to expose the base metal as measured in Clause 8.5.8.

8.6 Wet locations (rain-tight) test

8.6.1 Two samples of each trade size of a FITTING intended for use in a wet location shall be tested as described in Clauses 8.6.3 and 8.6.4. As a result of the test, no amount of water greater than 0.1 ml or 0.1 g shall enter the FITTING. See Clause 7.1.5 and Table 19.

8.6.2 Prior to assembly, dry absorbent paper shall be placed in a resealable container. The paper and the sealed container shall be weighed. The paper shall then be removed from the container and placed in the interior of the enclosure at the point where the FITTING interfaces with the electrical enclosure and also where it interfaces with the cable, conduit, or tubing. A threaded end cap shall be used in place of the enclosure for a FITTING that is intended for securement to a threaded HUB only and marked in accordance with Clause 7.11.1.

8.6.3 The FITTING shall be assembled and vented to atmosphere to equalize the pressure during the test. The assembly shall be mounted under the apparatus described in Clause 8.6.4 and illustrated in Figure 4. The water spray shall be applied for 1 hour.

8.6.4 The water spray apparatus shall consist of three spray heads constructed in accordance with the details illustrated in Figure 5 and mounted in a water supply pipe rack as illustrated in Figure 4. The water pressure shall be maintained at each spray head at 34.47 kPa (5 psi). The distance between the center nozzle and the product shall be 1.52 m (5 ft). The product shall be brought into the focal area of the three spray heads in such a position and under such conditions that water enters when the FITTING is in its normal mounting position.

8.6.5 Immediately following the water spray, the outside of the test assembly shall be wiped dry. The test assembly shall then be disassembled. The absorbent paper shall be removed and placed in the container. The container shall then be resealed and weighed. The difference between the weight of the paper before and after the test shall be used to determine the quantity of water.

8.7 Concrete-tightness test

8.7.1 Two samples of each trade size of a concrete-tight FITTING shall be tested as described in Clauses 8.7.2 – 8.7.5. As a result of the test, concrete aggregate (Portland-type gray cement, and sand) shall not enter the FITTING, outlet box, conduit, or tubing used in the test assembly.

8.7.2 A concrete-tight FITTING shall be assembled in the intended manner to a concrete-tight outlet box and a short length of the conduit or tubing that it is intended to be used with. A concrete-tight COUPLING shall be assembled in the intended manner to two short lengths of the conduit or tubing that it is intended to be used with. The conduit or tubing shall be pushed against an end or centering stop of a FITTING before the FITTING is tightened in accordance with Clause 6.1. A slotted or unslotted bolthead screw shall be tightened with a torque of 118.1 N•m (160 lbf-in). The ends of the conduit shall be sealed. The FITTING assembly shall be secured to the bottom of the formwork used to contain the concrete. A COUPLING assembly shall be supported between 25.4 and 50.8 mm (1 and 2 in) above the bottom of the formwork. The formwork shall be filled with concrete prepared in accordance with Clause 8.7.3. The concrete shall be vibrated immediately after it is poured using a vibrator in accordance with Clause 8.7.4. The assembly shall be tested in accordance with Clause 8.7.5. Twenty-four hours after the concrete has been poured, it shall be broken loose from the assembly, and the interior of the FITTING, outlet box, and conduit or tubing shall be examined.

8.7.3 Portland-type gray cement shall be used in the preparation of the concrete for the test required by Clause 8.7.1. The sand shall be of the type known to the construction industry as mason sand. The cement-sand ratio shall be 1:2 by volume, and there shall be a 1.6 mm (1/16 in) deep film of water on the surface of the mixture after it has stood for 1 minute in the mixing vat.

8.7.4 The concrete shall be vibrated with an internal type vibrator that operates between 13,500 and 15,000 vibrations per minute in free air. The vibrator head shall have:

a) a circumference not less than 95 mm (3.75 in) and not greater than 140 mm (5.5 in), and

b) a length not less than 356 mm (14 in) and not greater than 406 mm (16 in).

A set-screw FITTING of the 1/2 – 2 (16 – 53) trade size is not required to be vibrated during the concrete-tightness test when the FITTING is intended to be installed in the field at a depth of concrete that is 610 mm (2 ft) or less.

8.7.5 The assembly shall be covered with a minimum of 610 mm (2 ft) of concrete. The vibrator head shall be placed into the concrete so that:

a) its major axis is vertical, and

b) its free end is within 25.4 mm (1 in) of the bottom of the formwork and within 25.4 mm (1 in) of the assembly.

The head shall then be withdrawn at a rate not less than 25.4 mm (1 in) per second and not more than 50.8 mm (2 in) per second. This procedure shall be repeated until all of the concrete has been vibrated as indicated by an overlap of vibration patterns over the entire surface. The vibrator shall not come in contact with the assembly or the formwork. The total vibration time shall be 10 seconds per cubic foot of concrete used.

8.8 Resistance test

8.8.1 The resistance between the points specified in Clause 8.8.2 shall not be greater than that specified in the individual requirements for the FITTING. The resistance shall be determined by passing a direct current of 30 amperes through the FITTINGS and connections between the FITTING and the conduit, tubing, cable, box, or enclosure to which the FITTING is assembled. For a CONNECTOR, a threaded COUPLING or a plate used to simulate a box shall be allowed to be used for the test.

8.8.2 For a COUPLING, the voltage drop shall be measured between two points, one on each section of the conduit, tubing, or cable. For a CONNECTOR, the voltage drop shall be measured between a point on the conduit, tubing, or cable and a point on the box, enclosure, or threaded COUPLING used to simulate a box. The point on the box, enclosure, or threaded COUPLING shall be 1.6 mm (1/16 in) from the FITTING. The point on the conduit, tubing, or cable shall be 1.6 mm (1/16 in) from the FITTING or the contact point between the FITTING and the conduit, tubing, or cable.

8.9 Current test

8.9.1 Three samples of each FITTING shall be tested as described in Clauses 8.9.2 – 8.9.6. A FITTING shall carry the specified current for the time indicated in Table 21. As a result of the test, the FITTING shall not crack or break, and there shall be continuity between the enclosure, FITTING, and raceway following the test. A throat insulator complies where the insulator arcs and burns as a result of the test.

8.9.2 Each FITTING shall be assembled to a minimum 152 mm (6 in) length of raceway of the intended size and an unpainted, plated or unplated, steel enclosure (as shown in Figure 6) or steel plate simulating an enclosure (as shown in Figure 7). A FITTING for metal-clad cable shall be tested with smooth-sheath or continuous-corrugated cable. The thickness of the enclosure or plate shall be as specified in Clauses 8.9.4 and 8.9.5.

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

8.9.3 A LOCKNUT shall be hand-tightened and then further tightened 1/4 turn with a hammer and a standard screwdriver or by an equivalent method. A copper wire lead, not less than 610 mm (2 ft) long, shall be connected:

a) to the enclosure by a pressure wire CONNECTOR, and

b) to the raceway, 0.8 mm (1/32 in) from the FITTING, by a ground clamp that is sized accordingly.

Pressure wire CONNECTORS shall be tightened using the torque specified in Table 22. The test current shall be passed through the wire and assembly.

8.9.4 For 3/8 – 1-1/4 (12 – 35) trade sizes, a FITTING shall be tested with:

a) a steel enclosure or plate of thickness 1.35 – 1.40 mm (0.053 – 0.055 in) at the currents specified in Table 21, and

b) a steel enclosure or plate of thickness 0.66 – 0.71 mm (0.026 – 0.028 in) at 470 amperes for 4 seconds.

A FITTING of the 3/8 – 1-1/4 (12 – 35) trade sizes shall be allowed to be tested with only a steel enclosure or plate of 0.66 – 0.71 mm (0.026 – 0.028 in) thickness when the FITTING is tested at the currents and for the times specified in Table 21.

8.9.5 For 1-1/2 – 6 (41 – 155) trade sizes, a FITTING shall be tested with a steel enclosure or plate of 1.35 – 1.40 mm (0.053 – 0.055 in) thickness in accordance with Table 21.

8.9.6 After having carried the test current, continuity shall exist between the parts of the test assembly when measured between a point on the raceway and a point on the enclosure 6.4 mm (1/4 in) from the FITTING. An indicating device, such as an ohmmeter or battery-and-buzzer combination, shall be used to determine whether continuity exists.

8.10 THREADLESS FITTINGS for non-flexible metallic raceways

8.10.1 General

8.10.1.1 One as-received sample of each trade size of a THREADLESS FITTING for electrical metallic tubing that employs a set screw shall be subjected to the deformation test in Clause 8.10.2.

8.10.1.2 Six as-received samples of each trade-size of a THREADLESS FITTING shall be subjected to the following test sequence:

a) assembly test, Clause 8.10.3, followed by,

b) resistance test, Clause 8.10.4, followed by,

c) bend test, Clause 8.10.5, followed by,

d) repeated resistance test, Clause 8.10.6, followed by,

e) pull test, Clause 8.10.7.

The same samples shall be used throughout the test sequence.

8.10.2 Deformation test

8.10.2.1 A THREADLESS FITTING for electrical metallic tubing, when installed as intended, shall not decrease the internal diameter of the tubing by more than 15 percent, and the end of the tubing shall not be deformed when installed with the tubing displaced 6.4 mm (1/4 in) from the end stop. Compliance shall be determined by the insertion of a plug ″go″ gauge having a diameter as specified in Table 23.

8.10.2.2 The sample shall be assembled and tightened to the torque specified in Clause 6.2.2.

8.10.2.3 A bolt head screw capable of being tightened with or without a screwdriver shall be wrench-tightened to a torque of 18.1 N•m (160 lbf-in).

8.10.3 Assembly test

8.10.3.1 Samples of a THREADLESS FITTING for non-flexible metallic raceways shall be assembled in accordance with Clause 6.2.2. After assembly, the samples shall comply with Clause 6.1.1.

8.10.3.2 A THREADLESS FITTING provided with a compression nut shall have the tightening torque applied by means of an open, box, or crescent wrench. When a compression nut is not provided with flats for use with such wrenches, the nut shall be tightened by means of a pipe wrench in accordance with Clause 6.1.

8.10.4 Resistance test

8.10.4.1 A THREADLESS FITTING for non-flexible metallic raceways shall be subjected to the resistance test described in Clause 8.8. As a result of the test, the voltage drop shall not be greater than 10 millivolts.

8.10.5 Bending test

8.10.5.1 A THREADLESS FITTING for non-flexible metallic raceways shall be tested as described in Clause 8.10.5.2. As a result of the test, the FITTING shall not become separated from the conduit or tubing.

8.10.5.2 A THREADLESS FITTING shall be attached to two lengths of electrical metallic tubing or conduit and the assembly shall be placed across a 760 mm (30 in) span. The bending force specified in Table 24 shall be applied at the center of the assembly and in such a manner that the assembly of the FITTING and tubing or conduit is rotated as shown in Figure 8. The assembly shall be rotated through one complete revolution within 1 minute. For a CONNECTOR FITTING, the FITTING shall be attached to a COUPLING and the supports shall be separated an additional distance (more than the 760 mm) equal to the length of the COUPLING.

8.10.6 Repeated resistance test

8.10.6.1 Following the bending test in Clause 8.10.5, each test assembly shall be subjected to the resistance test described in Clause 8.8. As a result of the test, the voltage drop shall not be greater than 15 millivolts.

8.10.7 Pull test

8.10.7.1 A THREADLESS FITTING for non-flexible metallic raceways shall withstand a steady pull, as specified in Table 24, for 1 minute. Following the steady pull, the FITTING shall not be damaged and shall not pull loose from the raceway.

8.10.8 Submersion test

8.10.8.1 In Canada, in accordance with Clause 6.3.3.2, a sample of submersible THREADLESS FITTINGS shall not result in water seeping through the connection into conduit or electrical metallic tubing when it is connected to conduit or tubing in the intended manner and when the assembly is immersed in water to a depth of 1.8 m (5.9 ft) for a period of 30 min.

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

8.11 LIQUID-TIGHT FITTINGS for rigid metal conduit

8.11.1 Six samples of each trade size of a LIQUID-TIGHT FITTING for rigid metal conduit shall be subjected to the bending test described in Clause 8.10.5.2. As a result of the test, the FITTING shall not become separated from the conduit.

8.11.2 After the FITTING assembly has been subjected to the bending test, oil shall not enter inside the FITTING when the assembly is subjected for 30 minutes to the test described in Clause 8.26.4 or Clause 8.27.5. The ends of the conduit shall be sealed.

8.12 Threaded FITTINGS for rigid metal conduit and intermediate metal conduit (IMC)

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

8.12.1 CONDUIT LOCKNUTS

8.12.1.1 With reference to Clause 5.19.2, six pairs of each trade size of a CONDUIT LOCKNUT that are thinner than specified in Table 1 shall be assembled to threaded conduit and steel plates. The steel plates shall be assembled as illustrated in Figure 9. Each assembly shall comply with the sequence of tests specified in Clause 8.10.1.2.

8.12.1.2 With reference to Clause 5.19.3, a CONDUIT LOCKNUT having an incomplete or nonstandard thread shall freely thread onto conduit having threads complying with NMX-J-534-ANCE, CSA C22.2 No. 45, UL 6, or UL 6A without damage to the LOCKNUT or the threads of the conduit to which it is assembled.

8.12.2 HUBS

8.12.2.1 Six samples of each trade size of a HUB, when assembled in openings in surfaces of 1.59 mm (0.0625 in) thick metal, shall withstand the tightening torque specified in Clause 8.12.2.2 without turning in the opening, without stripping any threads, and without damaging the HUB.

8.12.2.2 The HUB shall be assembled in the enclosure opening in the intended manner, making use of a wrench or other tool, when required, to restrain that portion of the HUB from turning inside the enclosure. The enclosure shall be firmly supported or mounted in the intended manner, a short length of intermediate metal conduit or rigid metal conduit shall be threaded into the HUB, and the applicable tightening torque shall be applied to the conduit in a direction tending to tighten the conduit, with the lever arm measured from the center of the conduit. The tightening torque shall be 90.4 N•m (800 lbf-in) for 3/4 (21) and smaller trade sizes, 113 N•m (1000 lbf-in) for 1, 1-1/4, and 1-1/2 (27, 35, and 41) trade sizes, and 181 N•m (1600 lbf-in) for 2 (53) and larger trade sizes.

8.12.2.3 A HUB, assembled as described in Clause 8.12.2.2, shall not have a voltage drop of more than 10 millivolts as a result of the test described in Clause 8.8. The two test points specified in Clause 8.8.2 shall be on the conduit and on the outside of the enclosure.

8.12.2.4 A HUB intended for use in wet locations or with service-entrance conduit shall provide a rain-tight connection to the enclosure when assembled to the enclosure as described in Clause 8.12.2.2. Compliance of the assembly shall be determined by the test described in Clause 8.6.

8.12.3 Studs

8.12.3.1 A stud shall comply with Clauses 8.12.3.2 – 8.12.3.6. A new sample shall be used for each test. A stud intended for use with an outlet box shall be assembled to a standard octagonal outlet box for each test.

8.12.3.2 A stud and its attachment to a box, cover, or other device shall withstand a direct pull of 890 N (200 pounds) for 5 minutes. As a result of the direct pull, the assembly shall not pull apart or break.

8.12.3.3 A stud and its attachment to a box or cover shall withstand for 1 minute, without visible damage, the application of a load as specified in Table 25. The load shall be applied at the end of a 508 mm (20 in) rigid luminaire stem attached to the stud, with the stud assembly mounted in the intended manner on the under side of a platform that is at an angle of 30 degrees with the horizontal and that is able to be rotated about the axis of the luminaire stud. The platform shall be rotated for six complete revolutions during the test.

8.12.3.4 The load applied at the end of the stem shall be reduced by an amount that compensates for the bending moment due to the weight of the stem.

8.12.3.5 A stud and its attachment to a box or cover shall withstand the application of a torque having the value specified in Table 26 for 1 minute. As a result of the application of the torque, the assembly shall not show signs of visible damage or relative movement.

8.12.3.6 With reference to Clause 8.12.3.5, the stud shall be rigidly supported in the intended manner, and the torque shall be applied at the end of a lever arm attached to the stud or to an extension member which is in turn attached to the stud. The torque shall be applied in the direction tending to tighten the screw connections. The lever arm shall be measured from the axis of the stud to the point of application of the torque, and the lever arm shall be perpendicular to the axis of the stud.

8.13 FITTINGS for flexible metal conduit (FMC)

8.13.1 General

8.13.1.1 Six as-received samples of a flexible metal conduit FITTING shall be subjected to the following test sequence:

a) assembly test, Clause 8.13.2, followed by,

b) resistance test, Clause 8.13.3, followed by,

c) pull test, Clause 8.13.4, followed by,

d) repeated resistance test, Clause 8.13.5.

8.13.2 Assembly test

8.13.2.1 Samples of a FITTING for flexible metal conduit shall be assembled in accordance with Clause 8.14.2. The conduit shall have square ends. After assembly, the conduit shall not be punctured or deformed so that sharp edges are present in the wireway.

8.13.2.2 Samples of a FITTING for flexible metal conduit of the external type shall be assembled to the end of the flexible metal conduit that winds inside itself. Samples of a FITTING of the internal type shall be assembled to the end of the flexible metal conduit that winds outside itself. Each conduit sample shall be 0.3 m (12 in) long.

8.13.3 Resistance test

8.13.3.1 Samples of a FITTING for flexible metal conduit shall be subjected to the test described in Clause 8.8. As a result of the test, the voltage drop shall not be greater than 50 millivolts.

8.13.4 Pull test

8.13.4.1 Samples of a FITTING for flexible metal conduit shall secure the conduit so that the connection withstands a steady pull, as specified in Table 27, for 5 minutes. Following the steady pull, bending or flexing shall not remove the conduit.

8.13.4.2 Samples of a flexible metal conduit FITTING for multiple conduits, such as a duplex FITTING, shall be tested with conduit attached to each opening or section as intended. Each conduit shall be subjected to the pull specified in Clause 8.13.4.1, applied individually.

8.13.5 Repeated resistance test

8.13.5.1 Following the tests required by Clauses 8.13.4.1 and 8.13.4.2, each test assembly shall comply with Clause 8.13.3.1.

8.14 FITTINGS for armored cable

8.14.1 General

8.14.1.1 Six samples of a FITTING for armored cable shall be subjected to the following test sequence:

a) assembly test, Clause 8.14.2, followed by,

b) resistance test, Clause 8.14.3, followed by,

c) pull test, Clause 8.14.4, followed by,

d) repeated resistance test, Clause 8.14.5.

The same set of test samples shall be used throughout the test sequence.

8.14.2 Assembly test

8.14.2.1 Samples of a FITTING for armored cable shall be assembled in accordance with Clause 6.2.2. After assembly:

a) a FITTING shall not crack or break,

b) the thread of any clamping means shall not strip, and

c) the cable shall not be punctured or deformed so that sharp edges are present in the wireway.

8.14.2.2 Each FITTING shall be assembled to the end of armored cable that winds inside itself. For a FITTING intended to be used with a range of cable diameters, the FITTING shall be tested with the smallest and largest diameter cable in the range. A ±0.51 mm (0.020 in) tolerance for a cable not more than 19.1 mm (3/4 in) in diameter and a ±0.762 mm (0.030 in) tolerance for a cable more than 19.1 mm (3/4 in) in diameter, comply. The FITTING shall then be assembled to an outlet box as intended.

8.14.2.3 During assembly, the wires in armored cable shall project 152 mm (6 in) inside the box. Each cable shall be 305 mm (12 in) long, not including the 152 mm (6 in) of wire inside the box.

8.14.3 Resistance test

8.14.3.1 Samples of a FITTING for armored cable shall be subjected to the test described in Clause 8.8. As a result of the test, the voltage drop shall not be greater than 50 millivolts. The two test points specified in Clause 8.8.2 shall be between the box and armored cable as shown in Figure 10.

8.14.4 Pull test

8.14.4.1 Samples of a FITTING for armored cable shall secure the cable so that it withstands a steady pull, as specified in Table 27, for 5 minutes. Following the steady pull, bending or flexing shall not remove the conduit.

8.14.4.2 Samples of an armored-cable FITTING for multiple cables, such as a duplex FITTING, shall be tested with the cable attached to each opening or section as intended. Each cable shall be subjected to the pull specified in Clause 8.14.4.1, applied individually.

8.14.5 Repeated resistance test

8.14.5.1 Following the tests specified in Clauses 8.14.4.1 and 8.14.4.2, each test assembly shall comply with the requirement in Clause 8.14.3.1.

8.15 BUSHINGS for armored cable

8.15.1 Assembly test

8.15.1.1 Six samples of each size of a BUSHING for armored cable shall be assembled in accordance with Clause 8.15.1.2. The BUSHING shall be capable of being installed between the conductor and the armor without the use of tools. Following assembly, the BUSHING shall remain in place after the installation pressure is removed.

8.15.1.2 Samples of each size of BUSHING shall be tested. Each BUSHING shall be tested with a 457.2 mm (18 in) long piece of armored cable of the intended size. On three of the pieces of cable, 51 mm (2 in) of armor shall be removed from the end of the cable in which the armor wraps on the outside of itself. On the remaining three pieces of cable, 51 mm (2 in) of armor shall be removed from the end of the cable in which the armor wraps on the inside of itself. The fibrous covering on the 51 mm (2 in) of exposed conductor in all six pieces of cable shall also be removed. The BUSHING shall be inserted between the conductors and the armor at the end where the armor and covering have been removed.

8.15.2 Accelerated aging test

8.15.2.1 Six samples of each size of a BUSHING for armored cable shall be subjected to the test described in Clause 8.15.2.2. After conditioning, the BUSHING shall not crack when closed to form a complete circle.

8.15.2.2 A BUSHING as described in Clause 8.15.2.1 shall be conditioned for 168 hours at a temperature of 112 ±1°C (234 ±2°F) in a full-draft air-circulating oven that has been preheated at full draft. After the conditioning, the samples shall then be cooled to room temperature for not less than 4 hours before being handled and examined.

8.15.3 Low temperature test

8.15.3.1 Six samples of each size BUSHING for armored cable shall be conditioned as specified in Clause 8.15.3.2. After the conditioning, the BUSHING shall not crack when closed to form a complete circle within 15 seconds after being conditioned.

8.15.3.2 A BUSHING as described in Clause 8.15.3.1 shall be conditioned for 4 hours at a temperature of minus 40 ±1°C (minus 40 ±2°F).

8.15.4 Dielectric voltage-withstand test

8.15.4.1 A BUSHING for armored cable shall be subjected to the test described in Clause 8.15.4.2. As a result of the test, the BUSHING shall withstand the test potential without electrical breakdown.

8.15.4.2 Six samples of each size of a BUSHING for armored cable shall be used for the test. A 60-hertz sinusoidal potential of 1500 volts rms shall be raised gradually to the full value and applied for one minute to each BUSHING. The potential shall be applied between two 6.3 mm (1/4 in) diameter brass balls. Each ball shall be supported by an adjustable rod. The BUSHING shall be placed between the brass balls, and the rods shall be adjusted until the balls fit snugly against the BUSHING.

8.16 FITTINGS for liquid-tight flexible metal conduit

8.16.1 General

8.16.1.1 Six samples of a FITTING for liquid-tight flexible metal conduit of each trade size shall be subjected to the following test sequence:

a) assembly test, Clause 8.16.2, followed by,

b) resistance test, Clause 8.16.3, followed by,

c) pull test, Clause 8.16.4, followed by,

d) repeated resistance test, Clause 8.16.5.

Two additional samples shall be subjected to the oil spray test described in Clause 8.16.6.

8.16.1.2 A FITTING of the 3/8 – 1-1/4 (12 – 35) trade size shall comply with the current test described in Clause 8.9 (see Clause 7.14.1).

8.16.2 Assembly test

8.16.2.1 The samples shall be assembled to a 305 mm (12 in) length of liquid-tight flexible conduit of the intended trade size in the manner specified by the manufacturer using the torque values specified in Table 15. Following the assembly, the samples shall comply with Clause 6.1.1.

8.16.3 Resistance test

8.16.3.1 A FITTING for liquid-tight flexible metal conduit shall be subjected to the test described in Clause 8.8. As a result of the test, the voltage drop shall not be greater than 50 millivolts.

8.16.4 Pull test

8.16.4.1 A FITTING for liquid-tight flexible metal conduit shall secure the conduit so that it withstands a steady pull as specified in Table 27 for 5 minutes. Following the steady pull, bending or flexing shall not remove the conduit.

8.16.5 Repeated resistance test

8.16.5.1 Following the test required by Clause 8.16.4.1, each test assembly shall comply with the requirement in Clause 8.16.3.1.

8.16.6 Oil spray test

8.16.6.1 Sample assemblies shall be subjected to the test described in Clause 8.16.6.2. As a result of the test, there shall not be evidence of oil inside the test enclosure.

8.16.6.2 The sample assembly of conduit and FITTING shall be assembled in the intended manner to an enclosure rated for use with oil in accordance with NMX-J-235/1-ANCE,NMX-J-235/2-ANCE, CAN/CSA C22.2 No. 94, or UL 50, and mounted in a fixed position. The sample shall be tested as described in Clause 8.26.4.2. The sample shall be subjected to the oil spray for 30 minutes. The ends of the conduit shall be sealed.

8.16.7 Elastomeric materials accelerated aging test

8.16.7.1 Six samples of a sleeve or ring of elastomeric material that is used to comply with Clause 8.16.6.1 shall be conditioned as described in Clause 8.3.2. As a result of the conditioning, the sleeve or ring shall not show visible signs of deterioration.

8.16.7.2 Six samples of a sleeve or ring of elastomeric material that fits over the outside of the tubing, and is exposed after installation on the tubing, shall comply with Clause 8.16.7.3 after conditioning as described in Clause 8.3.2.

8.16.7.3 Six samples of an elastomeric material used in a part that fits over the outside of the conduit and that is exposed after installation shall comply with Clause 8.16.7.1 and the following:

a) the tensile strength of the elastomeric material shall not decrease more than 25 percent, and

b) the elongation of the elastomeric material shall not decrease more than 35 percent.

8.16.7.4 Six samples of a sleeve or ring of elastomeric material shall not show a decrease of more than 40 percent in tensile strength or elongation after immersion in mineral oil for 18 hours at a temperature of 70 ±1°C (158 ±2°F).

8.16.8 Thermoplastic materials accelerated aging test

8.16.8.1 Six samples of a sleeve or ring of thermoplastic material shall be assembled in accordance with Clause 8.16.2.1 and conditioned in accordance with Clause 8.16.8.2. After conditioning, the sleeve or ring shall comply with Clause 8.16.4.1.

8.16.8.2 The test specified in Clause 8.16.8.1 shall be performed on previously untested samples. If agreeable to those concerned, the test shall be performed on the same samples used for the test specified in Clause 8.16.6.1. The sleeve or ring shall be conditioned for 168 hours at a temperature of 100 ±1°C (212 ±2°F) in an full-draft air-circulating oven that has been preheated at full draft. The samples shall return to room temperature before the pull specified in Clause 8.16.4.1 is applied.

8.17 FITTINGS for flexible metallic tubing

8.17.1 General

8.17.1.1 In Mexico and the United States, the requirements in Clauses 8.17.1.2 – 8.17.9.2 apply.

In Canada, the requirements in Clauses 8.17.1.2 – 8.17.9.2 do not apply.

8.17.1.2 Six samples of flexible metallic tubing FITTINGS of each trade size shall be subjected to each test sequence specified in Table 28. Two additional samples, or two of those used for Test Sequence A or Test Sequence B, shall comply with Clause 8.17.7.

8.17.2 Assembly test

8.17.2.1 Flexible metallic tubing FITTINGS shall be assembled to 915 mm (36 in) lengths of flexible metallic tubing of the intended trade size in the manner specified by the manufacturer. For screw-in CONNECTORS, the tubing shall be within 0.08 mm (0.003 in) of the maximum inside diameter of the tubing. After assembly, the samples shall comply with Clause 6.1.1. See Clause 7.1.5.

8.17.2.2 For CONNECTORS assembled to the outside of the tubing, the tubing shall be within 0.13 mm (0.005 in) of the minimum outside diameter of the tubing.

8.17.2.3 Samples of flexible metallic tubing FITTINGS of the external type shall be assembled to the end of the flexible metallic tubing that winds inside itself. Sample FITTINGS of the internal type shall be assembled to the end of the flexible metallic tubing that winds outside itself.

8.17.3 Resistance test

8.17.3.1 A FITTING for flexible metallic tubing shall be subjected to the resistance test described in Clause 8.8. As a result of the test, the voltage drop shall not be greater than 50 millivolts.

8.17.4 Flexing test

8.17.4.1 A sample assembly of tubing and FITTING shall be subjected to the flexing test described in Clause 8.17.4.2. As a result of the test, the sample shall remain secure.

8.17.4.2 The FITTING shall be secured with the axis of the tubing in line with the axis of the FITTING and mounted vertically in a fixed position. Starting in a vertical position, the tubing shall be bent around a wooden form having a radius as specified in Table 29. The tubing shall be bent in one direction so that a 90-degree bend is formed. The wooden form shall then be positioned on the opposite side of the tubing. The tubing shall then to be bent 180 degrees in the opposite direction, and then back to its original position in line with the axis of the FITTING.

8.17.5 Pull test

8.17.5.1 A sample assembly of FITTING and tubing shall withstand a direct pull of 667 N (150 lbf) between the FITTING and the tubing for 5 minutes. Following the steady pull, the assembly shall remain secure.

8.17.6 Repeated resistance test

8.17.6.1 Following the tests required by Clauses 8.17.4.1, 8.17.4.2, and 8.17.5.1, a sample assembly shall comply with the requirement in Clause 8.17.3.1.

8.17.7 Water spray test

8.17.7.1 A sample assembly of FITTING and tubing shall be subjected to the wet locations (rain-tight) test in Clause 8.6. As a result of the test, a joint of the assembly shall not allow the entrance of water.

8.17.8 Elastomeric materials accelerated aging test

8.17.8.1 Six samples of a sleeve or ring of elastomeric material that is used to comply with Clause 8.17.7.1 shall be conditioned as described in Clause 8.3.2. After conditioning, the sleeve or ring shall not show visible signs of deterioration.

8.17.8.2 A sleeve as specified in Clause 8.17.8.1 that fits over the outside of the tubing, and is exposed after installation on the tubing, shall comply with Clause 8.21.8.2 after being conditioned for 70 hours at a temperature of 100 ±1°C (212 ±2°F) in an full-draft air-circulating oven that has been preheated at full draft.

8.17.9 Thermoplastic materials accelerated aging test

8.17.9.1 Six samples of a sleeve or ring of thermoplastic material shall be assembled in accordance with Clause 8.17.2.1 and conditioned as described in Clause 8.17.9.2. After conditioning, the sleeve or ring shall comply with the pull test described in Clause 8.17.5.

8.17.9.2 The test shall be performed on previously untested samples. If agreeable to those concerned, the test shall be performed on the same samples used for the test specified in Clause 8.17.7.1. The sleeve or ring shall be conditioned for 168 hours at a temperature of 100 ± 1°C (212 ± 2°F) in a full-draft air-circulating oven that has been preheated at full draft. The samples shall return to room temperature before the pull specified in Clause 8.17.5.1 is applied.

8.18 FITTINGS for liquid-tight flexible nonmetallic conduit

8.18.1 General

8.18.1.1 Six as-received samples of a FITTING for liquid-tight flexible nonmetallic conduit of each trade size shall be subjected to the following test sequence:

a) assembly test, Clause 8.18.2, followed by,

b) pull test, Clause 8.18.3.

8.18.1.2 Two additional samples shall be subjected to the oil spray test in Clause 8.18.4, and two separate additional samples shall be subjected to the ultraviolet light and water test in Clause 8.26.7.

A FITTING molded from a material that complies with the requirements for ultraviolet light and water exposure in Clause 8.26.7.2 is not required to be tested as specified in Clauses 8.26.7.1 – 8.26.7.3.

8.18.2 Assembly test

8.18.2.1 Liquid-tight flexible nonmetallic conduit FITTINGS shall be assembled to 0.9 m (3 ft) lengths of liquid-tight flexible nonmetallic conduit of the intended trade size in the manner specified by the manufacturer. After assembly, the samples shall comply with Clause 6.1.1.

8.18.3 Pull test

8.18.3.1 A FITTING for liquid-tight flexible nonmetallic conduit shall secure the conduit so that the connection withstands a steady pull, as specified in Table 27, for 5 minutes. Following the steady pull, bending or flexing shall not remove the conduit.

8.18.4 Oil spray test

8.18.4.1 Sample assemblies shall be subjected to the test described in Clause 8.18.4.2. As a result of the test, there shall not be evidence of oil inside the test enclosure.

8.18.4.2 The sample assembly of conduit and FITTING shall be assembled in the intended manner to an enclosure rated for use with oil in accordance with NMX-J-235/1-ANCE, NMX-J-235/2-ANCECAN/CSA C22.2 No. 94, or UL 50, and mounted in a fixed position. The sample shall be subjected to the test described in Clause 8.26.4.2. The sample shall be subjected to the oil spray for 30 minutes. The ends of the conduit shall be sealed.

8.18.5 Elastomeric materials accelerated aging test

8.18.5.1 Six samples of a sleeve or ring of elastomeric material that is used to comply with Clause 8.18.4.1 shall be conditioned as described in Clause 8.3.2. As a result of the conditioning, the sleeve or ring shall not show visible signs of deterioration.

8.18.5.2 Six samples of a sleeve or ring of elastomeric material that fits over the outside of the conduit, and is exposed after installation on the conduit, shall comply with Clause 8.18.5.3 after conditioning as described in Clause 8.3.2.

8.18.5.3 Six samples of an elastomeric material used in a part that fits over the outside of the conduit and that is exposed after installation shall comply with Clause 8.18.5.1 and the following:

a) the tensile strength of the elastomeric material shall not decrease more than 25 percent, and

b) the elongation of the elastomeric material shall not decrease more than 35 percent.

8.18.5.4 Six samples of a sleeve or ring of elastomeric material shall not show a decrease of more than 40 percent in tensile strength or elongation when immersed in mineral oil for 18 hours at a temperature of 70 ±1°C (158 ±2°F).

8.18.6 Thermoplastic materials accelerated aging test

8.18.6.1 Six as-received samples of a sleeve or ring, as described in Clause 8.18.5.1, of thermoplastic material shall be assembled in accordance with Clause 8.18.2.1. The assembly shall then be subjected to the test described in Clause 8.18.6.2. After conditioning, the sleeve or ring shall comply with the pull test described in Clause 8.18.3.1.

8.18.6.2 The test shall be performed on previously untested samples. If agreeable to those concerned, the test shall be performed on the same samples used for the test specified in Clause 8.18.4.1. The sleeve or ring shall be conditioned for 168 hours at a temperature of 100 ±1°C (212 ±2°F) in a full-draft air-circulating oven that has been preheated at full draft. The samples shall return to room temperature before the pull specified in Clause 8.18.3.1 is applied.

8.19 FITTINGS for flexible nonmetallic tubing

8.19.1 General

8.19.1.1 In Mexico and the United States, the requirements of Clauses 8.19.2.1 and 8.19.2.2 apply.

In Canada, the requirements of Clauses 8.19.2.1 and 8.19.2.2 do not apply.

8.19.2 Pull test

8.19.2.1 A FITTING for flexible nonmetallic tubing shall secure the tubing, with one wire in place as in actual service. Six as-received sample assemblies of tubing and wire shall withstand a steady pull of 133 N (30 pounds) in a direction that pulls the wire into the FITTING and a direction that pulls the wire out of the FITTING for 5 minutes. Following the steady pull applied in the specified directions, bending or flexing shall not remove the assembly of tubing. The pull shall be applied between the tubing and a box in which the FITTING is mounted in the intended manner.

8.19.2.2 The tubing to be employed in performing the test described in Clause 8.19.2.1 shall be standard 5.56 mm (7/32 in) flexible nonmetallic tubing. Type TW or THW, No. 14 AWG (2.08 mm^2) wire shall be used, and shall project 152 mm (6 in) inside the box.

8.20 Polyvinyl chloride (PVC) CONDUIT BODIES

8.20.1 General

8.20.1.1 In Mexico and the United States, the requirements of Clauses 8.20.1.2 – 8.20.12.11, Tables 30 and 31, and Figure 11 apply.

In Canada, the requirements in Clauses 8.20.1.2 – 8.20.12.11, Tables 30 and 31, and Figure 11 do not apply.

8.20.1.2 When a PVC CONDUIT BODY differs from the construction requirements specified in Clause 5.7 and the applicable requirements in Clause 5.8, tests other than, or in addition to, those specified in Clauses 8.20.2.1 – 8.20.12.11 shall be performed to determine compliance of the different construction. Among the factors that shall be investigated are:

a) installation,

b) resistance to arcing,

c) dimensional stability, and

d) resistance to the corrosive or degrading effects of reagents.

8.20.2 Water absorption test

8.20.2.1 A PVC CONDUIT BODY shall be subjected to the test described in Clause 8.20.2.2. As a result of the test, the CONDUIT BODY shall not absorb more water than 0.5 percent of its weight.

8.20.2.2 The CONDUIT BODY shall be cut into three samples. The samples shall be cleaned and dried in a desiccator for 24 hours. Each sample shall be weighed and then immersed in water for 24 hours at a temperature of 23 ±2°C (73 ±4°F). After removal from the water, each sample shall be dried with a clean piece of soft, lint-free cloth to remove all surface water and re-weighed.

8.20.3 Flammability test

8.20.3.1 A PVC CONDUIT BODY shall be subjected to the test described in Clause 8.20.3.2. As a result of the test, the CONDUIT BODY:

a) shall not continue to flame for more than 5 seconds after the third application of the test flame;

b) shall not have flaming particles drop or fall from the body during or after any application of the test flame; and

c) shall not be entirely consumed during or after any application of the test flame.

8.20.3.2 Each sample CONDUIT BODY shall be subjected to the test described in Clause 8.2.4 and Clauses 8.2.6 – 8.2.9. The valve supplying the gas shall be opened for 1 minute and closed for 30 seconds for each of three applications of the test flame. The test sample shall be located so that the test flame is directed at the center of the largest surface.

8.20.3.3 When the CONDUIT BODY is too large to be tested in the chamber described in Clause 8.2.4, the CONDUIT BODY shall be tested in a chamber that is constructed as described in Clause 8.2.4 with proportionately larger dimensions.

8.20.4 Heat-distortion test

8.20.4.1 A PVC CONDUIT BODY shall be subjected to the test described in Clause 8.20.4.2. As a result of the test, there shall not be a change in any dimension greater than 15 percent for a PVC CONDUIT BODY, cracks or openings in a CONDUIT BODY, or openings wider than 1.6 mm (1/16 in) between a CONDUIT BODY and its cover.

8.20.4.2 Three as-received samples shall be conditioned for 1 hour at a temperature of 92 ±1°C (198 ±2°F) in a full-draft air-circulating oven that has been preheated at full draft. Samples shall be supported in the oven so that they do not touch each other or the sides of the oven. A CONDUIT BODY shall be tested with its blank cover in place.

8.20.5 Extrusion or molding-process test

8.20.5.1 The surface of one sample of a PVC CONDUIT BODY shall not exhibit any evidence of incomplete fusion after immersion of the finished product in reagent grade anhydrous acetone.

8.20.5.2 The acetone specified in Clause 8.20.5.1 shall not absorb moisture. The test shall be performed with each sample in its own covered container. With attention to the health and fire risks involved, a sample of the CONDUIT BODY shall be immersed in reagent grade anhydrous acetone for 5 minutes at a temperature of 23 ±2°C (73 ±4°F) and then examined. Acetone is not effective for this test if it absorbs moisture. In case of absorption, the acetone shall be allowed to be dehydrated by filtering it through anhydrous calcium sulfate, $CaSO_4$.

Note: Acetone [diethyl keytone, $(CH_3)_2CO$] is an extremely volatile liquid, the vapors of which can form explosive mixtures with air. Do not expose the acetone specified in Clause 8.20.5.1 to open flames, glowing cigarettes, and other sources of ignition. Acetone and acetone-PVC products are toxic to humans if inhaled or absorbed through the skin or eyes.

8.20.5.3 A CONDUIT BODY does not comply with Clause 8.20.5.1 when there is flaking or peeling covering 50 percent or greater of the interior or exterior surfaces (see Note 2 of Figure 11) or in the event the CONDUIT BODY splits. The presence of a weld (bond) line that is not uniform in width and depth or that is positively recessed below adjacent surfaces – for example, shows a definite crack or separation in the material – does not comply (see Note 4 of Figure 11).

8.20.6 Identification test

8.20.6.1 The manufacturer's specified specific gravity and tolerance for polyvinyl chloride (PVC) material shall be verified using three samples, and shall be within the manufacturer's specified tolerance for the compound used.

8.20.7 Resistance to crushing test

8.20.7.1 The resistance to crushing of all sizes of CONDUIT BODIES shall be such that, when the CONDUIT BODIES are tested as described in Clauses 8.20.7.2 – 8.20.7.5, the minor axis shall retain at least 70 percent of its original inside diameter, and there shall not be evidence of buckling.

8.20.7.2 Samples for the test shall consist of circular sections cut from the socket end of six samples of molded CONDUIT BODIES, three of which have been conditioned as described in Clause 8.20.7.3 and three of which are unaged.

8.20.7.3 The samples shall be supported in a full-draft, air-circulating oven that has been preheated at full draft to a temperature of 113 ±1°C (235 ±2°F). The samples shall be supported so that they do not touch each other or the sides of the oven. The samples shall be conditioned for 168 hours at full draft and then cooled gradually for 16 to 96 hours in still air before being handled.

8.20.7.4 Prior to application of the load, measurements shall be made of the internal diameters of the test samples. Each sample shall be placed with its longitudinal axis horizontal between two rigid, flat, parallel, steel plates that are at least as long as the sample. The load shall be applied to the center of the upper plate by means of a machine, the jaws of which close at the rate of 12.7 mm (1/2 in) per minute.

8.20.7.5 The load shall be increased until the load value specified in Table 30 is attained. Measurement of the minor axis of the inside dimension shall be made at the instant the load is attained. Observations for buckling shall be made at the points at which the sample is in contact with the test plates. Buckling shall be determined to have occurred when a surface of the sample in contact with a test plate starts to pull away from the plate. The load shall then be released immediately.

8.20.8 Bending test

8.20.8.1 A CONDUIT BODY shall be subjected to the bending test described in Clauses 8.20.8.2 – 8.20.8.5. As a result of the test, the CONDUIT BODY shall not be damaged or separate from the conduit.

8.20.8.2 In the event breakage of the conduit occurs prior to separation at the joint, the CONDUIT BODY complies.

8.20.8.3 Samples secured by cement, welded in the intended manner, to 457 mm (18 in) lengths of heavy-wall polyvinyl chloride (PVC) conduit of the trade size for which the CONDUIT BODY is intended shall be tested as described in Clause 8.20.8.4. The test shall be performed no sooner than 24 hours after assembly.

8.20.8.4 The required bending moment for the test described in Clause 8.20.8.1, performed on the six CONDUIT BODY assembly samples, shall be obtained by separating the supports 760 mm (30 in) apart. The required bending moment for tests performed on a CONDUIT BODY assembly sample shall be obtained by separating the supports 760 mm (30 in) plus the distance equal to the distance between the ends of the CONDUIT BODY.

8.20.8.5 The load specified in Table 31 for the size of conduit used shall be suspended from the center of the CONDUIT BODY for 60 seconds, during which time the CONDUIT BODY and the lengths of conduit shall be rotated through 1 complete revolution about the major axis of the assembly.

8.20.9 Pull test

8.20.9.1 Following the tests described in Clauses 8.20.8.4 and Clause 8.20.8.5, a polyvinyl chloride (PVC) CONDUIT BODY shall withstand a direct pull, as specified in Table 31, for 1 minute. Following the direct pull, the CONDUIT BODY shall not be damaged or pull loose from the conduit. See Clause 8.20.8.2.

8.20.10 Resistance to specific reagents test – general

8.20.10.1 Usually, a reagent is understood to be a substance used to produce a characteristic reaction in chemical analysis. For the purpose of this standard, however, the word is defined in the less restrictive sense of any chemical, oil, or other substance that has a corrosive or degrading influence on polyvinyl chloride (PVC).

8.20.11 Resistance to specific reagents – absorption test

8.20.11.1 A CONDUIT BODY shall be tested as described in Clause 8.20.12 after the specified conditioning. When the CONDUIT BODY is intended for use where it is wetted by, or immersed in, a specific reagent as defined in Clause 8.20.10.1, samples cut from the finished CONDUIT BODY – each 50 mm (2 in) in length – that have been immersed for 60 and 120 days in the reagent at the intended concentration and temperature shall not exhibit greater than a 2.50 percent change in weight. In the event there is a gain in weight at the end of 120 days, and in the event that gain exceeds 1.00 percent, that gain shall not be more than 1.65 times the gain at the end of 60 days.

8.20.12 Resistance to specific reagents – crushing strength test

8.20.12.1 When the CONDUIT BODY is intended for use where it is wetted, or immersed in, a specific reagent as defined in Clause 8.20.10.1, samples cut from the finished CONDUIT BODY – each 50 mm (2 in) in length – that have been immersed for 60 and 120 days in the reagent at the intended concentration and temperature shall not have less than 85 percent of the crushing strength of similar unaged samples. The tests shall be performed as indicated in Clauses 8.20.12.3 – 8.20.12.11.

8.20.12.2 The results of tests on trade size 1 (27) or smaller CONDUIT BODIES shall be taken as representative of the results for larger trade sizes of CONDUIT BODIES.

8.20.12.3 Twelve samples that are each 50 mm (2 in) long shall be cut from clean sample lengths of the finished CONDUIT BODY and cleaned of loose particles and ragged edges. The weight (W_1) within 10 mg (0.0003 oz) of balance of six of the twelve samples shall be recorded, and the remaining six shall be set aside for unaged crushing tests.

8.20.12.4 Care shall be taken throughout the procedure outlined in Clauses 8.20.12.5 – 8.20.12.11 to reduce the risk of injury from handling reagents that involve such a risk.

8.20.12.5 A covered container constructed of material that does not react with the reagent shall be used to test each sample. The test container shall be of a size that allows the CONDUIT BODY sample to be completely immersed when the CONDUIT BODY sample is stood on end in the container. Each container shall be filled with the reagent at the intended concentration and temperature to the depth required to completely cover the sample that is to be placed in it. The reagent shall come to a rest in each container. The weighed samples shall then be placed on end in a container. The cover of each container shall be closed and kept at the intended temperature for 60 days without agitation of the reagent.

8.20.12.6 After 60 days, the samples shall be removed from the reagent and given time to cool to room temperature in still air before being rinsed carefully and wiped dry inside and out with a clean piece of lint-free, absorbent cloth. Each of the six dried samples shall be weighed (W_2) to within 10 mg (0.0003 oz) of balance. The weight (W_2) of the samples shall not be greater than 2.50 percent heavier or lighter than the weight (W_1) of the samples recorded in Clause 8.20.12.3.

8.20.12.7 Three of the samples immersed for 60 days and three of those set aside for unaged crushing tests shall be brought into thermal equilibrium with one another, the testing machine, and the surrounding air at a temperature of 23.0 ±2.0°C (73.4 ±3.6°F) and shall be kept so throughout the test. The inside diameter of each sample shall be measured. The samples shall then be tested separately between a pair of rigid, flat, steel plates that are at least 152 mm (6 in) long and are horizontal and parallel to one another. One plate shall be moved toward the other at the rate of 10.0 ± 2.5 mm per minute (1/2 ±1/8 in per minute) until the surface of the sample pulls away from contact with either plate – that is, until the sample buckles, or until the minor axis measured inside the flattening sample is 60 percent of the inside diameter measured before the test.

8.20.12.8 The crushing loads at the buckling and the 60-percent points shall be derived from the dial on the machine and recorded for each sample. The loads at each of these points shall be averaged for each of the three sets of samples. The average loads at each of these points for the aged samples shall each be divided by the average loads at each of these points for the unaged samples. The resulting ratios shall not be less than 0.85, and the samples shall not crack or collapse before the buckling or 60-percent points are reached.

8.20.12.9 The three remaining samples immersed for 60 days shall be returned to their containers and the immersion continued for an additional 60 days at the intended temperature. After the full 120 days, the samples shall be removed from the reagent and given time to cool in still air before being rinsed carefully and wiped dry inside and out with a clean piece of lint-free absorbent cloth. The three dried samples shall each be weighed (W_3) to within 10 mg of balance. W_3 shall not be more than 2.50 percent heavier or lighter than W_1. In the event W_3 is greater than 1.00 percent heavier than W_1, $W_3 - W_1$ shall not be greater than 1.65 ($W_2 - W_1$).

8.20.12.10 The three samples immersed for 120 days and the last three of the samples set aside for unaged tests shall be brought into thermal equilibrium with one another, the testing machine, and the surrounding air at a temperature of 23.0 ±2.0°C (73.4 ±3.6°F) and shall be kept so throughout the test. The inside diameter of each sample shall be measured. The samples shall then be tested separately between a pair of rigid, flat, steel plates that are at least 152 mm (6 in) long and are horizontal and parallel to one another. One plate shall be moved toward the other at the rate of 10.0 ±2.5 mm per min (1/2 ±1/8 in per min) until the surface of the sample pulls away from contact with either plate – that is, until the sample buckles – or until the minor axis measured inside the flattening sample is 60 percent of the inside diameter measured before the test.

8.20.12.11 The crushing loads at the buckling and the 60-percent points shall be derived from the dial on the machine and recorded for each sample. The loads at each of these points shall be averaged for each of the three sets of samples. The average loads at each of these points for the aged samples shall be divided by the average loads at each of these points for the unaged samples. The resulting ratios shall not be less than 0.85, and the samples shall not crack or collapse before the buckling or 60-percent points are reached.

8.21 FITTINGS for metal-clad (MC) cable

8.21.1 General

8.21.1.1 In Mexico and the United States, the requirements in Clauses 8.21.1.2 – 8.21.9.2 and Tables 32 and 33 apply.

In Canada, the requirements in Clauses 8.21.1.2 – 8.21.9.2 and Tables 32 and 33 do not apply.

8.21.1.2 Samples of a metal-clad cable FITTING shall be subjected to the following test sequence:

a) assembly test, Clause 8.21.2, followed by,

b) resistance test, Clause 8.21.3, followed by,

c) bending test, Clause 8.21.4, followed by,

d) repeated resistance test, Clause 8.21.5, followed by,

e) pull test, Clause 8.21.6.

The same samples shall be used throughout the test sequence. (See Clause 8.21.2.4 for the number of samples to be tested.) The wet locations (rain-tight) test specified in Clause 8.21.7.1 shall be performed using previously untested samples.

8.21.2 Assembly test

8.21.2.1 Sample FITTINGS for testing shall be assembled to lengths of metal-clad cable as described in Clause 6.1.

8.21.2.2 Other than as specified in Clause 8.21.2.3, a FITTING employing a gland shall be tightened with the torque specified in Table 32.

8.21.2.3 When a torque for a FITTING is specified by the manufacturer in the assembly instructions, the FITTING shall be assembled using the torque specified in the instructions.

8.21.2.4 Twelve samples of each trade size of FITTING shall be tested in accordance with Clauses 8.21.2.5 – 8.21.6.1. A separate set of samples shall be tested for each type of cable that the FITTING is intended to be used with. Six of the samples shall be tested with the minimum diameter cable and six with the maximum diameter cable for which the FITTING has been rated by the manufacturer. A ± 0.51 mm (± 0.020 in) tolerance for a cable not more than 19.1 mm (0.75 in) in diameter, and a ± 0.762 mm (± 0.030 in) tolerance for a cable more than 19.1 mm (0.75 in) in diameter comply. When at least four trade sizes of a particular construction are being investigated, three samples shall be tested with the minimum diameter cable, and three with the maximum diameter cable.

8.21.2.5 A FITTING for an interlocking type metal-clad cable shall be assembled to the end of the cable that winds inside itself. A FITTING for all other types of metal-clad cable shall be assembled at either end of the cable. Each cable shall have a length as specified in Table 33. The assembly shall then be secured to a box, enclosure, or threaded COUPLING used to simulate a box, employing knockouts of the trade size for which the FITTING and cable are intended. A 152 mm (6 in) lead shall project out of the assembly at the point of connection between the FITTING and the cable.

8.21.3 Resistance test

8.21.3.1 The sample assemblies of metal-clad cable FITTINGS shall be subjected to the resistance test described in Clause 8.8. As a result of the test, the voltage drop shall not be greater than 50 millivolts. One of the two points specified in Clause 8.8.2 shall be on the cable sheath.

8.21.4 Bending test

8.21.4.1 The sample assembly of the FITTING and cable shall be subjected to the test described in Clause 8.21.4.2. As a result of the test, the assembly shall remain secure.

8.21.4.2 The FITTING shall be secured with the axis of the cable in line with the axis of the FITTING and mounted vertically in a fixed position. Starting in a vertical position, the cable shall be bent around a wooden form having a radius as specified in Table 33. The cable shall be bent in one direction so that a 90-degree bend is formed. The wooden form shall then be positioned on the opposite side of the cable. The cable shall then be bent 180 degrees in the opposite direction, and then back to its original position in line with the axis of the FITTING.

8.21.5 Repeated resistance test

8.21.5.1 Following the test required by Clauses 8.21.4.1 and 8.21.4.2, each test assembly shall comply with the resistance test described in Clause 8.21.3.

8.21.6 Pull test

8.21.6.1 The sample assembly of the FITTING and cable shall withstand a steady pull, as specified in Table 27, for 5 minutes. Following the steady pull, the assembly shall remain secure. The pull shall be in the direction that the cable exits the FITTING. For a straight FITTING, the pull shall be between the cable and a box, enclosure, or threaded COUPLING used to simulate a box. For an ANGLE FITTING, the pull shall be between the cable and the FITTING. The cable shall not be displaced more than 3.2 mm (1/8 in) from its original position.

8.21.7 Wet locations (rain-tight) test

8.21.7.1 Unless a FITTING is marked in accordance with Clause 7.12.4, the cable FITTING assembled to cable in accordance with Clause 8.21.7.2 shall comply with the wet locations (rain-tight) test described in Clause 8.6.

8.21.7.2 For the wet locations (rain-tight) test, one previously untested sample of each trade size of the FITTING shall be assembled to a 152 mm (6 in) length of cable in accordance with Clause 8.21.2.2. The ends of the cable and the threaded ends of the FITTING shall be sealed with tape and then dipped in wax.

8.21.8 Elastomeric materials accelerated aging test

8.21.8.1 Three samples of elastomeric material that is used to comply with Clause 8.21.7.1 shall be conditioned as described in Clause 8.3.2. After conditioning, samples shall not show visible signs of deterioration.

8.21.8.2 An elastomeric material used in a part that fits over the outside of the cable and that is exposed after installation shall comply with Clause 8.21.8.1 and with the following:

a) the tensile strength of the elastomeric material shall not decrease more than 25 percent, and

b) the elongation of the elastomeric material shall not decrease more than 35 percent.

8.21.9 Thermoplastic materials accelerated aging test

8.21.9.1 Three samples of a sleeve or ring of thermoplastic material shall be assembled in accordance with Clause 8.21.2.2. After conditioning, the sleeve or ring shall comply with the pull test described in Clause 8.21.6.1.

8.21.9.2 The test described in Clause 8.21.9.1 shall be performed on previously untested samples. The sleeve or ring shall be conditioned for 168 hours at a temperature of 121 ±1°C (250 ±2°F) in a full-draft air-circulating oven that has been preheated at full draft. The samples shall return to room temperature before the pull specified in Clause 8.21.6.1 is applied.

8.22 FITTINGS for aluminum-sheathed cable

8.22.1 General

8.22.1.1 Six samples of each trade size of a FITTING for aluminum-sheathed cable shall be subjected to the following test sequence:

a) assembly test, Clause 8.22.2, followed by,

b) resistance test, Clause 8.22.3, followed by,

c) pull test, Clause 8.22.4, followed by,

d) repeated resistance test, Clause 8.22.5.

8.22.2 Assembly test

8.22.2.1 A FITTING for aluminum-sheathed cable that is threaded onto the end of the cable shall be hand tightened. A FITTING with a compression nut shall be assembled in accordance with Clause 6.1.1.

8.22.3 Resistance test

8.22.3.1 A FITTING for aluminum-sheathed cable shall be subjected to the resistance test described in Clause 8.8. As a result of the test, the voltage drop shall not exceed 50 millivolts.

8.22.4 Pull test

8.22.4.1 A FITTING shall be capable of securing a cable so that it withstands a steady pull for a period of 5 minutes at the force specified in Table 27. Following the steady pull, bending or flexing shall not remove the conduit.

8.22.4.2 For the sample used in the pull test, the FITTING shall be installed and secured on the cable. The clamp screw of the FITTING shall be tightened to 1.7 N•m (15.05 lbf-in) unless otherwise specified by the manufacturer on the smallest unit shipping package. Special installation instructions provided by the manufacturer for field assembly shall be followed. The pull shall be applied gradually between the cable and a box in which the FITTING is installed in the intended manner.

8.22.5 Repeated resistance test

8.22.5.1 Following the tests required by Clauses 8.22.4.1 and 8.22.4.2, the sample assembly shall comply with the requirement in Clause 8.22.3.1.

8.23 FITTINGS for mineral-insulated (MI) cable

8.23.1 General

8.23.1.1 A FITTING for mineral-insulated cable shall comply with the tests described in Clauses 8.23.2.1 – 8.23.9.2. Other than as specified in Clauses 8.23.5.2 and 8.23.5.5, samples of each FITTING construction shall be tested.

8.23.1.2 A sample FITTING for mineral-insulated cable shall be subject to the following test sequence:

a) resistance test, Clause 8.23.2, followed by,

b) bend test, Clause 8.23.3, followed by,

c) pull test, Clause 8.23.4.

The same samples shall be used throughout the test sequence.

8.23.1.3 With respect to Clause 8.23.1.1, FITTINGS for every combination of conductor size and number of conductors per cable available in mineral-insulated metal-sheathed cable are not required to be tested.

8.23.2 Resistance test

8.23.2.1 A FITTING for mineral-insulated cable shall be subjected to the test described in Clause 8.8. As a result of the test, the voltage drop shall not be greater than 10 millivolts. One of the two points specified in Clause 8.8.2 shall be on the cable sheath.

8.23.3 Bend test

8.23.3.1 A fitting for mineral-insulated cable shall be subjected to the test specified in Clause 8.23.3.2. During the test, the assembly of the FITTING and cable shall remain secure.

8.23.3.2 The FITTING shall be connected to a box, enclosure, or threaded COUPLING used to simulate a box with the axis of a 760 mm (30 in) length of cable in line with the axis of the FITTING. The cable shall be bent around a wooden form having a radius equal to five times the diameter of the cable. The cable shall be grasped at a point 610 mm (2 ft) from the FITTING and bent in one direction so that a 90-degree bend is formed. The cable shall then be bent back 180 degrees in the opposite direction, and then back to its original position in line with the axis of the FITTING.

8.23.4 Pull test

8.23.4.1 The sample assembly of the FITTING and cable shall withstand a direct pull of 667 N (150 lbf) applied between the cable and the FITTING for 5 minutes. Following the direct pull, the sample assembly shall remain secure.

8.23.5 Insulation resistance test

8.23.5.1 A fitting for mineral-insulated cable shall be subjected to the test specified in Clause 8.23.5.2. As a result of the test, the insulation resistance shall not be less than 1,000,000 ohms after 3 hours of immersion, and not less than 250,000 ohms after 720 hours of immersion.

8.23.5.2 Two 3.35 m (11 ft) lengths of cable shall be stripped of the outer sheath and mineral fill for 152 mm (6 in) at each end, and a FITTING with insulating sleeving shall be installed at one end of each cable. The cable with FITTING shall then be immersed in tap water at room temperature with the bared ends of the insulated conductors at the end with the FITTING, and the bared conductors of the end without the FITTING above the water. The end of the cable without the FITTING shall be sealed so that the mineral insulation does not absorb moisture from the air. The insulation resistance between conductors, and between the conductors and the outer cable sheath, shall be measured:

a) before the cable FITTING has been installed,

b) after the FITTING has been installed and before the assembly has been immersed in water,

c) after the assembly has been immersed in water for 3 hours, and

d) after the assembly has been immersed in water for 720 hours.

8.23.5.3 When the cable is coiled for the test described in Clause 8.23.5.2, the inside diameter of the coil shall not be less than ten times the outside diameter of the cable.

8.23.5.4 When tested as described in Clause 8.23.5.5, the insulation resistance of a 2-conductor, No. 14 AWG (2.1 mm^2) or smaller cable and a FITTING provided with a means for sealing the end of the cable shall not be less than 250,000 ohms after being immersed for 336 hours in water at a temperature of 50 ±1°C (122 ± 2°F).

8.23.5.5 Two 1.8 m (6 ft) lengths of the cable shall be used. The outer sheath and mineral fill shall be stripped from 760 mm (30 in) at each end, and a FITTING installed at each end of the remaining 300 mm (1 ft) center section. The bared conductors shall be insulated with 760 mm (30 in) of the flexible tubing supplied with the FITTING. The entire assembly, other than the bared ends of the conductors at the end of the flexible tubing, shall be immersed under a 300 mm (1 ft) head of tap water maintained at 50 ±1°C (122 ±2°F).

8.23.6 Dielectric voltage-withstand test

8.23.6.1 The cable and FITTING assemblies used for Clause 8.23.5 shall be subjected to the insulation resistance test described in Clause 8.23.6.2. As a result of the test, the assembly shall withstand the test potential without electrical breakdown.

8.23.6.2 The test shall be performed on the samples immediately following the insulation resistance test specified in Clause 8.23.5.2. Samples shall be removed from the water for this test, and shall be wiped dry on the outside. A 60-hertz sinusoidal potential of 1500 volts rms shall be raised gradually to the full value and applied for 1 minute to each assembly. The potential shall be applied first between conductors and then between all conductors electrically connected and the outer cable sheath.

8.23.7 Wet locations (rain-tight) test

8.23.7.1 A FITTING intended for use with a separate sealing FITTING, when assembled as intended to mineral-insulated cable, shall not allow water to enter when tested as described in Clause 8.6. Two previously untested samples shall be used for this test.

8.23.8 Elastomeric materials accelerated aging test

8.23.8.1 Three samples of an internal elastomeric part of a FITTING shall be conditioned as described in Clause 8.3.2. After conditioning, the FITTING shall not show visible signs of deterioration.

8.23.9 Thermoplastic materials accelerated aging test

8.23.9.1 Three samples of parts provided for sealing the end of the cable and for insulating the cable conductors shall be conditioned as described in Clause 8.23.9.2. After conditioning, the parts shall not show visible signs of deterioration and shall not affect each other such that the parts do not perform their intended function.

8.23.9.2 The complete assembly, including any sealing compound and flexible tubing, shall be conditioned for 1440 hours at a temperature of 97 ±1°C (207 ±2°F) in a full-draft air-circulating oven that has been preheated at full draft.

8.24 FITTINGS for nonmetallic-sheathed cable

8.24.1 Pull test

8.24.1.1 A FITTING for nonmetallic-sheathed cable assembled as specified in Clauses 8.24.1.2 – 8.24.1.4 shall secure the cable so that it withstands the pull specified in Clause 8.24.1.5 for 5 minutes. Following the steady pull, there shall not be:

a) damage to the cable sheath or individual conductor insulation,

b) displacement of more than 3.2 mm (1/8 in) of the cable from the FITTING,

c) dislodgment of the FITTING from the surface on which it is mounted,

d) loosening so that the cable is removable without the use of tools, or

e) cracking, breaking, or other indication that the FITTING has been damaged.

8.24.1.2 Two sets of six samples of each size shall be assembled as intended. One set shall be assembled to the smallest trade size cable and one to the largest trade size for which the FITTING is intended. See Clauses 5.13.1, 7.4.1, and 7.4.2.

8.24.1.3 After assembly, the cut end of the cable sheath shall be in contact with the end stop of the FITTING. When the FITTING does not have an end stop, the cut end of the sheath shall extend 6.4 mm (1/4 in) beyond the FITTING. Each assembly shall be attached to a box or enclosure. The wires of the cable shall project 152 mm (6 in) inside the test box. A screw capable of being tightened with a screwdriver shall be tightened as specified in Clauses 6.1.1 – 6.2.2 for the test in Clause 8.24.1.5 a), or 1.7 N•m (15.05 lbf-in) for the test in Clause 8.24.1.5 b).

8.24.1.4 The free end of the cable shall be formed into a loop and securely fastened by tape or equivalent means. The pull shall be applied to the loop by a hook or other convenient method. A FITTING that is intended to secure more than one cable shall have the pull applied separately to each cable.

8.24.1.5 The FITTING shall be subjected to:

a) a direct pull of 267 N (60 lbf), or

b) a direct pull of 110 N (25 lbf) followed by the tests specified in Clause 8.24.4.

8.24.2 Mold stress-relief test

8.24.2.1 A FITTING for nonmetallic-sheathed cable made of nonmetallic material, or having parts made of a nonmetallic material, shall be conditioned as described in Clause 8.24.2.2. As a result of the conditioning, the FITTING shall not have cracks or change in any dimension greater than 10 percent.

A FITTING or part employing only thermosetting materials is not required to be subjected to this test.

8.24.2.2 Six unassembled samples of a nonmetallic-sheathed cable FITTING made of a nonmetallic material, or having parts made of a nonmetallic material, shall be conditioned for 7 hours at a temperature of 90 ±1°C (194 ±2°F) in a full-draft air-circulating oven that has been preheated at full draft. Following removal from the oven, the samples shall cool to room temperature in still air for not less than 4 hours before being examined. After cooling, each sample shall be examined to determine whether it complies with Clause 8.24.2.1.

8.24.3 Polymeric FITTINGS without LOCKNUTS – pull test

8.24.3.1 A FITTING that does not use a LOCKNUT shall comply with Clause 8.24.1.1 when tested as described in Clauses 8.24.3.2 and 8.24.3.3.

8.24.3.2 Three sample FITTINGS shall each be assembled to a nonmetallic-sheathed cable sample and an outlet box or a plate with a thickness of 1.59 – 1.64 mm (0.0625 – 0.0645 in). Each FITTING shall then be subjected to a direct pull of 110 N (25 lbf).

In Canada, a box or plate thickness of 1.3 – 1.4 mm (0.051 – 0.055 in) shall be used.

8.24.3.3 Three sample assemblies consisting of a FITTING, a nonmetallic-sheathed cable, and a metallic outlet box or plate with a thickness of 1.59 – 1.64 mm (0.0625 – 0.0645 in) shall be conditioned for 24 hours at a temperature of minus 25 ±1°C (minus 13 ±2°F). Immediately after removal from the cooling chamber, the assembly shall be subjected to a direct pull of 110 N (25 lbf).

In Canada, a box or plate thickness of 1.3 – 1.4 mm (0.051 – 0.055 in) shall be used.

8.24.4 Metallic FITTING accelerated aging and dielectric voltage-withstand test

8.24.4.1 Six samples of the largest trade size of metallic FITTING shall be subjected to the test described in Clause 8.24.4.2. As a result of the test, the FITTING and assembly shall withstand the specified potential without electrical breakdown.

8.24.4.2 Each new sample shall be assembled as described in Clauses 8.24.1.2 – 8.24.1.4. The assembly shall be conditioned for 168 hours at a temperature of 90 ±1°C (194 ±2°F) in an full-draft air-circulating oven that has been preheated at full draft. Following removal from the oven, the samples shall cool to room temperature before the potential is applied. After cooling, a 60-hertz sinusoidal potential of 5000 volts rms shall be raised gradually to the full value and applied for 1 minute to each sample. The potential shall be applied between the insulated conductors of the cable and the insulated conductors and the FITTING or bare wire ground. See test sequence 1 or 2 in Figure 13.

8.25 FITTINGS for service-entrance cable

8.25.1 Pull test

8.25.1.1 A FITTING for service-entrance cable shall be assembled as specified in Clause 8.25.1.2. The assembly shall secure the cable so that it withstands the pull specified in Clause 8.25.1.2 for 5 minutes. Following the steady pull, bending or flexing shall not remove the cable.

8.25.1.2 Two sets of six samples of each size shall be assembled as intended. One set shall be assembled to the smallest trade size cable and one to the largest trade size with which it is intended to be used. When the FITTING is intended to be used with a range of oval or round cable, the FITTING shall secure the smallest and largest diameter cables in the range. The assembly shall be subjected to a steady pull of 222 N (50 lbf) for 5 minutes. The pull shall be applied between the cable and a box in which the FITTING is mounted in the intended manner.

8.25.1.3 In preparing the samples for the test in Clause 8.25.1.1, the conductors of the cable shall project 152 mm (6 in) inside the box.

8.25.2 Wet locations (rain-tight) test

8.25.2.1 Two samples of a service-entrance cable FITTING intended for use in wet locations shall comply with the wet locations (rain-tight) test described in Clause 8.6. When the FITTING is intended to be used with a range of cable diameters, the FITTING shall be tested with the smallest diameter cable of the shape and size in the range.

8.25.3 Elastomeric materials hardness test

8.25.3.1 Six samples of an elastomeric component of a service-entrance cable FITTING shall comply with the elastomeric materials hardness test described in Clause 8.3.

8.25.4 Thermoplastic materials accelerated aging test

8.25.4.1 Six samples of a thermoplastic component of a FITTING for service-entrance cable shall be conditioned as described in Clause 8.25.4.2. After conditioning, the sleeve or ring shall comply with the pull test described in Clause 8.25.1.

8.25.4.2 The component specified in Clause 8.25.4.1 shall be conditioned for 168 hours at a temperature of 100 ±1°C (212 ±2°F) in an full-draft air-circulating oven that has been preheated at full draft. Following removal from the oven, the sample shall cool to room temperature for not less than 4 hours before the pull specified in Clause 8.25.1 is applied.

8.25.5 Probe test

8.25.5.1 Six samples of a FITTING, when assembled with the smallest cable in the range, shall inhibit the passage of a 6.7 mm (17/64 in) diameter probe through any opening between the inside of the FITTING and the cable.

8.26 FITTINGS for flexible cord

8.26.1 General

8.26.1.1 A FITTING for flexible cord other than a LIQUID-TIGHT FITTING shall be subjected to the following test sequence:

a) assembly test, Clause 8.26.2, followed by,

b) accelerated aging test, Clause 8.26.3, followed by,

c) flexing test, Clause 8.26.5, followed by,

d) pull test, Clause 8.26.6.

The same set of test samples shall be used throughout the test sequence and shall not be conditioned in any way during the tests.

8.26.1.2 A liquid-tight FITTING for flexible cord shall be subjected to the following test sequence:

a) assembly test, Clause 8.26.2, followed by,

b) accelerated aging test, Clause 8.26.3, followed by,

c) oil spray test, Clause 8.26.4, followed by,

d) flexing test, Clause 8.26.5, followed by,

e) pull test, Clause 8.26.6.

The same set of test samples shall be used throughout the test sequence and shall not be conditioned in any way during the tests.

8.26.1.3 A separate set of samples of LIQUID-TIGHT FITTINGS for flexible cord shall be subjected to the following test sequence:

a) assembly test, Clause 8.26.2, followed by,

b) ultraviolet light and water test, Clause 8.26.7 (see Clause 8.26.1.4), followed by,

c) flexing test, Clause 8.26.5, followed by,

d) pull test, Clause 8.26.6, followed by,

e) oil spray test, Clause 8.26.4.

The same set of test samples shall be used throughout the test sequence and shall not be conditioned in any way during the tests.

8.26.1.4 With reference to 8.26.1.3 b), the ultraviolet light and water test is not required for:

a) a FITTING that, when assembled to cord as required by Clause 8.26.2, has no exposed nonmetallic parts,

b) a FITTING made from a material that is rated for exposure to ultraviolet light and water, or

c) a metallic FITTING that encloses at least 95 percent of the surface area of a nonmetallic gland. In determining surface area of a gland, that portion of the gland that bears directly against the cord in an assembled sample is not part of the surface area.

8.26.1.5 Two samples of each trade size of a FITTING for flexible cord shall be subjected to each test sequence specified in Clauses 8.26.1.1 – 8.26.1.3. With respect to trade size of FITTINGS, when the gland ends of two trade sizes are identical, only one trade size of FITTING shall be required to be tested in each required sequence.

8.26.1.6 One of the two samples of each trade size specified in Clause 8.26.1.5 shall be tested with a gland that is intended for the smallest diameter cord within the range of sizes specified for use with the FITTING. The other sample shall be tested with a gland that is intended for the largest diameter cord within the range.

8.26.1.7 Two samples of the elastomeric gland intended for use with each trade size of a FITTING for flexible cord shall comply with the elastomeric materials hardness test described in Clause 8.3, and two additional samples shall be conditioned as described in Clauses 8.26.7.2 – 8.26.7.4 and then shall comply with the elastomeric materials hardness test described in Clause 8.3.

8.26.2 Assembly test

8.26.2.1 Samples of a FITTING for flexible cord shall be assembled to flexible cord, using the torque specified in Table 15. Each FITTING shall be assembled to cord so that between 38 mm (1-1/2 in) and 51 mm (2 in) of cord projects beyond the throat of the FITTING. See Clause 6.1.

8.26.2.2 The flexible cord used in a sample assembly shall not be less than 457 mm (18 in) long, and shall have the smallest or largest, as specified in these requirements, overall diameter specified by the manufacturer for the gland under test. A ±0.51 mm (±0.020 in) tolerance for a cord not more than 19.1 mm (0.75 in) in diameter and a ±0.76 mm (±0.030 in) tolerance for a cord more than 19.1 mm (0.75 in) in diameter comply. The cord used for the testing shall have a temperature rating not less than the temperature rating of the FITTING.

8.26.3 Accelerated aging test

8.26.3.1 A FITTING for a flexible cord shall be conditioned as specified in Clause 8.26.3.2. As a result of the conditioning, the FITTING shall not warp, char, or blister.

8.26.3.2 A FITTING that is not marked for use with a specific cord type or a temperature rating shall be conditioned for 168 hours at a temperature of 70 ±1°C (158 ±2°F) in a full-draft air-circulating oven that has been preheated at full draft. For a FITTING that is marked for a rating higher than 60°C (140°F), the oven temperature shall be 10 ±1°C (18 ±2°F) above the rated temperature of the FITTING. See Clause 7.9.1. Following removal from the oven, the samples shall cool to room temperature for not less than 4 hours before being examined. Each sample shall be examined to determine whether it complies with Clause 8.26.3.1.

8.26.4 Oil spray test

8.26.4.1 Sample assemblies of LIQUID-TIGHT FITTINGS for flexible cord shall be subjected to the test described in Clause 8.26.4.2. As a result of the test, there shall not be evidence of oil inside the test enclosure.

8.26.4.2 A sample cord and FITTING shall be assembled in the intended manner to an enclosure rated for use with oil in accordance with NMX-J-235/1-ANCE, NMX-J-235/2-ANCE, CAN/CSA C22.2 No. 94, or UL 50, and mounted in a fixed position. The cord shall be suspended so that the axis of the entire assembly is at an angle of 45 degrees from the vertical. A stationary nozzle with a 9.5 mm (3/8 in) diameter opening shall be located 254 mm (10 in) above the surface of the cord and directed so as to spray oil vertically downward to strike the cord 25.4 mm (1 in), measured along the axis of the assembly, above the FITTING. See Figure 15. A mixture of 10 parts water to 1 part water-soluble oil shall be sprayed through the nozzle at a rate of not less than 7.6 L (2 gallons) per minute. The sample shall be subjected to the oil spray for 30 minutes.

8.26.5 Flexing test

8.26.5.1 Sample assemblies shall be subjected to the test described in Clause 8.26.5.2. As a result of the test, there shall not be:

a) cord displacement of more than 3.2 mm (1/8 in),

b) loosening of the cord in the FITTING, or

c) loss of integrity of the FITTING components such that they are no longer capable of performing their intended function.

8.26.5.2 Sample assemblies shall be wiped dry, and then mounted vertically in a fixed position. Starting from the vertical position, the cord shall be flexed through a 90-degree angle having a radius of 127 mm (5 in) for cord 19.1 mm (0.75 in) in diameter or less or 254 mm (10 in) for cord more than 19.1 mm (0.75 in) in diameter. The cord shall then be flexed through a 180-degree angle of the same radius in the opposite direction, and then back to the vertical position. This is one complete cycle of flexing. The samples shall be subjected to 500 cycles of flexing for the test.

8.26.6 Pull test

8.26.6.1 The sample assembly of flexible cord shall be subjected to the pull test described in Clause 8.26.6.2. As a result of the test, the cord shall not be displaced more than 3.2 mm (1/8 in) from its original position, as measured from the plane of the test enclosure to which the FITTING is secured.

8.26.6.2 An assembly shall be mounted in a fixed position and a reference mark shall be made on the cord jacket to indicate displacement of the jacket from the FITTING. A 15.9 kg (35 pound) weight shall be secured to the end of the cord so that the load is applied to both the jacket and the conductors in a direction along the axis of the FITTING. The load shall be applied gradually and shall be maintained for 1 minute. After removal of the load, the cord shall recover for 1 minute before the displacement is measured.

8.26.7 Ultraviolet light and water test

8.26.7.1 A LIQUID-TIGHT FITTING for flexible cord shall be subjected to the conditioning described in Clause 8.26.7.2 – 8.26.7.4. As a result of the conditioning, the FITTING shall not crack or break.

8.26.7.2 Each sample shall be exposed to ultraviolet light and water in accordance with Xenon-arc, Type B, ISO 4892-2. Continuous exposure to light and intermittent exposure to water spray, with a programmed cycle of 120 minutes consisting of a 102 minute light exposure and an 18 minute exposure to water spray with light, shall be used. The sample shall be exposed for a total of 1000 hours. The apparatus shall operate with a 6500 W, water-cooled Xenon-arc lamp, borosilicate glass inner and outer optical filters, a spectral irradiant of 0.35 W/m^2/nm at 340 nm and a black-panel temperature of 63 ±3°C (145 ±5°F).

Note: ASTM G 155 is considered technically equivalent to ISO 4892-2.

In Mexico, use of the resistance to ultraviolet light and water test described in NMX-J-023/1-ANCE complies with the requirement.

In Canada and the United States, the ultraviolet light and water test described in NMX-J-023/1-ANCE does not apply.

8.26.7.3 The sample shall be mounted on the inside of the cylinder in the ultraviolet light apparatus so they do not touch each other. After the exposure, the sample shall be removed from the cylinder and visually compared to unconditioned samples.

8.26.7.4 With reference to Clause 8.26.7.1, using the twin enclosed carbon-arc method described in Annex B complies with the requirement.

8.27 FITTINGS for tray cable

8.27.1 General

8.27.1.1 Three samples of a FITTING for tray cable intended for use in dry locations shall comply with the following test sequence:

a) assembly test, Clause 8.27.2, followed by,

b) accelerated aging test, Clause 8.27.4, followed by,

c) pull test, Clause 8.27.6.

The same set of test samples shall be used throughout the test sequence.

8.27.1.2 A FITTING for tray cable intended for use with sunlight-resistant tray cable shall comply with the tests described in Clauses 8.27.1.1 and 8.6.

8.27.1.3 A separate set of three samples of FITTINGS intended for use with sunlight-resistant tray cable shall be subjected to the following test sequence:

a) assembly test, Clause 8.27.2, followed by,

b) ultraviolet light and water test, Clause 8.27.3, followed by,

c) pull test, Clause 8.27.6.

The same set of test samples shall be used throughout the test sequence.

A FITTING for tray cable intended for use with sunlight-resistant tray cable that employs a metal gland or direct-bearing metal clamp is not required to comply with the requirements in Clause 8.27.1.3. See Clause 8.27.1.5.

8.27.1.4 A FITTING for tray cable intended for use with sunlight- and oil-resistant tray cable shall comply with Clauses 8.27.1.1 – 8.27.1.3, using separate sets of test samples for each sequence. In addition, the test samples used for the sequence in Clause 8.27.1.2 and Clause 8.27.1.3 shall be subjected to the oil spray test described in Clause 8.27.5, followed by the pull test described in Clause 8.27.6.

A FITTING for tray cable intended for use with sunlight- and oil-resistant tray cable and that employs a metal gland or direct-bearing metal clamp is not required to comply with Clause 8.27.1.3. See Clause 8.27.1.5.

8.27.1.5 A separate set of three samples of a FITTING for tray cable that employs a metal gland or a direct-bearing metal clamp shall comply with Clauses 8.27.1.1, 8.27.1.2, and 8.27.1.6, and a separate set of three samples shall be subjected to the following test sequence:

a) assembly test, Clause 8.27.2, followed by,

b) accelerated aging test, Clause 8.27.4, followed by,

c) dielectric voltage-withstand test, Clause 8.27.7.

8.27.1.6 Samples of an oil-resistant tray-cable FITTING assembly shall be subjected to the oil spray test described in Clause 8.27.5, followed by the dielectric voltage-withstand test described in Clause 8.27.7.

8.27.1.7 Two samples of the smallest elastomeric sealing gland in a line of FITTINGS shall comply with the elastomeric materials hardness test described in Clause 8.3, and two additional samples shall comply with the elastomeric materials hardness test described in Clause 8.3 after being subjected to the ultraviolet light and water requirements as described in Clauses 8.26.7.2 or 8.26.7.4.

8.27.2 Assembly test

8.27.2.1 A FITTING shall be assembled in accordance with Clause 8.27.2.2. The FITTING or its components shall not deform during assembly so that the FITTING does not perform its intended function. A FITTING that employs a metal gland or direct-bearing metal clamp shall be assembled in accordance with Clause 8.27.2.4. After assembly, the cable shall not be damaged.

A metal gland or direct-bearing metal clamp that deforms during assembly complies when such deformation does not impair its intended function.

8.27.2.2 Three samples of each trade size of a FITTING for tray cable shall be tested with a gland, metal gland, or direct-bearing metal clamp that is intended for the smallest cable specified for use with the FITTING. The FITTING shall be assembled to a minimum 305 mm (1 ft) length of tray cable using the torque value specified by Table 15. A gland of one size that is used in FITTINGS of two or more trade sizes, such as trade size 12 (3/8) and 16 (1/2), is only required to be tested once. Not less than one gland size shall be tested for each trade size of FITTING. The tray cables and FITTINGS used for the assemblies shall be intended for use in the same location. For example, a sunlight-resistant FITTING shall be assembled to sunlight-resistant tray cable. These sample assemblies shall be used for the test sequences specified in Clause 8.27.1.

8.27.2.3 A FITTING intended for use with a range of tray-cable sizes shall be assembled to the largest overall diameter tray cable specified by the manufacturer that the FITTING accommodates. Tolerances of ±0.51 mm (±0.020 in) for cable not more than 19.1 mm (0.75 in) in diameter and ±0.76 mm (±0.030 in) for cable more than 19.1 mm (0.75 in) in diameter apply.

Where it is obvious that a FITTING accommodates the largest size tray cable, the FITTING shall not be required to be so assembled.

8.27.2.4 For FITTINGS described in Clause 8.27.1.5, three sample assemblies without prior conditioning shall be used for these tests. When the FITTING is intended for a range of tray-cable sizes, the largest size tray cable that the FITTING is intended for shall be used. The FITTINGS shall be assembled to a tray cable using a torque of 130 percent of the value specified in Table 15. In the event the FITTING is damaged using a 130-percent torque and the tray cable is not damaged, a new FITTING shall be assembled to the cable using the applicable torque value specified in Table 15.

8.27.3 Ultraviolet light and water test

8.27.3.1 A FITTING for tray cable assembly that employs parts made of thermoplastic material shall not crack or break after being conditioned as described in Clause 8.26.7.2 or 8.26.7.4.

8.27.3.2 When a FITTING is assembled to tray cable as required by Clause 8.27.2.1, and encloses at least 95 percent of the surface area of the gland, the FITTING is not required to be subjected to the conditioning described in Clause 8.26.7.2 or 8.26.7.4. When determining surface area of the gland, that portion of the gland that bears directly against the cable in an assembled sample is not regarded as part of the surface area.

8.27.4 Accelerated aging test

8.27.4.1 A FITTING of a thermoplastic material shall be conditioned as specified in Clause 8.27.4.2 or 8.27.4.3. As a result of the conditioning, the FITTING shall not warp, char, or blister.

8.27.4.2 A FITTING of a thermoplastic material that is not marked for use with a specific cable type or temperature rating shall be conditioned for 168 hours at a temperature of 70 ±1°C (158 ±2°F) in a full-draft air-circulating oven that has been preheated at full draft. For a FITTING that is marked for a rating higher than 60°C (140°F), the oven temperature shall be 10 ±1°C (18 ±2°F) above the rated temperature of the assembly.

8.27.4.3 A FITTING that employs a metal gland or direct-bearing metal clamp shall be conditioned for 168 hours at the temperature specified in Table 34 in a full-draft air-circulating oven that has been preheated at full draft. See Clause 8.27.1.4.

8.27.5 Oil spray test

8.27.5.1 A FITTING for tray-cable assembly shall be subjected to the test described in Clause 8.27.5.2 and Clause 8.27.5.3. As a result of the test, there shall not be evidence of oil inside the test enclosure.

8.27.5.2 Each sample assembly of a FITTING for tray cable shall be immersed for 24 hours in IRM 902 oil so that the major axis of the FITTING is vertical with the HUB end up, and the complete sealing gland is below the surface of the oil:

a) at 60°C (140°F) when marked ″Oil Resistant I,″ or

b) at 75°C (167°F) when marked ″Oil Resistant II.″

8.27.5.3 After being conditioned as described in Clause 8.27.5.2, each sample assembly shall be subjected to an oil spray as described in Clause 8.26.4.2 for 30 minutes.

8.27.6 Pull test

8.27.6.1 A sample of a tray-cable FITTING assembly shall be subjected to the test described in Clause 8.27.6.2. As a result of the test, the cable shall not be displaced more than 3.2 mm (1/8 in), measured from the plane of the test enclosure to which the FITTING is secured.

8.27.6.2 The tray-cable FITTING assembly shall be mounted in a fixed position. A steady pull of 222 N (50 lbf) shall be applied for 5 minutes between the end of the cable and the outside face of the FITTING in the direction along the axis of the FITTING. After removal of the load, the cable shall recover for 1 minute before the displacement is measured.

8.27.7 Dielectric voltage-withstand test

8.27.7.1 A FITTING for tray cable that employs a metal gland or direct-bearing metal clamp, as described in Clause 8.27.1.5, after being conditioned in accordance with Clause 8.27.4.2, shall be subjected to the test in Clause 8.27.7.2. As a result of the test, the cable insulation shall withstand the test potential without electrical breakdown.

8.27.7.2 The cable conductors shall be electrically connected together. A 60-hertz sinusoidal potential, as specified in Table 35, shall be raised gradually to the full value and applied for 1 minute to each FITTING. The potential shall be applied between the cable conductors and any metal of the FITTING.

8.28 BUSHINGS, INSULATING BUSHINGS, and FITTINGS with throat liners

8.28.1 Flammability test

8.28.1.1 Six samples of each size of BUSHING or an INSULATING BUSHING made entirely of polymeric material shall be subjected to the test described in Clause 8.28.1.2. As a result of the test, the BUSHING shall comply with Clause 8.2.1 b), d), and e).

8.28.1.2 A sample of a BUSHING or an INSULATING BUSHING as specified in Clause 8.28.1.1 shall be mounted on a 0.30 m (1 ft) length of conduit and suspended at an angle of 45 degrees to the axis of the test flame described in Clauses 8.2.4 and 8.2.6 – 8.2.9. The sample shall be subjected to five 15-second applications of the test flame with 15 seconds between successive applications of the flame. The tip of the inner blue cone of the flame shall be applied to the upper edge of the inner diameter of the BUSHING or INSULATING BUSHING.

8.28.2 Accelerated aging test

8.28.2.1 Six samples of each size of BUSHING or INSULATING BUSHING shall be subjected to the test described in Clause 8.28.2.2. As a result of the test, the inside diameter of the throat of a BUSHING or an INSULATING BUSHING shall not be reduced to a dimension less than 90 percent of the minimum value specified in Table 1.

8.28.2.2 The BUSHING or INSULATING BUSHING described in Clause 8.28.2.1 shall be conditioned for 168 hours at the temperature specified in Table 18 in a full-draft air-circulating oven that has been preheated at full draft. After the conditioning, the samples shall then be cooled to room temperature for not less than 4 hours. The inside diameter shall then be measured.

8.28.3 Heat distortion test

8.28.3.1 A BUSHING or INSULATING BUSHING shall be subjected to the test specified in Clause 8.28.3.2. As a result of the test, the BUSHING shall not show evidence of cracking or softening so as to expose metal or form an incomplete insulating throat.

8.28.3.2 An INSULATING BUSHING shall be mounted on tubing or conduit as intended. The tubing or conduit shall be mounted horizontally as illustrated in Figure 14 and conditioned for 72 hours at the temperature specified in Table 18 in a full-draft air-circulating oven that has been preheated at full draft. A loop of No. 12 AWG (3.3 mm^2) bare, solid copper conductor shall be brought through the open end of each section of tubing or conduit. A 4.54-kg (10-pound) weight shall be suspended from each loop of conductor. Immediately after the 72 hours, the weights shall be removed and the samples shall then be cooled to room temperature for not less than 4 hours before being handled and examined.

8.28.4 Drop test

8.28.4.1 The six samples conditioned in accordance with Clause 8.28.3.2 shall be dropped onto a hardwood surface from a height of 305 mm (12 in). The throat or throat liner shall not be dislodged by the impact.

8.29 Nonmetallic SERVICE-ENTRANCE HEADS

8.29.1 Wet locations (rain-tight) test

8.29.1.1 Two samples of each trade size of nonmetallic SERVICE-ENTRANCE HEADS shall comply with the wet locations (rain-tight) test described in Clause 8.6.

8.29.2 Ultraviolet light and water test

8.29.2.1 Six as-received SERVICE-ENTRANCE HEADS shall be conditioned as described in Clause 8.26.7.2. As a result of the conditioning, the FITTINGS:

a) shall not have cracks or openings, and

b) shall comply with the impact test described in Clause 8.29.4.

8.29.3 Accelerated aging test

8.29.3.1 Six as-received SERVICE-ENTRANCE HEADS shall be conditioned as specified in Clause 8.29.3.2. As a result of the conditioning, the SERVICE-ENTRANCE HEADS:

a) shall not have cracks or openings, and

b) shall comply with the impact test described in Clause 8.29.4.

8.29.3.2 A SERVICE-ENTRANCE HEAD described in Clause 8.29.3.1 shall be conditioned for 168 hours at a temperature of 100 ±1°C (212 ±2°F) in a full-draft air-circulating oven that has been preheated at full draft.

8.29.4 Impact test

8.29.4.1 Eighteen SERVICE-ENTRANCE HEADS shall be subjected to an impact as described in Clause 8.29.4.2. The eighteen FITTINGS shall come from the following sources: six in the as-received condition, six that have been subjected to the ultraviolet light and water test described in Clause 8.29.2, and six that have been subjected to the accelerated aging test described in Clause 8.29.3. The FITTINGS shall withstand the impact without splitting, crushing, or breaking.

8.29.4.2 A FITTING to be impacted shall be placed on a flat steel plate. The impact shall be produced by dropping a weight through the vertical distance specified in Table 36 to strike the FITTING. The weight shall consist of a steel cylinder 31.8 mm (1.25 in) in diameter and weighing 2.3 kg (5 lb). Nine FITTINGS, three from each of the sources described in Clause 8.29.4.1, shall be impacted on the top of their cover. The remaining nine FITTINGS shall be impacted on the side of their cover where the cover is secured to the body.

8.29.5 Impact after cold conditioning test

8.29.5.1 Six as-received SERVICE-ENTRANCE HEADS shall be conditioned at minus 20 ±1°C (minus 4 ±2°F) for 5 hours. Immediately after removal from the conditioning, the samples shall comply with the impact test described in Clause 8.29.4.

8.29.6 Pull test for SERVICE-ENTRANCE HEADS with clamps to secure to conduit

8.29.6.1 A SERVICE-ENTRANCE HEAD shall be tested as described in Clauses 8.29.6.2 – 8.29.6.4. As a result of the test:

a) the force required to pull a SERVICE-ENTRANCE HEAD from the nonmetallic conduit on which it is mounted shall not be less than 222 N (50 lbf), and

b) the average force required to pull off the conditioned SERVICE-ENTRANCE HEAD shall not be less than the average force required to pull off the as-received SERVICE-ENTRANCE HEAD.

8.29.6.2 Six as-received SERVICE-ENTRANCE HEADS of each trade size shall be mounted on 152 mm (6 in) lengths of nonmetallic conduit in the intended manner, and the clamping screw shall be tightened to 4.2 N•m (35 lbf-in).

8.29.6.3 Three as-received FITTING-to-conduit assemblies of each trade size shall be subjected to a pull force between the FITTING and the conduit until the assembly separates. The force required to separate each FITTING-to-conduit assembly shall comply with Clause 8.29.6.1. The average force required to separate the three FITTING-to-conduit assemblies shall be calculated.

8.29.6.4 Three FITTING-to-conduit assemblies of each trade size shall be conditioned for 21 days at a temperature of 92 ±1°C (198 ±2°F) in a full-draft air-circulating oven that has been preheated at full draft. The FITTING-to-conduit assemblies shall be removed from the oven and cooled to room temperature for not less than 4 hours. The assemblies shall then be subjected to a pull force between the FITTING and the conduit until the assembly separates. The force required to separate each FITTING-to-conduit assembly shall comply with Clause 8.29.6.1. For each trade size, the average force required for separation shall be in compliance with Clause 8.29.6.1.

8.29.7 Pull test for SERVICE-ENTRANCE HEADS with clamps to secure to cable

8.29.7.1 Six as-received SERVICE-ENTRANCE HEADS shall be tested as described in Clause 8.29.7.2. As a result of the test, there shall not be slipping of the cable or loosening of the clamp on the SERVICE-ENTRANCE HEAD.

8.29.7.2 A SERVICE-ENTRANCE HEAD shall be secured to a length of service-entrance cable in the intended manner and mounted by its bracket. A pull of 222 N (50 lbf) shall be applied between the SERVICE-ENTRANCE HEAD and the cable for 5 minutes.

8.29.8 Water absorption test

8.29.8.1 A SERVICE-ENTRANCE HEAD shall be tested as described in Clause 8.29.8.2. As a result of the test, the SERVICE-ENTRANCE HEAD shall not absorb more water than 0.5 percent of its weight.

8.29.8.2 The SERVICE-ENTRANCE HEAD shall be cut into three samples. The samples shall be cleaned and dried in a desiccator for 24 hours. Each sample shall be weighed and then immersed in water for 24 hours at a temperature of 23 ±2°C (73 ±4°F). After removal from the water, each sample shall be dried with a clean piece of soft, lint-free cloth to remove all surface water and re-weighed.

8.29.9 Flammability test

8.29.9.1 In Mexico and the United States, the requirements in Clauses 8.29.9.2 – 8.29.9.4 apply.

In Canada, the requirements in Clauses 8.29.9.2 – 8.29.9.4 do not apply.

In Canada, plaque samples or nonmetallic SERVICE-ENTRANCE HEADS shall comply with the requirements for the 5-VB material rating in CAN/CSA C22.2 No. 0.17. The burn-through hole shall not be larger than 6.4 mm (1/4 in).

8.29.9.2 Six samples of a nonmetallic SERVICE-ENTRANCE HEAD shall be subjected to the test described in Clause 8.29.9.3. As a result of the test, a SERVICE-ENTRANCE HEAD:

a) shall not continue to flame for greater than 5 seconds after the third application of the test flame,

b) shall not have flaming particles drop or fall from the SERVICE-ENTRANCE HEAD during or after any application of the test flame, and

c) shall not be entirely consumed during or after any application of the test flame.

8.29.9.3 Each sample SERVICE-ENTRANCE HEAD shall be subjected to the test described in Clause 8.2.4 and Clauses 8.2.6 – 8.2.9. The valve supplying the gas shall be opened for 1 minute and closed for 30 seconds for each of three applications of the test flame. The test sample shall be located so that the test flame is directed at the center of the largest surface.

8.29.9.4 When the SERVICE-ENTRANCE HEAD is too large to be tested in the chamber described in Clause 8.2.4, the SERVICE-ENTRANCE HEAD shall be tested in a chamber that is constructed as described in Clause 8.2.4 with proportionately larger dimensions.

8.30 EXPANSION FITTINGS

8.30.1 General

8.30.1.1 An EXPANSION FITTING shall be assembled to conduit in accordance with Clause 8.30.2. The FITTING shall then be subjected to the test sequence specified in Table 37. See Clause 8.30.8.1.

8.30.2 Assembly test

8.30.2.1 For the tests in Clause 8.30, a set of FITTINGS shall consist of six samples each of the smallest, the largest, and one intermediate trade size in a line of FITTINGS, and of any additional trade size that employs a construction or feature unique to that trade size.

8.30.2.2 For all lines of EXPANSION FITTINGS, one set of FITTINGS shall be assembled in the intended manner to zinc-coated ferrous-metal conduit having the dimensions specified in Table 38, and one set shall be assembled to rigid nonferrous-metal conduit. When the FITTINGS are intended for outdoor use, one additional set shall be assembled to rigid nonferrous-metal conduit.

8.30.3 Resistance test

8.30.3.1 An EXPANSION FITTING, assembled as described in Clauses 8.30.2.1 and 8.30.2.2, shall be subjected to the resistance test described in Clause 8.8. As a result of the test, the voltage drop shall not be greater than 10 millivolts.

The resistance test is not required for an EXPANSION FITTING intended for use with an external bonding jumper. See Clause 7.18.1.

8.30.4 Reciprocation test

8.30.4.1 An EXPANSION FITTING shall be conditioned as described in Clauses 8.30.4.2 and 8.30.4.3 and then subjected to the resistance test described in Clause 8.8. As a result of the test, the voltage drop shall not be greater than 15 millivolts.

The resistance test is not required for an EXPANSION FITTING intended for use with an external bonding jumper. See Clause 7.18.1.

8.30.4.2 Each EXPANSION FITTING assembled to rigid nonferrous-metal conduit and zinc-coated ferrous-metal conduit as required by Clauses 8.30.2.1 and 8.30.2.2 shall be subjected to 500 cycles of reciprocation. One cycle of reciprocation shall consist of a 19.1 mm (3/4 in) insertion of the conduit into the FITTING, followed by withdrawal of the conduit from the FITTING to its original position. The speed of insertion and withdrawal shall not exceed 12.7 mm (0.50 in) per minute.

8.30.4.3 After 500 cycles of reciprocation, each sample shall be subjected to the resistance test described in Clause 8.8. In the event the millivolt drop shows an increase of 5 millivolts or more from the original measurement, and does not exceed the 15 millivolts requirement in Clause 8.30.4.1, the total number of reciprocations shall be increased to 750 cycles.

8.30.4.4 After 750 cycles, in the event the millivolt drop shows an increase of 5 millivolts from the 500 cycle measurement, the total number of reciprocations shall be increased to 1000 cycles to determine compliance with Clause 8.30.4.1. See Clause 8.30.4.5.

8.30.4.5 When more than 500 cycles of reciprocations are required to determine whether a FITTING complies with the 15 millivolts requirement in Clause 8.30.4.1, additional samples shall be assembled in accordance with Clauses 8.30.2.1 and 8.30.2.2 and subjected to 500 cycles of reciprocation. This second group of samples shall then be used to determine compliance with Clauses 8.30.5.1 – 8.30.7.1.

8.30.5 Wet locations (rain-tight) test

8.30.5.1 A set of outdoor EXPANSION FITTINGS that are assembled to conduit shall comply with the wet locations (rain-tight) test described in Clause 8.6.

8.30.6 Corrosion resistance test

8.30.6.1 As a result of the conditioning required by Clauses 8.30.4.2 and 8.30.4.5 if needed, each sample of a FITTING that is assembled to zinc-coated ferrous-metal conduit shall not remove more than 25 percent of the coating used for protection against corrosion on the conduit in the area of reciprocation contact.

8.30.6.2 The coating thickness on the conduit at the area of reciprocation contact determined to have lost the most material shall be measured using the metallic-coating thickness test described in Clause 8.5. To determine a reference measurement for total coating thickness, the area not subjected to reciprocations or damage that is directly adjacent to the area previously measured shall also be measured using the metallic-coating thickness test described in Clause 8.5.

8.30.7 Fault current test

8.30.7.1 A set of EXPANSION FITTINGS shall withstand currents specified in Table 21 without damage. The same zinc-coated ferrous-metal conduit used in the reciprocations conditioning shall be used for the test.

8.30.8 Galvanic compatibility test

8.30.8.1 An outdoor EXPANSION FITTING that has dissimilar metals, such as copper and aluminum, and is in intimate contact with conduit when assembled shall be subjected to a comparative investigation to determine that it has galvanic compatibility and resistance to corrosion at least equivalent to that of a zinc-coated malleable-iron FITTING having a copper slip-ring as assembled to zinc-coated rigid-steel conduit. Among the factors that shall be investigated are exposure to salt spray, moist carbon dioxide-sulfur dioxide-air mixtures, and warm humid air.

8.31 Gaskets – expanded closed cell materials

8.31.1 Insulation resistance test

8.31.1.1 A sample of a finished gasket or a 102 x 102 mm (4 x 4 in) square plaque of the gasket material shall be tested in accordance with Clause 8.31.1.2. As a result of the test, the resistance between the metal plates shall not be less than 25 megohms.

8.31.1.2 The sample shall be placed in contact with two metal plates under minimal compressive force. The leads of a megohmeter shall be secured to the plates and 500 volt dc potential shall be applied at room temperature.

8.31.2 Compression set test

8.31.2.1 Samples of an expanded (foam) closed cell material shall be tested as described in Clause 8.31.2.2. The thickness of a sample after conditioning shall not be less than five-sixths of its original (before conditioning) thickness.

8.31.2.2 Three samples, each 29.0 ±0.5 mm (1.14 ±0.02 in) in diameter and 12.7 ±0.5 mm (0.50 ±0.02 in) thick, shall be prepared, using as many thicknesses of the material as required. Each sample shall be conditioned for 24 hours at a temperature of 23 ±2°C (73 ±4°F) while compressed by one-third its original thickness between flat steel plates. At the end of this period, the samples shall be removed from between the compression plates. After an additional 24 hours, the thickness shall be measured at the center of each samples.

8.32 Mesh grips

8.32.1 Abrasion test

8.32.1.1 A mesh grip shall be tested as described in Clauses 8.32.2.1 – 8.32.4.2. As a result of the tests, a mesh grip shall not severely abrade, cut, rupture, or damage the wire, electrical cable, flexible cord, or flexible conduit of the test assemblies.

8.32.2 PULLING GRIPS and SUPPORT GRIPS tension test

8.32.2.1 A PULLING GRIP or SUPPORT GRIP shall be tested as described in Clause 8.32.2.2. Following the steady pull, the grip shall not break or damage the cable, conduit, or cord. The grip shall withstand for 15 minutes a direct pull equal to 67 percent of its calculated break strength specified by the manufacturer.

8.32.2.2 Three grips shall be assembled to rods of a specified diameter. The diameter of the rod shall be determined by using the lower part of the specified cable diameter range of the grip. For a grip having a range up to 12.7 mm (0.50 in) diameter, a steel rod shall be used. For a grip having a range above 12.7 mm (0.50 in) diameter, an aluminum rod shall be used.

8.32.3 STRAIN RELIEF GRIPS tension test

8.32.3.1 Tests shall be performed using flexible cord, wire conduit, and other material the grip is intended to support. Six samples of each trade size of a STRAIN RELIEF GRIP shall hold for 5 min a gradually applied direct pull with a force as specified in Table 27. When the grip is attached to a FITTING, the point of attachment of the grip shall be subject to the test at the same time. The FITTING shall be loosely assembled to the material it is intended to support so that the pull force is applied to the grip and its attachment to the FITTING.

8.32.4 Grips of nonmetallic materials accelerated aging test

8.32.4.1 Six samples of each size of a grip constructed of nonmetallic materials shall be conditioned as specified in Clause 8.32.4.2. As a result of the conditioning, a nonmetallic grip shall not crack when wrapped 360 degrees around the applicable mandrel in Table 39. The tension applied to the sample shall result in the sample just conforming to the curved surface of the mandrel.

8.32.4.2 A grip as specified in Clause 8.32.4.1 shall be conditioned for 168 hours at the temperature specified in Table 18 in an full-draft air-circulating oven that has been preheated at full draft.

8.33 Reducing washers resistance test

8.33.1 Six pairs of reducing washers shall be assembled to threaded conduit and unpainted steel plates as illustrated in Figure 16, and then subjected to the resistance test described in Clause 8.8. As a result of the test, the voltage drop shall not be greater than 10 millivolts. The samples shall then comply with the current test described in Clause 8.9.

8.34 BUSHINGS for metal studs

8.34.1 Secureness of BUSHING test

8.34.1.1 Six samples of each size of a metallic or nonmetallic BUSHING for metal studs shall be subjected to the test specified in Clause 8.34.1.2. The BUSHING shall not become removed or dislodged from the metal stud.

8.34.1.2 A BUSHING shall be installed as intended to a metal stud. The BUSHING and metal-stud assembly shall then be dropped on a bare concrete floor from a height of 1 m (3.3 ft). After being dropped, a force of 110 N (25 lbf) shall be applied for 30 s to the BUSHING and metal-stud assembly at a point with the greatest risk of dislodging the BUSHING from the metal stud.

8.34.2 Nonmetallic BUSHING accelerated aging test

8.34.2.1 Six samples of each size of a nonmetallic BUSHING for use with metal studs shall be conditioned as specified in Clause 8.34.2.2. As a result of the conditioning, the BUSHING shall not warp, char, or blister, and there shall not be dimensional change greater than 5 percent.

8.34.2.2 A nonmetallic BUSHING as described in Clause 8.34.2.1 shall be conditioned for 168 hours at a temperature of 112 ±1°C (234 ±2°F) in an full-draft air-circulating oven that has been preheated at full draft. The sample shall then be removed from the oven and cooled to room temperature for not less than 4 hours.

8.34.3 Nonmetallic BUSHING dielectric-voltage withstand test

8.34.3.1 Six samples of each size of a nonmetallic BUSHING for use in metal studs shall be subjected to the tests described in Clause 8.34.3.2. As a result of the test, the samples shall withstand the test potential without electrical breakdown.

8.34.3.2 Each BUSHING specified in Clause 8.34.3.1 shall be installed as intended in a metal stud. A cone-shaped rod, 100 mm (4 in) in length, with a 12 degree taper, shall be passed through the BUSHING. The rod shall fit snugly into the inside diameter of the BUSHING. The metal stud shall be mounted on insulated stands and the metal rod shall be grounded. A 60-hertz sinusoidal potential of 1000 volts rms shall be raised gradually to the full value and applied for 1 minute to each assembly. The specified potential shall be applied between the metal stud and the grounded metal rod. The test shall be repeated with the metal rod inserted into the opposite side of the BUSHING.

8.34.4 Metal BUSHING dielectric-voltage withstand test

8.34.4.1 A metal BUSHING and cable assembly shall be subjected to the test described in Clause 8.34.4.2. As a result of the test, the cable used as part of the test assembly shall withstand the test potential without electrical breakdown, and the cable sheath shall not be cut through.

8.34.4.2 Two samples of metal studs, each 200 mm (8 in) long and provided with a factory made opening for cable, shall be used for the test. The metal-stud samples shall be attached to a fixture as specified in Figure 17. Metal BUSHINGS intended for use with metal studs shall be installed as intended in the sample studs. A 2000 mm (80 in) length of two-conductor 14/2 AWG nonmetallic-sheathed cable shall be inserted through the BUSHINGS and a 9 kg (20 lb) weight shall be attached to one end of the cable. Enough weight shall be attached to the other end of the cable to lift the 9 kg (20 lb) weight 305 mm (12 in) from its original position. The action shall be repeated 9 more times, for a total of 10 times, using the same cable sample. A 60-hertz sinusoidal potential of 5000 volts rms shall then be raised gradually to the full value and applied for 1 minute to the assembly between the insulated conductors and the BUSHINGS, and between the insulated conductors and the ground wire.

8.34.5 Metal BUSHING secureness test

8.34.5.1 A metallic BUSHING for metal studs shall be subjected to the test specified in Clause 8.34.5.2. As a result of the test, the BUSHING shall not be removed or dislodged from the stud.

8.34.5.2 Two samples of metal studs each 500 mm (20 in) long, and at least one sample provided with a factory made opening in the center for cable, shall be used for the test. The metal-stud samples shall be attached between two pieces of wallboard 500 X 500 mm (20 X 20 in) and 12.7 mm (1/2 in) thick, using wallboard mounting screws at each corner. Metal BUSHINGS intended for use with metal studs shall be installed in the sample studs. A 25.4 mm (1 in) wallboard mounting screw shall be inserted into the stud, using an electric powered screwdriver, at a point with the greatest risk of dislodging the BUSHING from the metal stud.

8.35 Permanence of markings test

8.35.1 In Mexico, the requirements in Clauses 8.35.2 and 8.35.3 apply.

In Canada and the United States, the requirements in Clauses 8.35.2 and 8.35.3 do not apply. See Clause 7.1.1 e).

8.35.2 An indelibly stamped marking shall be legible after rubbing the marking by hand for 15 seconds with a piece of cloth soaked with water and again for 15 seconds with a piece of cloth soaked with petroleum spirit.

8.35.3 The petroleum spirit used shall consist of a solvent hexane with an aromatic content of maximum 0.1 percent by volume, a kauributanol value of approximately 29, an initial boiling point of approximately 65°C (149°F), a dry point of approximately 69°C (156.2°F), and a density of approximately 0.68 g/cm^3 (0.025 lb/in^3).

8.36 Internal thread gauging test

8.36.1 The internal threads of 6 samples of each trade size of a fitting or conduit entry shall be tested as specified in Clauses 8.36.2 – 8.36.4. The number of turns to completely disengage the National Standard Pipe Taper (NPT) plug gauge shall be within the limits specified in Table 43. In all cases, the minimum hub depth (or thread depth in the case of an entry without a thread relief) shall be equivalent to the actual thread depth needed to achieve the required number of disengagement turns falling within the range specified plus the equivalent length of 2 additional threads.

8.36.2 For the test, the internal threads of a fitting or conduit entry shall be clean and undamaged. Any protective coatings or finishes intended to be used with the fitting or conduit entry shall be applied to the sample fitting or entry.

8.36.3 A pipe plug or conduit nipple having a minimum thread tolerance that complies with NMX-J-554-ANCE, CSA C22.2 No. 0.5, or ASME B1.20.1 shall be wrench-tightened into the fitting or conduit entry and removed before gauging. All foreign particles (plating, coating, etc.) shall be removed from the threads.

8.36.4 A standard NPT plug gauge that complies with NMX-J-554-ANCE, CSA C22.2 No. 0.5, or ASME B1.20.1 shall be inserted into the entry until it is firmly hand-tight. The gauge shall not bottom on an integral bushing. The plug gauge shall be turned to determine the number of turns required to completely disengage the gauge.

Table 1
Thickness and diameters of LOCKNUTS and BUSHINGS
(See Clauses 5.4.1.2, 5.4.1.3, 5.5.1.1, 5.5.1.4, 5.5.1.5, 5.5.2.1, 5.5.3.1, 5.5.4.1, 5.5.4.2, 5.10.2.1, 5.15.1, 5.19.2, 8.12.1.1, 8.28.2.1, Table 2, and Figure 1.)

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

NOTE – One means of determining compliance with the requirements for dimensional specifications for throat diameters is specified in Figure 1 and Table 2.

Table 2
Diameters of limit gauges for throats of BUSHINGS
(See Clause 5.4.1.3 and Table 1.)

Trade size of conduit	Metric designator	Diameter (Dg) of go gauge[a]		Diameter (Dn) of no-go gauge[a]	
		mm	(in)	mm	(in)
3/8	12	11.252	0.4430	12.548	0.4940
1/2	16	14.199	0.5590	15.824	0.6230
3/4	21	18.821	0.7410	20.955	0.8250
1	27	23.952	0.9430	26.670	1.0500
1-1/4	35	31.521	1.2410	35.077	1.3810
1-1/2	41	36.779	1.4480	40.919	1.6110
2	53	47.219	1.8590	52.527	2.0680
2-1/2	63	56.413	2.2210	62.738	2.4700
3	78	70.104	2.7600	77.953	3.0690
3-1/2	91	81.077	3.1920	90.145	3.5490
4	103	91.999	3.6220	102.286	4.0270
5	129	115.341	4.5410	128.219	5.0480
6	155	138.608	5.4570	154.076	6.0660

[a] A tolerance of ± 0.013 mm (0.0005 in) applies.

Table 3
Internal diameter of end stop of flexible metal conduit FITTING
(See Clause 5.4.3.3.)

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

Table 4
Internal diameter of end stop of flexible metallic tubing FITTINGS
(See Clause 5.4.5.1)

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

Table 5
External diameter of flexible metallic tubing FITTINGS
(See Clause 5.4.5.1.)

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

Table 6
Diameter of end stop of liquid-tight flexible conduit FITTINGS
(See Clause 5.4.6.1.)

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

Table 7
Diameter of end stop
(See Clauses 5.5.1.2 and 5.5.2.2.)

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

[a] A reduced diameter under the threaded section shall not result in a sudden reduction in the inside diameter of the raceway.

Table 8
PVC CONDUIT BODY socket dimensions in millimeters
(See Clauses 5.7.1.1, 5.7.2.7, 7.10.1, and 7.10.7.)

Trade size of conduit	Metric designator	Socket diameter						Max	Min[a]	Minimum Wall thickness
		At entrance			At bottom					
		Max	Min	Avg	Max	Min	Avg			
1/2	16	21.84	21.44	21.64 ± 0.10	21.44	21.03	21.23 ± 0.10	38.10	16.56	2.41
3/4	21	27.28	26.77	27.03 ± 0.10	26.82	26.31	26.57 ± 0.10	38.10	18.26	2.41
1	27	34.04	33.53	33.78 ± 0.13	33.53	33.02	33.27 ± 0.13	47.63	22.23	2.54
1 1/4	35	42.90	42.29	42.60 ± 0.13	42.34	41.73	42.04 ± 0.13	50.80	23.83	3.05
1 1/2	41	49.02	48.41	48.72 ± 0.15	48.41	47.80	48.11 ± 0.15	50.80	26.97	3.05
2	53	61.09	60.48	60.78 ± 0.15	60.48	59.87	60.17 ± 0.15	50.80	28.58	3.30
2 1/2	63	73.79	73.03	73.41 ± 0.18	73.23	72.47	72.85 ± 0.18	76.20	37.31	4.19

Table 8 Continued on Next Page

Table 8 Continued

Trade size of conduit	Metric designator	Socket diameter						Max	Min[a]	Minimum Wall thickness
		At entrance			At bottom					
		Max	Min	Avg	Max	Min	Avg			
3	78	89.66	88.90	89.28 ± 0.20	89.08	88.32	88.70 ± 0.20	79.38	40.49	5.49
3 1/2	91	103.25	100.71	101.98 ± 0.20	101.78	101.02	101.40 ± 0.20	82.55	42.85	5.74
4	103	115.95	113.41	114.68 ± 0.23	114.45	113.69	114.07 ± 0.23	85.73	44.45	6.02
5	129	143.33	140.79	142.06 ± 0.25	141.81	140.28	141.05 ± 0.25	92.08	49.20	6.55
6	155	170.38	167.84	169.11 ± 0.28	168.76	167.23	168.00 ± 0.28	95.25	53.98	7.11

[a] The minimum socket depth is not specified. Strength shall be evaluated by the bending test in Clauses 8.10.5.1 and 8.10.5.2, and the pull test in Clause 8.10.7.1. The depths shown are the smallest yet accepted. Tests are not required on sockets complying with these minimums.

Table 9
PVC CONDUIT BODY socket dimensions in inches
(See Clauses 5.7.1.1, 5.7.2.7, 7.10.1, and 7.10.7.)

Trade size of conduit	Metric designator	Socket diameter						Max	Min[a]	Minimum Wall thickness
		At entrance			At bottom					
		Max	Min	Avg	Max	Min	Avg			
1/2	16	0.860	0.844	0.852 ± 0.004	0.844	0.828	0.836 ± 0.004	1.500	0.652	0.095
3/4	21	1.074	1.054	1.064 ± 0.004	1.056	1.036	1.046 ± 0.004	1.500	0.719	0.095
1	27	1.340	1.320	1.330 ± 0.005	1.320	1.300	1.310 ± 0.005	1.875	0.875	0.100
1 1/4	35	1.689	1.665	1.677 ± 0.005	1.667	1.643	1.655 ± 0.005	2.000	0.938	0.120
1 1/2	41	1.930	1.906	1.918 ± 0.006	1.906	1.882	1.894 ± 0.006	2.000	1.062	0.120
2	53	2.405	2.381	2.393 ± 0.006	2.381	2.357	2.369 ± 0.006	2.000	1.125	0.130
2 1/2	63	2.905	2.875	2.890 ± 0.007	2.883	2.853	2.868 ± 0.007	3.000	1.469	0.165
3	78	3.530	3.500	3.515 ± 0.008	3.507	3.477	3.492 ± 0.008	3.125	1.594	0.216
3 1/2	91	4.065	3.965	4.015 ± 0.008	4.007	3.977	3.992 ± 0.008	3.250	1.687	0.226
4	103	4.565	4.465	4.515 ± 0.009	4.506	4.476	4.491± 0.009	3.375	1.750	0.237
5	129	5.643	5.543	5.593 ± 0.010	5.583	5.523	5.553 ± 0.010	3.625	1.937	0.258
6	155	6.708	6.608	6.685 ± 0.011	6.644	6.584	6.614 ± 0.011	3.750	2.125	0.280

[a] The minimum socket depth is not specified. The depths shown are the smallest yet accepted. Strength shall be evaluated by the bending test in Clauses 8.10.5.1 and 8.10.5.2, and the pull test in Clause 8.10.7.1. Tests are not required on sockets complying with these minimums.

Table 10
Throat diameters at any point in CONDUIT BODIES
(See Clauses 5.7.1.1, 5.5.1.3, 5.7.1.10, 5.7.1.12, and 5.7.1.13.)

Trade size of conduit	Metric designator	Minimum throat diameter					
		Field-attached COUPLINGS and FITTINGS other than adapters[a]		Factory-applied COUPLINGS with stops			
		mm	(in)	For use with heavy-wall conduit		For use with thin-wall conduit	
				mm	(in)	mm	(in)
1/2	16	18.49	0.728	16.00	0.630	18.49	0.728
3/4	21	21.34	0.840	21.18	0.834	21.34	0.840
1	27	30.61	1.205	26.90	1.059	30.61	1.205
1-1/4	35	38.91	1.532	35.36	1.392	38.91	1.532
1-1/2	41	44.50	1.752	41.20	1.622	44.50	1.752
2	53	55.55	2.187	52.81	2.079	55.55	2.187
2-1/2	63	67.82	2.670	63.09	2.484	67.82	2.670
3	78	85.47	3.365	78.31	3.083	85.47	3.365
3-1/2	91	95.50	3.760	91.39	3.598	95.50	3.760
4	103	107.95	4.250	103.53	4.076	107.95	4.250
5	129	129.46	5.097	129.46	5.097	–	–
6	155	155.32	6.115	155.32	6.115	–	–

[a] For reducers, the throat for the smaller of the two sizes of conduit applies.

Table 11
Dimensions of gauges for throats of CONDUIT BODIES
(See Clauses 5.5.1.3, 5.7.1.1, 5.7.1.10, and 5.7.1.11.)

Trade size of conduit	Metric designator	For internally and externally threaded adapters				Diameter (Dg) of go gauge for all field-attached COUPLINGS and for factory attached COUPLINGS that have stops and are for use with thin-wall PVC conduit and for FITTINGS other than adapters		Diameter (Dg) of go gauge for factory attached COUPLINGS that have stops and are for use with heavy-wall PVC conduit	
		Diameter (Dg) of go gauge		Diameter (Dn) of no-go gauge					
		mm[a]	(in)[a]	mm[a]	(in)[a]	mm[a]	(in)[a]	mm[a]	(in)[a]
1/2	16	14.986	0.5900	15.824	0.6230	18.466	0.7270	15.977	0.6290
3/4	21	19.863	0.7820	20.955	0.8250	21.311	0.8390	21.158	0.8330
1	27	25.298	0.9960	26.670	1.0500	30.582	1.2040	26.873	1.0580
1-1/4	35	33.274	1.3100	35.077	1.3810	38.887	1.5310	35.331	1.3910
1-1/2	41	38.811	1.5280	40.919	1.6110	44.475	1.7510	41.173	1.6210
2	53	49.860	1.9630	52.527	2.0680	58.064	2.2860	52.781	2.0780
2-1/2	63	59.593	2.3450	62.738	2.4700	67.793	2.6690	63.068	2.4830
3	78	74.016	2.9140	77.953	3.0690	85.446	3.3640	78.283	3.0820
3-1/2	91	85.598	3.3700	90.145	3.5490	95.479	3.7590	91.364	3.5970
4	103	97.130	3.8240	102.286	4.0270	107.925	4.2490	103.505	4.0750
5	129	121.768	4.7940	128.219	5.0480	129.438	5.0960	129.438	5.0960
6	155	146.329	5.7610	154.076	6.0660	155.296	6.1140	155.296	6.1140

[a] A tolerance of ± 0.013 mm (0.0005 in) applies.

Table 12
Minimum thread projection of FITTING
(See Clause 5.8.2.1.)

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

Table 13
Armored cable BUSHING dimensions
(See Clauses 5.12.2 and 5.12.4 and Table C.1.)

BUSHING size no.	Wall thickness		Tolerance (±)	
	mm	(in)	mm	(in)
0	0.65	0.025	0.25	0.010
1	0.75	0.029	0.28	0.011
2	0.85	0.033	0.30	0.012
3	0.85	0.034	0.30	0.012
4	0.85	0.034	0.30	0.012
5	1.00	0.038	0.33	0.013
6	1.00	0.043	0.36	0.014
7	1.30	0.050	0.38	0.015
8	1.80	0.070	0.38	0.015

NOTE – The recommended BUSHING size for a given range of armor is provided in Annex C.

Table 14
Dimensions of knockouts and reducing washers
(See Clause 5.18.1.)

Trade size	Metric designator	Outer diameter				Diameter of projection				Diameter of conduit opening			
		Minimum		Maximum		Minimum		Maximum		Minimum		Maximum	
		mm	(in)	mm	(in)	mm	(in)	mm	(in)	mm	(in)	mm	(in)
1/2	16	–	–	–	–	–	–	–	–	21.84	0.860	23.01	0.906
3/4	21	31.29	1.232	37.79	1.488	26.67	1.050	27.68	1.090	27.78	1.094	28.98	1.141
1	27	38.28	1.507	47.80	1.882	33.15	1.305	34.41	1.355	34.51	1.359	35.71	1.406
1-1/4	35	41.57	1.873	59.79	2.354	42.14	1.659	43.56	1.715	43.66	1.719	44.86	1.766
1-1/2	41	54.33	2.139	66.80	2.630	48.08	1.893	49.61	1.953	49.73	1.958	51.21	2.016
2	53	66.85	2.632	82.80	3.260	60.15	2.368	61.67	2.428	61.80	2.433	63.50	2.500
2-1/2	63	79.68	3.137	94.79	3.732	72.72	2.863	74.50	2.933	74.63	2.938	76.20	3.000
3	78	95.30	3.752	112.80	4.441	88.85	3.498	90.88	3.578	91.00	3.583	92.08	3.625
3-1/2	91	111.56	4.392	127.00	5.000	99.57	3.920	101.60	4.000	103.20	4.063	105.56	4.156
4	103	125.07	4.924	139.70	5.500	112.26	4.420	114.30	4.500	–	–	–	–

Table 15
Tightening torque
(See Clauses 6.2.1, 8.16.2.1, 8.26.2.1, 8.27.2.2, and 8.27.2.4.)

Trade size of FITTING	Metric designator	Tightening torque	
		N•m	(lbf-in)
1/4[a]	10	19.8	175
3/8	12	22.6[b]	200[b]
1/2	16	33.9	300
3/4	21	56.5	500
1	27	79.1	700
1-1/4	35	113	1000
1-1/2	41	136	1200
2	53	181	1600
2-1/2	63	181	1600
3	78	181	1600
3-1/2	91	181	1600
4	103	181	1600

[a] Applies to FLEXIBLE CORD FITTINGS only.

[b] A 3/8 (12) trade-size FITTING for use with liquid-tight flexible metal conduit shall be tightened with a torque of 26.6 N•m (235 lbf-in).

Table 16
Wall thickness of FITTINGS
(See Clauses 5.1.1.1 and 5.1.2.2.)

Material of FITTINGS	Minimum wall thickness of unthreaded parts		Minimum thickness at base of threads	
	mm	(in)	mm	(in)
Sheet steel or machine steel	0.63[e]	0.025[e]	0.63[a]	0.025[a]
			0.50[b]	0.02[b]
Sheet aluminum	0.78	0.031	0.78	0.031
Die-cast aluminum, die-cast zinc, or malleable iron	1.57	1/16	0.78	1/32
Die-cast zinc – ribbed or otherwise reinforced	1.2	3/64	0.8	1/32
Sand-cast aluminum, steel, bronze, or cast iron	3.17	1/8	2.36[c]	3/32[c]
			1.57[d]	1/16[d]

NOTE – Thickness at the base of threads shall be measured with a conical-nosed micrometer having points with a 0.4 mm (0.016 in) flat surface at the ends, and with the sides of the cone forming an angle of 60 degrees with the planes of the flat surfaces.

[a] At the base of cut threads.

[b] At the base of rolled threads.

[c] At the base of internal threads and at the base of external threads in FITTINGS of the 1 (27) and larger trade sizes.

[d] At the base of external threads in FITTINGS of the 3/4 (21) and smaller trade sizes.

[e] A flexible-conduit or armored-cable CONNECTOR less than 0.63 mm (0.025 in) and not less than 0.4 mm (0.016 in) thick complies when the CONNECTOR is manufactured from heat-treated steel with a Rockwell hardness on the C scale of 40 – 50.

Table 17
Thickness of zinc coating
(See Clause 5.1.3.1.)

Type of FITTING and material	Thickness of coating			
	Average[a]		Minimum	
	mm	(in)	mm	(in)
A FITTING part, locknut, or clamp intended for assembly inside a box	0.0038	0.00015	0.0025	0.0001
Outside of a sheet-steel or a machined-steel COUPLING, CONNECTOR, BUSHING, reducing washer, or CONDUIT LOCKNUT	0.0127	0.0005	0.0102	0.0004
Inside of a sheet-steel or machined-steel FITTING	b		b	
Malleable or cast-iron FITTINGS	b		b	
Screws	b		b	

[a] The average thickness shall be determined by averaging at least three measurements. Each measurement shall be taken on a different surface, when possible. When it is required to take multiple measurements on a single surface, they shall be spaced equally over that surface.

[b] The minimum thickness of the coating on these FITTINGS and components is not specified. Evidence of corrosion protection provided shall be verified by visual inspection.

Table 18
Temperature for conditioning polymeric materials
(See Clauses 5.2.2.1, 7.5.1, 8.28.2.2, and 8.32.4.2.)

Temperature rating of device		Conditioning temperature	
°C	(°F)	°C	(°F)
90	194	112	234
105	221	128	262
150	302	173	343
200	392	225	437

NOTE – The conditioning temperature is the rated temperature of the polymeric material plus 15°C (27°F) plus 2 percent of the rated temperature on the absolute scale.

Table 19
Carton markings
(See Clauses 7.1.5, 7.1.7, and 8.6.1.)

Item	Condition of use or installation	Carton marking[a]	
1	For use in poured concrete	Concrete-tight or Concrete-tight when taped	
2	For use with unthreaded rigid or intermediate metal conduit	Unthreaded for __ [b] conduit	
3	For use with threaded rigid or intermediate metal conduit	Unthreaded for threaded __ [b] conduit	
4	For liquid-tight applications	Liquid-tight	
5	For use with steel (FE) EMT	For EMT or EMT or Electrical Metallic Tubing	
6	For use with steel (FE) or aluminum (AL) EMT	For (FE or STEEL or AL) EMT or Electrical Metallic Tubing	
7	For use in dry locations	Dry locations	
8	For use in wet locations (rain-tight)	Wet locations or rain-tight	
9	For use in wet locations only with a separate gasket installed between the box and FITTING	In wet locations, use __ [d] between box and FITTING	
10	For use with specific type of rigid nonmetallic conduit above or below ground	For __ [c] rigid nonmetallic conduit	
11	For use in COUPLING cable and/or conduit to different raceway systems	For __ [e] and rigid metal conduit, IMC[e], and EMT or Electrical Metallic Tubing	
		Complete	Abbreviated
12	For use with all types of FMC (flexible metal conduit)	For FMC	FMC
13	For use with steel (FE) or aluminum (AL) FMC only	For FE FMC	FEFMC
		For STEEL FMC	STEELFMC
		For AL FMC	ALFMC
		For ALUM FMC	ALUMFMC
		For ALUMINUM FMC	ALUMINUMFMC
14	For use with reduced-wall FMC only	For RWFMC	RWFMC
15	For use with reduced-wall steel (FE) or aluminum (AL) FMC only	For FE RWFMC	FERWFMC
		For STEEL RWFMC	STEELRWFMC
		For AL RWFMC	ALRWFMC
		For ALUM RWFMC	ALUMRWFMC
		For ALUMINUM RWFMC	ALUMINUMRWFMC

[a] The carton marking specified above shall be prefixed by ″Intended for″ instead of ″For″ or shall use the word ″only.″

Table 19 Continued on Next Page

Table 19 Continued

Item	Condition of use or installation	Carton marking[a]
[b] Blank to be filled in with ″rigid,″ ″intermediate,″ or a combination of the two, followed by the material type – FE (or STEEL) or AL (or ALUM or ALUMINUM).		
[c] Blank to be filled in with the use of the intended type of conduit, such as ″PVC underground,″ as required or applicable.		
[d] Blank to be filled in with specific identification of the component to be used, including the part number, to identify the gasket, seal or similar component that must be installed to provide a rain-tight connection.		
[e] Blank to be filled in with specific identification of the cable or conduit to be used, such as NM, NMD90, NMSC, AC, MC, or FMC.		
In Canada, IMC is not recognized.		

Table 20
Thickness of zinc coatings
(See Clause 8.5.10.)

Temperature, degrees		Thickness factors
°C	(°F)	
21.1	70	0.980
21.7	71	0.990
22.2	72	1.000
22.8	73	1.010
23.3	74	1.015
23.9	75	1.025
24.4	76	1.033
25.0	77	1.042
25.6	78	1.050
26.1	79	1.060
26.7	80	1.070
27.2	81	1.080
27.8	82	1.085
28.3	83	1.095
28.9	84	1.100
29.4	85	1.110
30.0	86	1.120
30.6	87	1.130
31.1	88	1.141
31.7	89	1.150
32.2	90	1.160

Table 21
Test currents and times
(See Clause 8.9.1, 8.9.4, 8.9.5, and 8.30.7.1.)

Trade size	Metric designator	Test time, seconds	Current, amperes	Minimum size of copper leads used to connect sample assembly to current source	
				AWG	mm^2
3/8	12	4	470	12	3.3
1/2	16	4	1180	8	8.4
3/4, 1	21, 27	6	1530	6	13.3
1-1/4, 1-1/2	35, 41	6	2450	4	21.2
2	53	6	3900	2	33.6
2-1/2	63	6	4900	1	42.4
3, 3-1/2, 4	78, 91, 103	9	5050	1/0	53.5
5, 6	129, 155	9	8030	3/0	85.0

NOTE – Trade size for metal-clad cable FITTINGS refers to the associated knockout.

Table 22
Tightening torque value
(See Clause 8.9.3.)

Screw or bolt size	Tightening torque	
	N•m	lb-ft
No. 8	2	1.5
No. 10	3	2.0
1/4 in or less	8	6
5/16 in	15	11
3/8 in	26	19
7/16 in	41	30
1/2 in	54	40
9/16, 5/8 in, or larger	75	55

Table 23
Plug gauge diameters
(See Clause 8.10.2.1.)

Trade size of electrical metallic tubing	Metric designator	Diameter of plug gauge	
		mm[a]	(in)[a]
3/8	12	10.64	0.419
1/2	16	13.44	0.529
3/4	21	17.78	0.700
1	27	22.66	0.892
1-1/4	35	29.79	1.173
1-1/2	41	34.77	1.369
2	53	44.63	1.757
2-1/2	63	58.95	2.321
3	78	72.47	2.853
3-1/2	91	82.78	3.269
4	103	93.57	3.684

[a] Tolerance, ±0.03 mm (±0.001 in)

Table 24
Bending load, and pull force for THREADLESS FITTINGS
(See Clauses 8.10.5.2 and 8.10.7.1.)

Trade size of FITTING	Metric designator	Bending load				Pull force for EMT, IMC, or rigid conduit	
		EMT		IMC and rigid conduit		N	(lbf)
		kg	(lb)	kg	(lb)		
3/8	12	6.7	15	13.3	30	890	200
1/2	16	8.9	20	26.7	60	1334	300
3/4	21	15.6	35	35.6	80	2002	450
1	27	22.7	50	53.4	120	2668	600
1-1/4	35	33.3	75	71.2	160	3114	700
1-1/2	41	37.8	85	71.2	160	3559	800
2	53	48.9	110	71.2	160	4450	1000
2-1/2	63	48.9	110	71.2	160	4450	1000
3	78	48.9	110	71.2	160	4450	1000
3-1/2	91	48.9	110	71.2	160	4450	1000
4	103	48.9	110	71.2	160	4450	1000

Table 25
Bending load
(See Clause 8.12.3.3.)

Size of stud		Load	
mm	(in)	kg	(lb)
3.2	1/8	9.07	20
6.4 and larger	1/4 and larger	13.61	30

Table 26
Tightening torque
(See Clause 8.12.3.5.)

Size of stud		Torque	
mm	(in)	N•m	(lbf-in)
3.2	1/8	22.6	200
6.4 and larger	1/4 and larger	45.2	400

Table 27
Pull force
(See Clauses 8.13.4.1, 8.14.4.1, 8.16.4.1, 8.18.3.1, 8.21.6.1, 8.22.4.1, and 8.32.3.1.)

Trade size of FITTING	Metric designator	Force	
		N	(lbf)
1/2	16	333	75
3/4	21	444	100
1	27	556	125
1-1/4 to 4	35 to 103	667	150

Table 28
Test sequence for flexible metallic tubing FITTINGS
(See Clause 8.17.1.2.)

Test sequence A	Test sequence B
Assembly (8.17.2.1)	Assembly (8.17.2.1)
Resistance (8.17.3.1)	Resistance (8.17.3.1)
Flexing (8.17.4.1)	Pull (8.17.5.1)
Repeated Resistance (8.17.6.1)	Repeated Resistance (8.17.6.1)

NOTE – Numbers in parentheses are the clause numbers of the requirements.

Table 29
Bending radius for flexible metallic tubing
(See Clause 8.17.4.2.)

Trade size of tubing	Metric designator	Radius	
		mm	(in)
3/8	12	254.0	10
1/2	16	317.5	12-1/2
3/4	21	443.5	17-1/2

Table 30
Load for crushing test on FITTINGS
(See Clauses 8.20.1.1 and 8.20.7.5.)

Trade size of conduit socket	Metric designator	Load, N per linear mm	Load, lb per linear in
1/2	16	29.2	166.7
3/4	21	29.2	166.7
1	27	29.2	166.7
1-1/4	35	29.2	166.7
1-1/2	41	21.9	125.0
2	53	20.4	116.7
2-1/2	63	29.2	166.7
3	78	29.2	166.7
3-1/2	91	29.2	166.7
4	103	26.3	150.0
5	129	24.8	141.7
6	155	24.8	141.7

Table 31
Bending load and pull force
(See Clauses 8.20.1.1, 8.20.8.5, and 8.20.9.1.)

Trade size of FITTING	Metric designator	Bending load		Pull force	
		kg	(lb)	N	(lbf)
1/2	16	9.07	20	1334	300
3/4	21	15.88	35	2002	450
1	27	22.68	50	2669	600
1-1/4	35	34.02	75	3114	700
1-1/2	41	38.56	85	3559	800
2	53	49.89	110	4448	1000
2-1/2	63	49.89	110	4448	1000
3	78	49.89	110	4448	1000
3-1/2	91	49.89	110	4448	1000
4	103	49.89	110	4448	1000
5	129	49.89	110	4448	1000
6	155	49.89	110	4448	1000

Table 32
Tightening torque for a metal-clad cable FITTING employing a gland
(See Clauses 8.21.1.1 and 8.21.2.2.)

Trade size of FITTING	Metric designator	Tightening torque	
		N•m	(lbf-in)
1/2	16	33.9	300
3/4	21	56.5	500
Larger than 3/4	Larger than 21	79.1	700

Table 33
Bending radius for metal-clad cable
(See Clauses 8.21.1.1, 8.21.2.5, and 8.21.4.2.)

External diameter of cable		Cable with interlocked armor or corrugated sheath			Shielded conductors			Cables with smooth sheath		
		Multiplying factor for inner radius of cable bend[a]	Minimum test cable length		Multiplying factor for inner radius of cable bend[a]	Minimum test cable length		Multiplying factor for inner radius of cable bend[a]	Minimum test cable length	
mm	(in)		m	(ft)		m	(ft)		m	(ft)
Not more than 19.1	Not more than 3/4	7	0.61	2	12	0.91	3	10	0.91	3
More than 19.1 and not more than 38.1	More than 3/4 and not more than 1-1/2	7	0.91	3	12	1.22	4	12	1.22	4
More than 38.1 and not more than 63.5	More than 1-1/2 and not more than 2-1/2	7	1.22	4	12	1.83	6	15	2.44	8
More than 63.5	More than 2-1/2	7	1.83	6	12	2.44	8	15	3.05	10

[a] The factor shall be multiplied by the external diameter of the cable to get the inner radius of the bend.

Table 34
Oven temperature
(See Clause 8.27.4.3.)

Temperature rating of cable		Oven temperature ±1°C (±2°F)	
°C	(°F)	°C	(°F)
60	140	100	212
75	167	121	250
90	194	136	277

Table 35
Test potentials
(See Clause 8.27.7.2.)

Size of conductor		Test potential, volts (rms)
AWG or Kcmil	mm^2	
14 – 10	0.82 – 5.3	1500
8 – 2	8.4 – 33.6	2000
1 – 4/0	42.4 – 107.2	2500
250 – 500	110 – 253	3000
550 – 1000	254 – 506	3500

Table 36
Vertical drop distance for impact test
(See Clause 8.29.4.2.)

Trade size of FITTING	Metric designator	Vertical distance of weight above FITTING			
		Top of cover		Side of cover	
		mm	(ft)	mm	(ft)
1/2, 3/4, 1	16, 21, 27	910	3	610	2
1-1/4, 1-1/2, 2 – 4	35, 41, 53 – 103	910	3	910	3

Table 37
EXPANSION FITTING test program
(See Clause 8.30.1.1.)

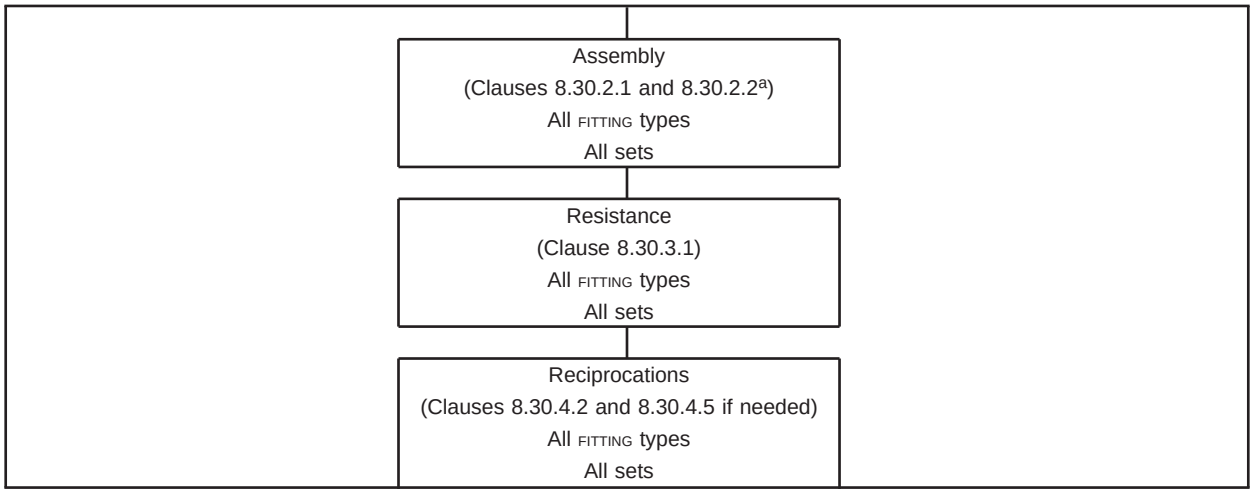


Table 37 Continued on Next Page

Table 37 Continued

Corrosion resistance[b] (Clause 8.30.6.1 and 8.30.6.2) All FITTING types 1 set	Wet locations (Clause 8.30.5.1) Outdoor FITTINGS 1 set	Fault current (Clause 8.30.7.1) All FITTING types 1 set

[a] Numbers in parentheses are clause numbers of requirements.
[b] Test to be performed on a set of FITTINGS that are assembled to zinc-coated ferrous-metal conduit.

Table 38
Dimension of zinc-coated ferrous-metal conduit for assembly
(See Clause 8.30.2.2.)

Trade size of conduit	Metric designator	Outside diameter[a]	
		mm	(in)
1/2	16	21.3	0.840
3/4	21	26.7	1.050
1	27	33.4	1.315
1-1/4	35	42.2	1.660
1-1/2	41	48.3	1.900
2	53	60.3	2.375
2-1/2	63	73.0	2.875
3	78	88.9	3.500
3-1/2	91	101.6	4.000
4	103	114.3	4.500
5	129	141.3	5.563
6	155	168.3	6.625

[a] Tolerances are plus 0.508 mm (0.020 in), minus 0.000 mm (0.000 in).

Table 39
Mandrel diameter
(See Clause 8.32.4.1.)

Overall diameter of grip		Diameter of mandrel	
mm	(in)	mm	(in)
0 – 7.62	0 – 0.300	31.75	1.250
7.65 – 9.53	0.301 – 0.375	38.10	1.500
9.55 – 10.80	0.376 – 0.425	44.45	1.750
10.82 – 12.70	0.426 – 0.500	50.80	2.000
12.73 – 13.97	0.501 – 0.550	57.15	2.250
14.00 – 15.88	0.551 – 0.625	63.50	2.500
15.90 – 19.05	0.626 – 0.750	76.20	3.000
19.08 – 21.59	0.751 – 0.850	88.90	3.500
21.62 – 24.13	0.851 – 0.950	101.60	4.000
24.16 – 26.67	0.951 – 1.050	114.30	4.500
26.70 – 31.75	1.051 – 1.250	127.00	5.000
31.78 – 38.10	1.251 – 1.500	152.40	6.000
38.13 – 44.45	1.501 – 1.750	177.80	7.000
44.48 – 50.80	1.751 – 2.000	203.20	8.000

Table 40
Cross-sectional area of CONDUIT BODIES
(See Clauses 5.7.1.1 and 5.7.1.2.)

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

Table 41
Minimum distance between CONDUIT BODY HUBS for three-conductor installation with no investigation
(See Clauses 5.7.1.1 and 5.7.1.3.)

Wire size		Minimum distance, mm								Minimum distance, (in)
		CONDUIT BODY hub trade size (metric designator)								
AWG or kcmil	mm^2	1 (27)	1-1/4 (35)	1-1/2 (41)	2 (53)	2-1/2 (63)	3 (78)	3-1/2 (91)	4 (103)	
4	21.2	114.30[a]	114.30[a]	114.30[a]	114.30[a]	114.30[a]	114.30[a]	114.30[a]	114.30[a]	4.50[a]
		57.15[b]	57.15[b]	57.15[b]	57.15[b]	57.15[b]	57.15[b]	57.15[b]	57.15[b]	2.25[b]
		101.60[c]	101.60[c]	101.60[c]	101.60[c]	101.60[c]	101.60[c]	101.60[c]	101.60[c]	4.00[c]
3	26.7	–	126.49[a]	126.49[a]	126.49[a]	126.49[a]	126.49[a]	126.49[a]	126.49[a]	4.98[a]
		–	64.77[b]	64.77[b]	64.77[b]	64.77[b]	64.77[b]	64.77[b]	64.77[b]	2.55[b]
		–	107.95[c]	107.95[c]	107.95[c]	107.95[c]	107.95[c]	107.95[c]	107.95[c]	4.25[c]
2	33.6	–	138.18[a]	138.18[a]	138.18[a]	138.18[a]	138.18[a]	138.18[a]	138.18[a]	5.44[a]
		–	69.09[b]	69.09[b]	69.09[b]	69.09[b]	69.09[b]	69.09[b]	69.09[b]	2.72[b]
		–	114.30[c]	114.30[c]	114.30[c]	114.30[c]	114.30[c]	114.30[c]	114.30[c]	4.50[c]
1	42.4	–	–	147.83[a]	147.83[a]	147.83[a]	147.83[a]	147.83[a]	147.83[a]	5.82[a]
		–	–	101.60[b]	101.60[b]	101.60[b]	101.60[b]	101.60[b]	101.60[b]	4.00[b]
		–	–	121.92[c]	121.92[c]	121.92[c]	121.92[c]	121.92[c]	121.92[c]	4.80[c]
0	53.5	–	–	153.92[a]	153.92[a]	153.92[a]	153.92[a]	153.92[a]	153.92[a]	6.06[a]
		–	–	113.79[b]	113.79[b]	113.79[b]	113.79[b]	113.79[b]	113.79[b]	4.48[b]
		–	–	127.00[c]	127.00[c]	127.00[c]	127.00[c]	127.00[c]	127.00[c]	5.00[c]
00	67.4	–	–	–	191.26[a]	191.26[a]	191.26[a]	191.26[a]	191.26[a]	7.53[a]
		–	–	–	127.00[b]	127.00[b]	127.00[b]	127.00[b]	127.00[b]	5.00[b]
		–	–	–	149.35[c]	149.35[c]	149.35[c]	149.35[c]	149.35[c]	5.88[c]
000	85.0	–	–	–	234.95[a]	234.95[a]	234.95[a]	234.95[a]	234.95[a]	9.25[a]
		–	–	–	136.65[b]	136.65[b]	136.65[b]	136.65[b]	136.65[b]	5.38[b]
		–	–	–	174.50[c]	174.50[c]	174.50[c]	174.50[c]	174.50[c]	6.87[c]
0000	107.2	–	–	–	245.87[a]	245.87[a]	245.87[a]	245.87[a]	245.87[a]	9.68[a]
		–	–	–	146.05[b]	146.05[b]	146.05[b]	146.05[b]	146.05[b]	5.75[b]
		–	–	–	203.20[c]	203.20[c]	203.20[c]	203.20[c]	203.20[c]	8.00[c]
250	127.0	–	–	–	–	259.08[a]	259.08[a]	259.08[a]	259.08[a]	10.20[a]
		–	–	–	–	170.43[b]	170.43[b]	170.43[b]	170.43[b]	6.71[b]
		–	–	–	–	213.36[c]	213.36[c]	213.36[c]	213.36[c]	8.40[c]
300	152.0	–	–	–	–	321.06[a]	321.06[a]	321.06[a]	321.06[a]	12.64[a]
		–	–	–	–	188.47[b]	188.47[b]	188.47[b]	188.47[b]	7.42[b]
		–	–	–	–	221.49[c]	221.49[c]	221.49[c]	221.49[c]	8.72[c]

Table 41 Continued on Next Page

Table 41 Continued

Wire size		Minimum distance, mm								Minimum distance, (in)
		CONDUIT BODY hub trade size (metric designator)								
AWG or kcmil	mm^2	1 (27)	1-1/4 (35)	1-1/2 (41)	2 (53)	2-1/2 (63)	3 (78)	3-1/2 (91)	4 (103)	
350	177.0	–	–	–	–	–	377.10[a]	377.10[a]	377.10[a]	14.87[a]
		–	–	–	–	–	201.68[b]	201.68[b]	201.68[b]	7.94[b]
		–	–	–	–	–	227.08[c]	227.08[c]	227.08[c]	8.94[c]
400	203.0	–	–	–	–	–	–	–	–	–
		–	–	–	–	–	–	–	–	–
		–	–	–	–	–	10.30[c]	10.30[c]	261.62[c]	10.30[c]
500	253.0	–	–	–	–	–	–	–	–	–
		–	–	–	–	–	–	–	–	–
		–	–	–	–	–	12.43[c]	12.43[c]	12.43[c]	12.43[c]

NOTE – Where values are not specified, an investigation shall be performed to determine acceptability of the intended installation.

[a] Applies to straight pull CONDUIT BODY.

[b] Applies to CONDUIT BODY with HUB inside.

[c] Applies to CONDUIT BODY with HUB in back.

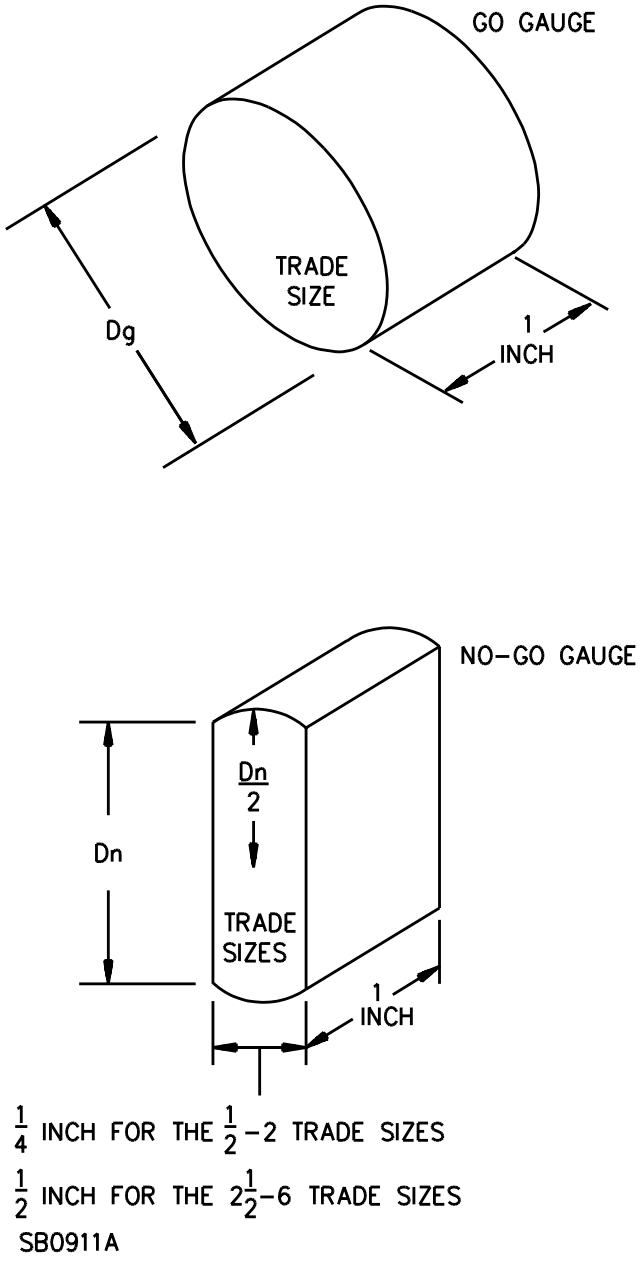
Table 42
Space inside a CONDUIT BODY
(See Clauses 5.7.1.1 and 5.7.1.5.)

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

Table 43
Number of turns required for complete disengagement of hand-tight NPT plug gauge from a fitting or conduit entry
(See Clause 8.36.1.)

Conduit entry trade size	Metric designator	Minimum L_1 + 1/2	Maximum L_1 + 5
1/2	16	4.98	9.48
3/4	21	5.25	9.25
1	27	5.10	9.60
1-1/4	35	5.33	9.83
1-1/2	41	5.33	9.83
2	53	5.51	10.01
2-1/2	63	5.96	10.46
3	78	6.63	11.13
3-1/2	91	7.07	11.57
4	103	7.25	11.75
5	129	8.00	12.50
6	155	8.16	12.66

Figure 1
Hardened tool steel gauges for throats of FITTINGS
(See Clauses 5.4.1.3, 5.5.1.3, 5.7.1.10, and 5.7.1.11 and Table 1.)



NOTE – SI values for the dimensions in this figure are:

mm	(in)
6.4	1/4
12.7	1/2
25.4	1

Figure 2
Obvious construction for threadless concrete-tight and wet (rain-tight) locations in Canada
(See Clause 7.3.2.)

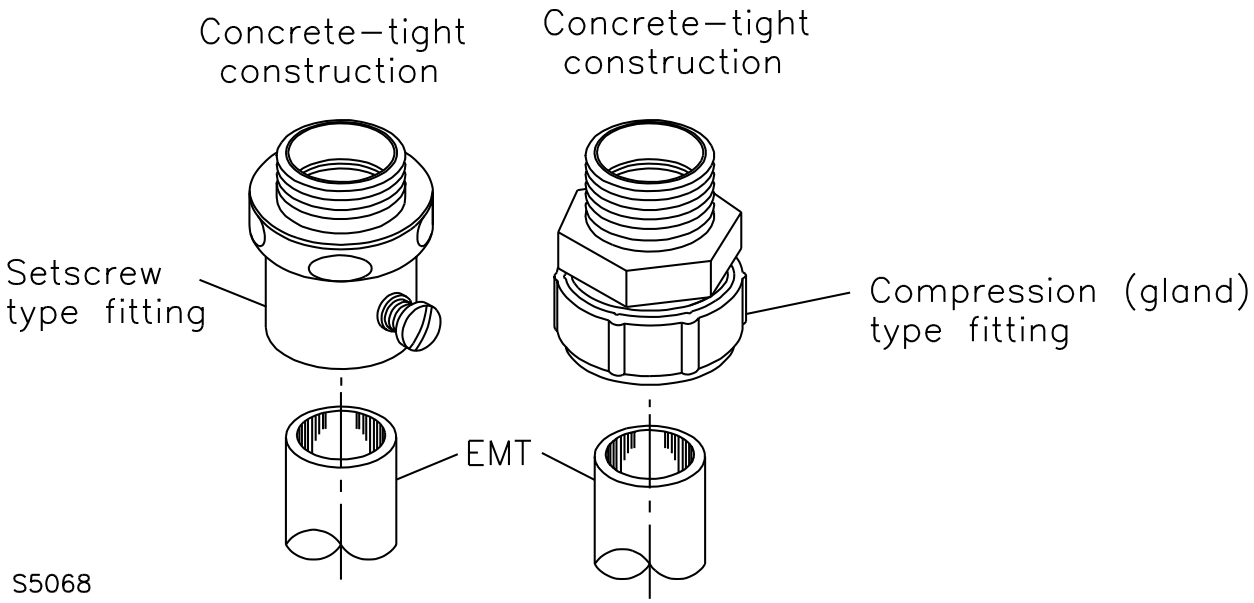
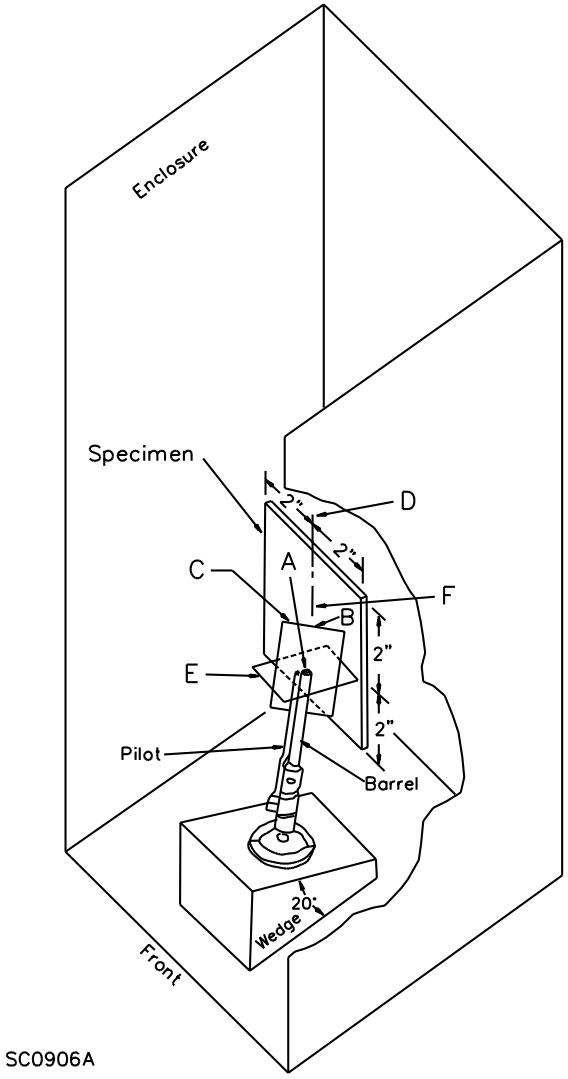


Figure 3
Flammability test apparatus and sample dimensions
(See Clauses 8.2.5, 8.2.7, and 8.2.8.)



NOTES –

1. Units for the values specified are: 102 mm (4 in); 50.8 mm (2 in); 38.1 mm (1-1/2 in).

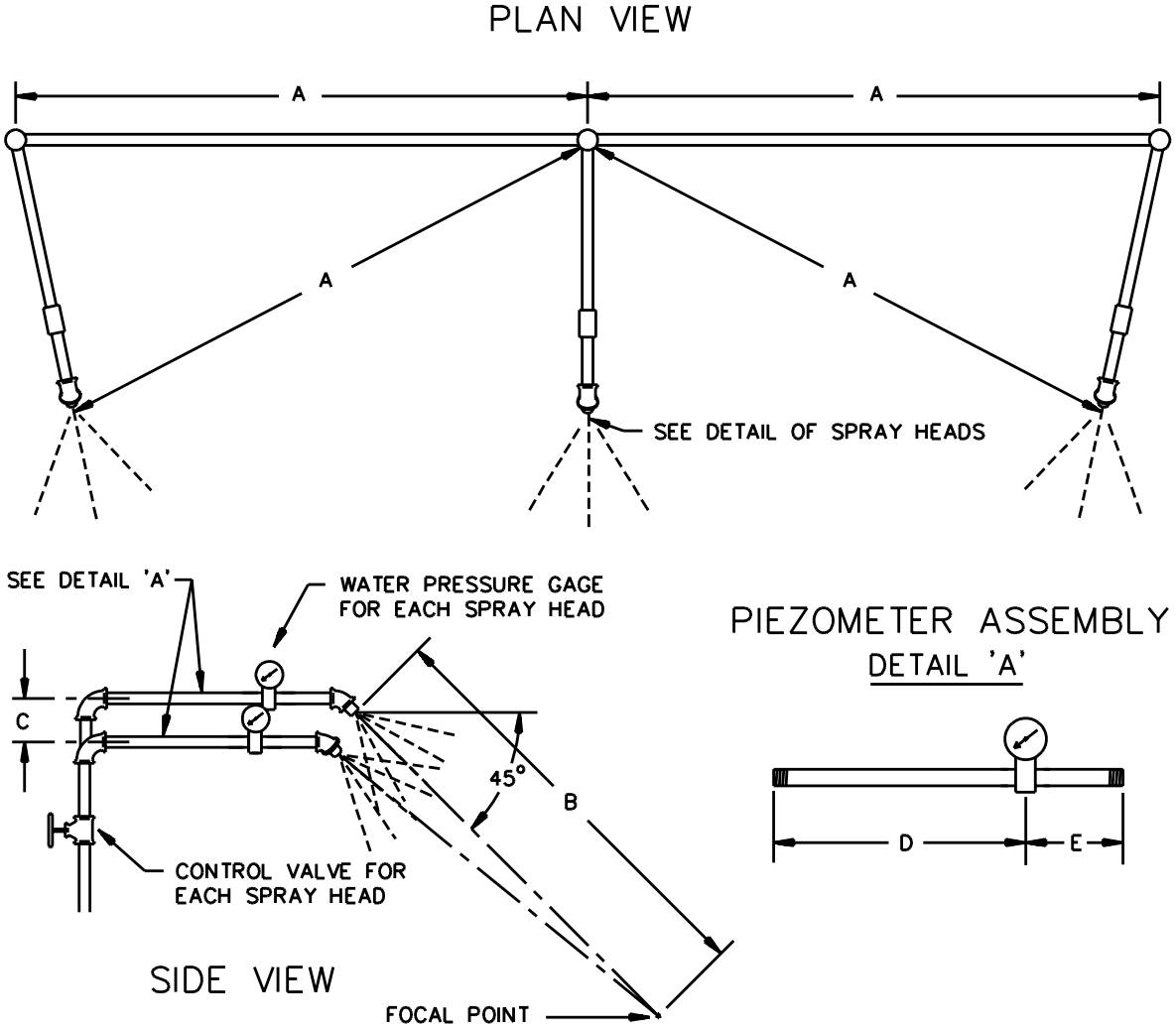
2. C is the vertical plane parallel to the sides of the enclosure and containing the vertical axis of the sample and the longitudinal axis of the barrel.

3. D is the vertical axis of the sample in the center of the enclosure and parallel to the back of the enclosure.

4. E is the plane of the tip of the barrel.

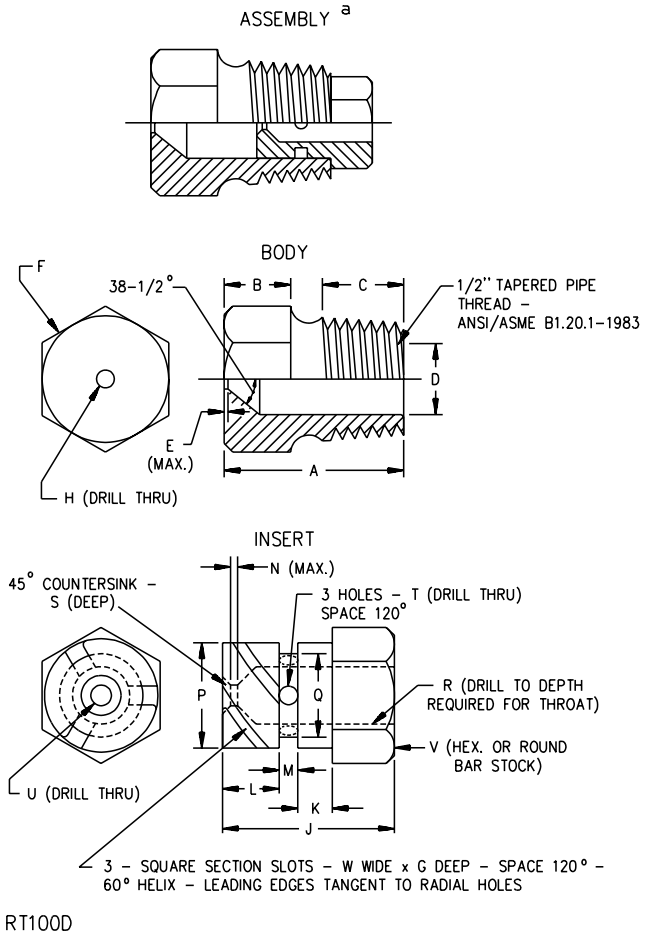
5. F is the longitudinal axis of the barrel.

Figure 4
Rain-test spray head piping
(See Clauses 8.6.3 and 8.6.4.)



Item	mm	(in)
A	710	28
B	1400	55
C	55	2-1/4
D	230	9
E	75	3

Figure 5
Rain-test spray-head
(See Clause 8.6.4.)



Item	mm	(in)	Item	mm	(in)
A	31.0	1-7/32	N	0.80	1/32
B	11.0	7/16	P	14.61	0.575
C	14.0	9/16		14.53	0.576
D	14.68	0.578	Q	11.51	0.453
	14.73	0.580		11.53	0.454
E	0.40	1/64	R	6.35	1/4
F	c	c	S	0.80	1/32
G	1.52	0.06	T	2.80	(No. 35)[b]
H	5.0	(No. 9)[b]	U	2.50	(No. 40)[b]
J	18.3	23/32	V	16.0	5/8
K	3.97	5/32	W	1.52	0.06
L	6.35	1/4			

[a] Nylon rain-test spray heads are available from Underwriters Laboratories.
[b] ANSI B94.11M drill size.
[c] Alternate – to serve as a wrench grip.

Figure 6
Current test using an enclosure
(See Clause 8.9.2.)

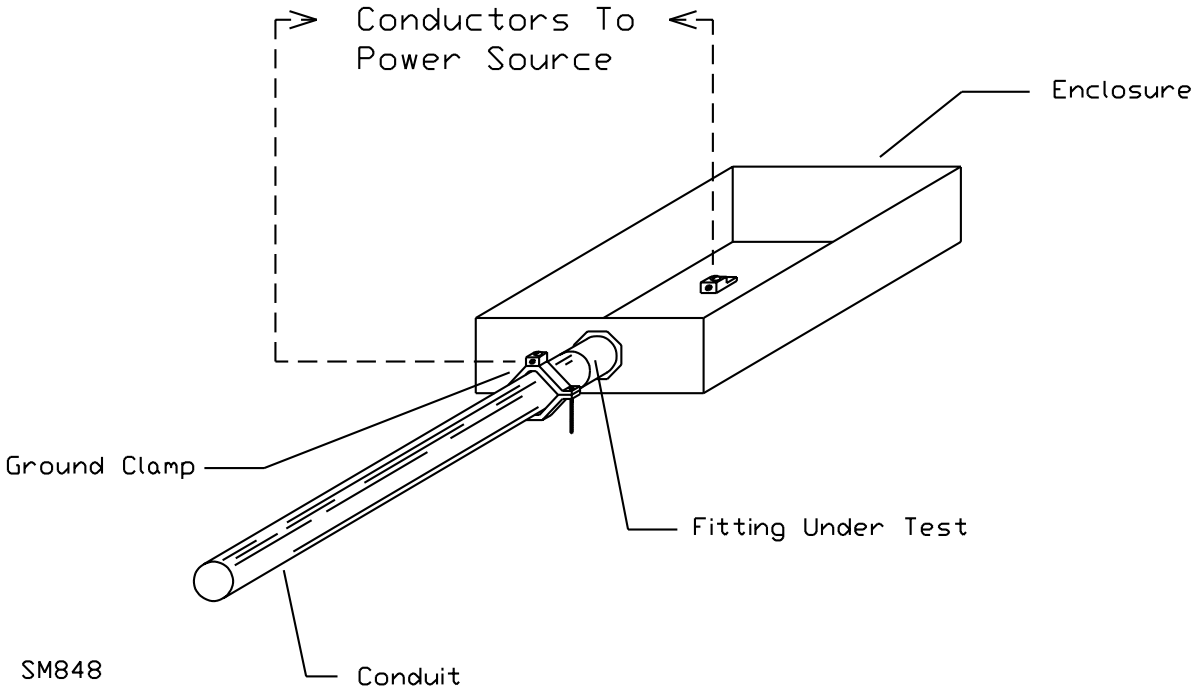


Figure 7
Current test using a steel plate
(See Clause 8.9.2.)

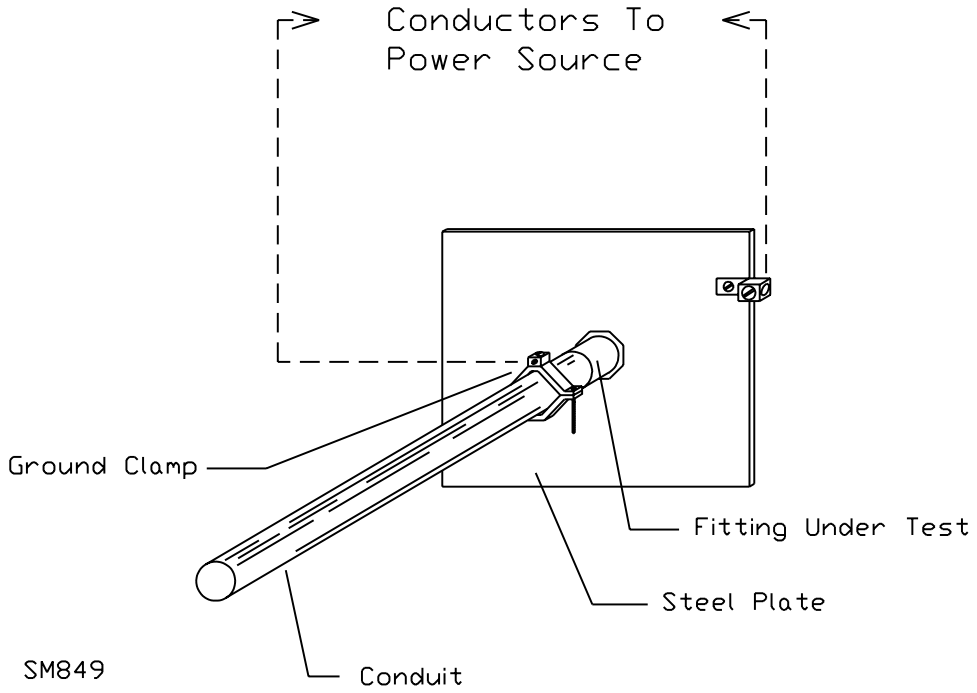


Figure 8
(See Clause 8.10.5.2.)

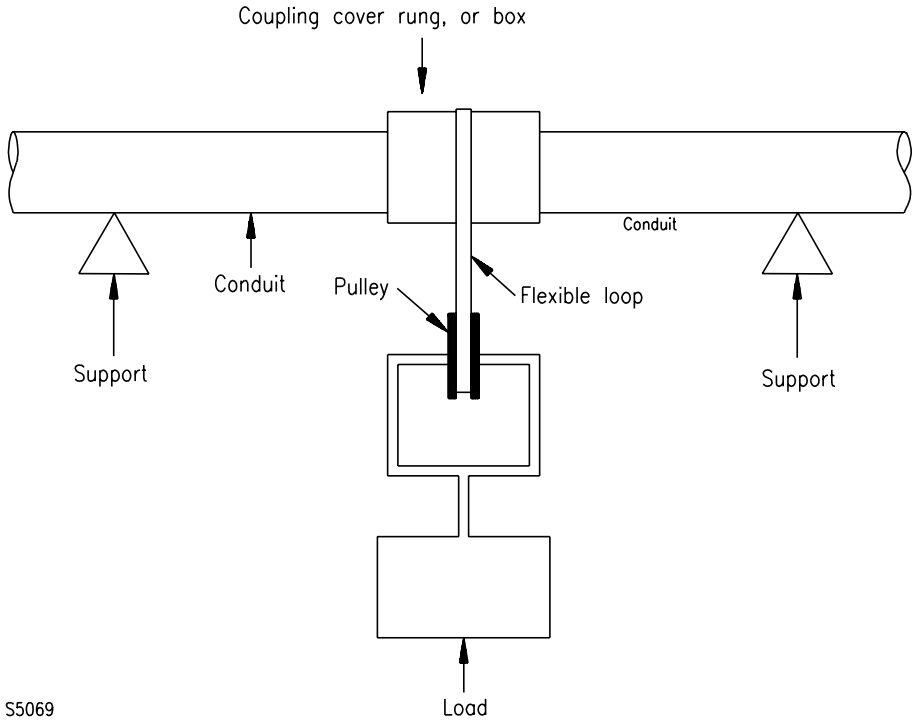


Figure 9
Bending test arrangement
(See Clause 8.12.1.1.)

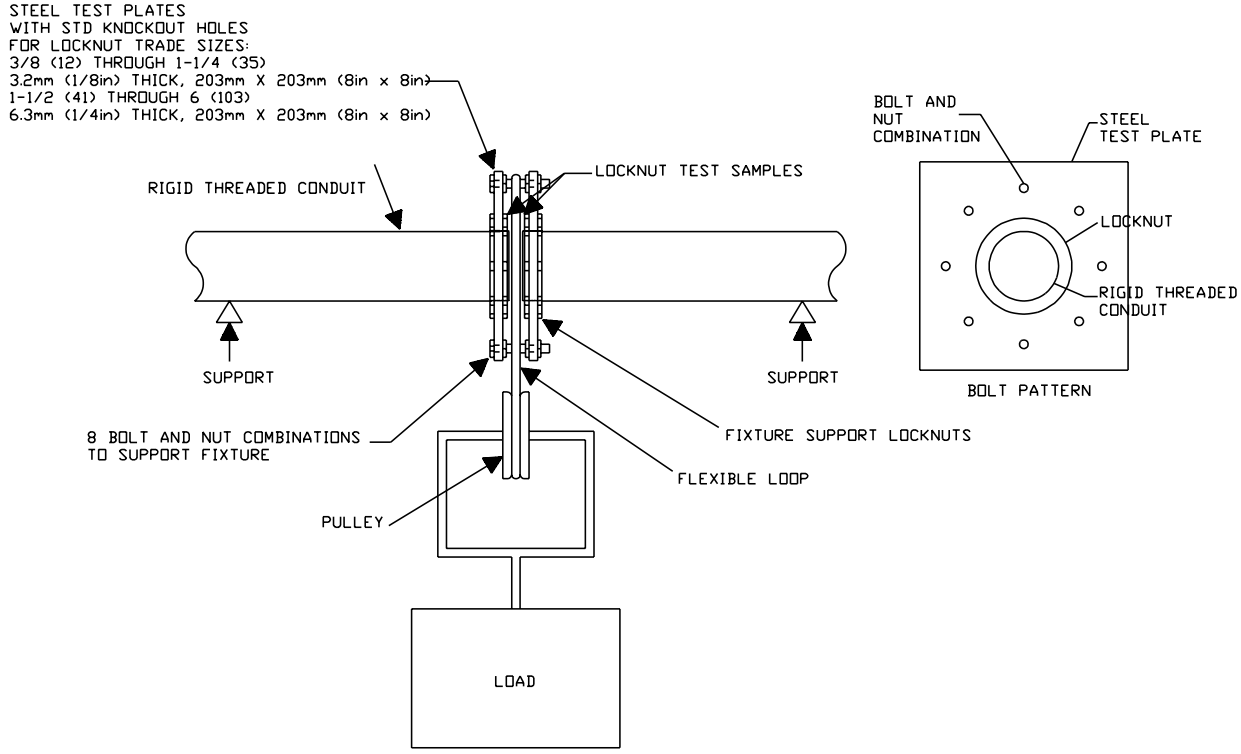
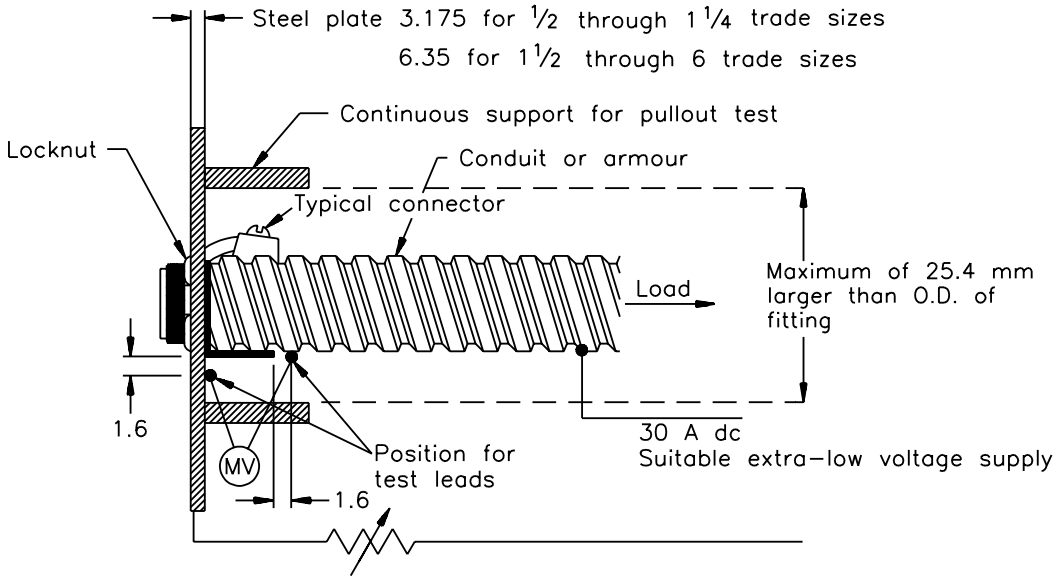


Figure 10
Measurement of voltage drop clamps and FITTINGS
(See Clause 8.14.3.1.)



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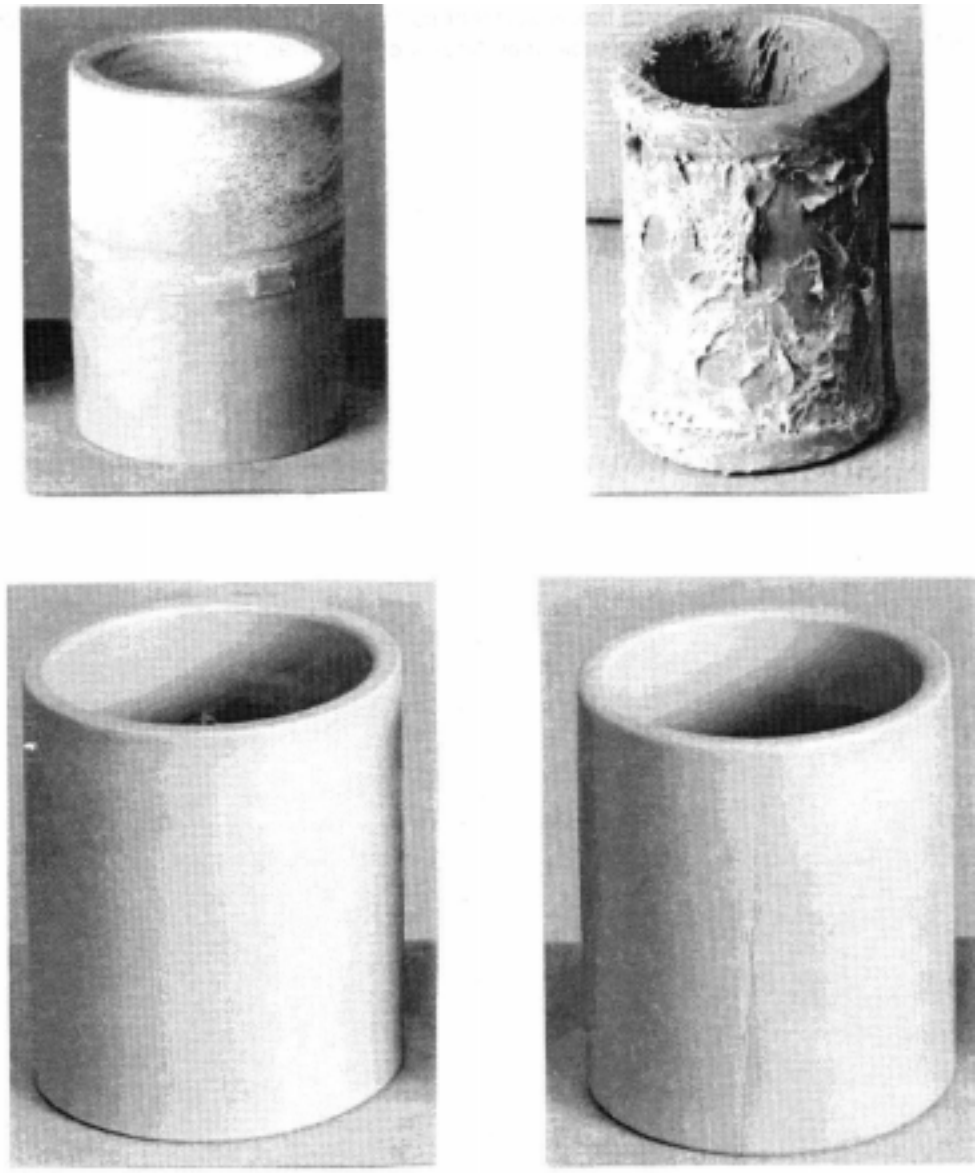
Note: Linear dimensions are in millimetres

Figure 11
Samples after molding-process test
(See Clauses 8.20.1.1 and 8.20.5.3.)



NOTES –

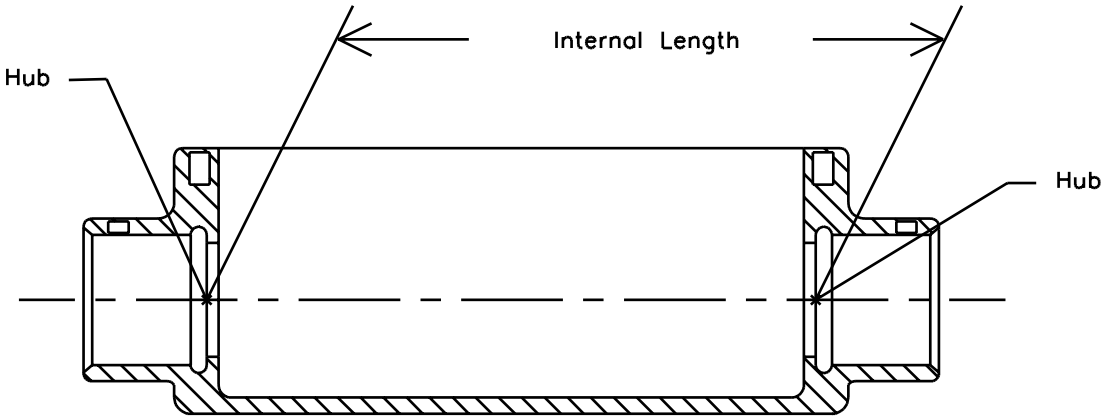
1. Upper left corner – flaking (mild and covers only part of surface) – complies.

2. Upper right corner – flaking and peeling (severe and covers 50 percent or greater of surface) – does not comply.

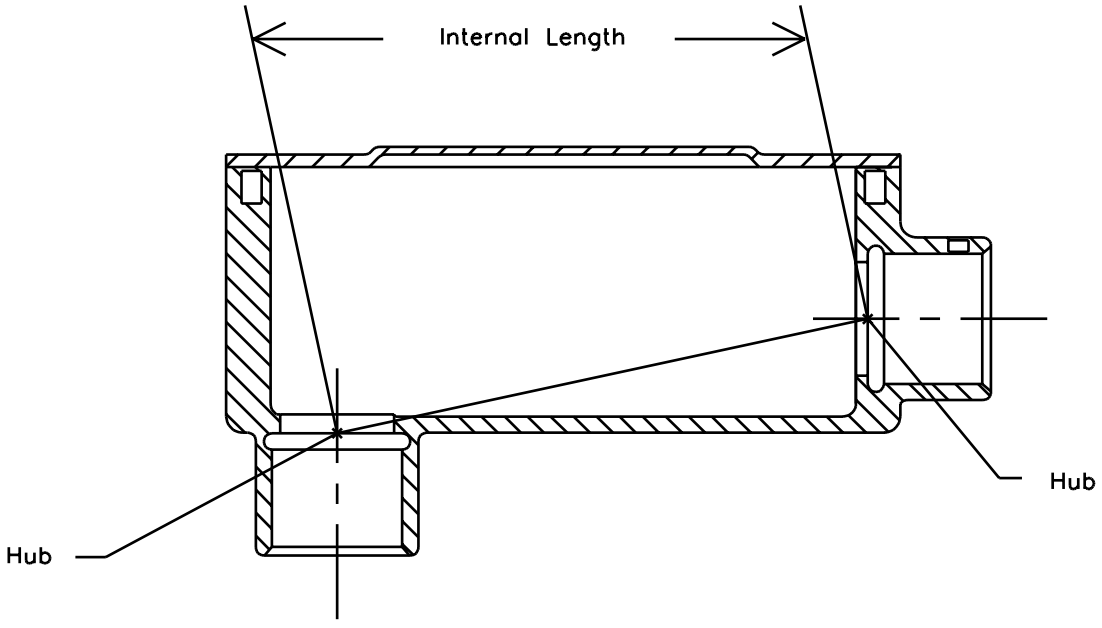
3. Lower left corner – weld line (uniform width and depth with no cracks) – complies.

4. Lower right corner – weld line (uneven depth and definite crack in center) – does not comply.

Figure 12
CONDUIT BODY internal length measurement
(See Clauses 5.7.1.1 and 5.7.1.3 – 5.7.1.6.)



Straight Pull Conduit Body



Angle Pull Conduit Body

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Figure 13
Test setup for nonmetallic-sheathed cable CONNECTORS utilizing a 5000 V dielectric test
(See Clause 8.24.4.2.)

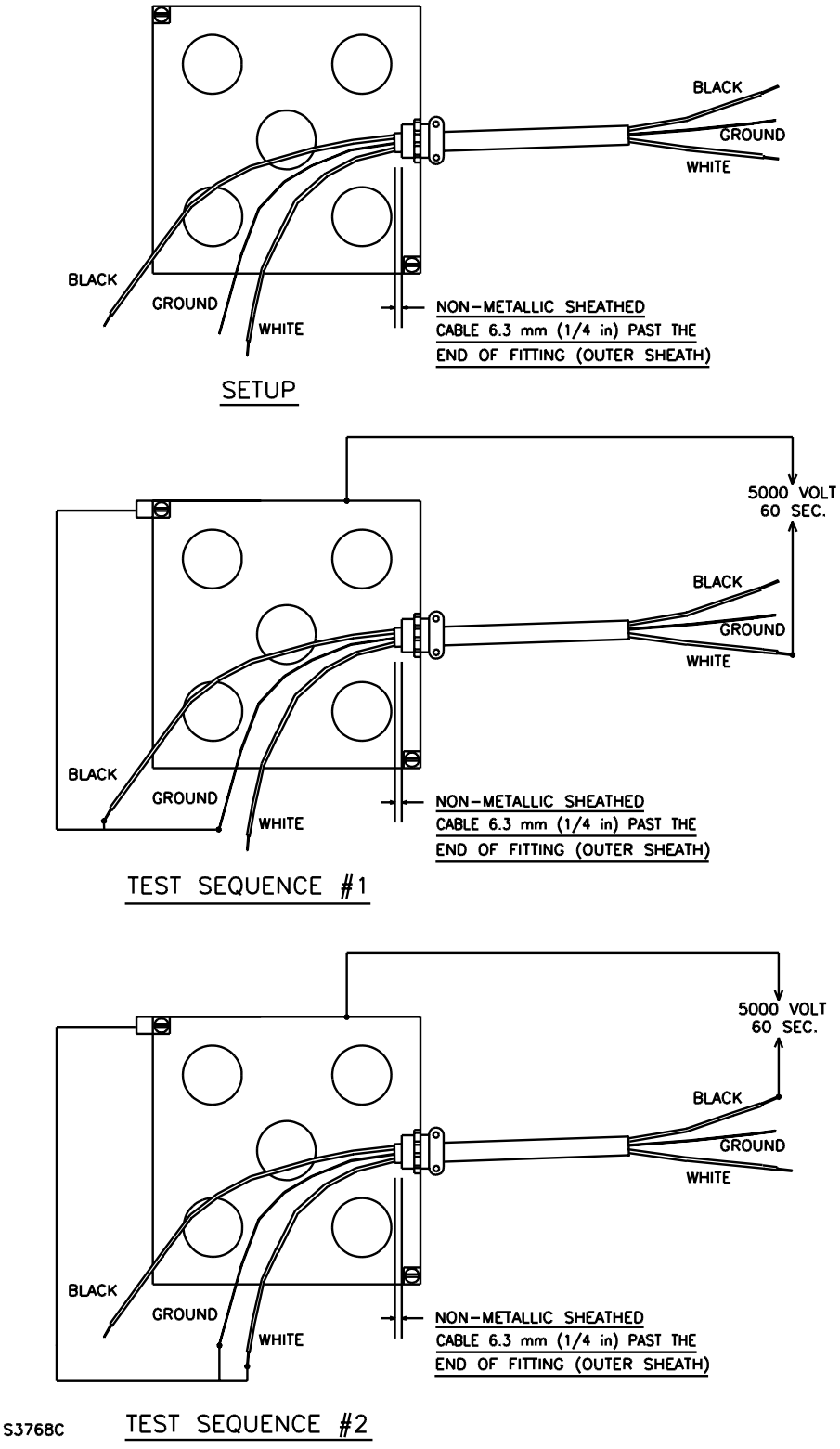


Figure 14
Insulated BUSHING test setup
(See Clause 8.28.3.2.)

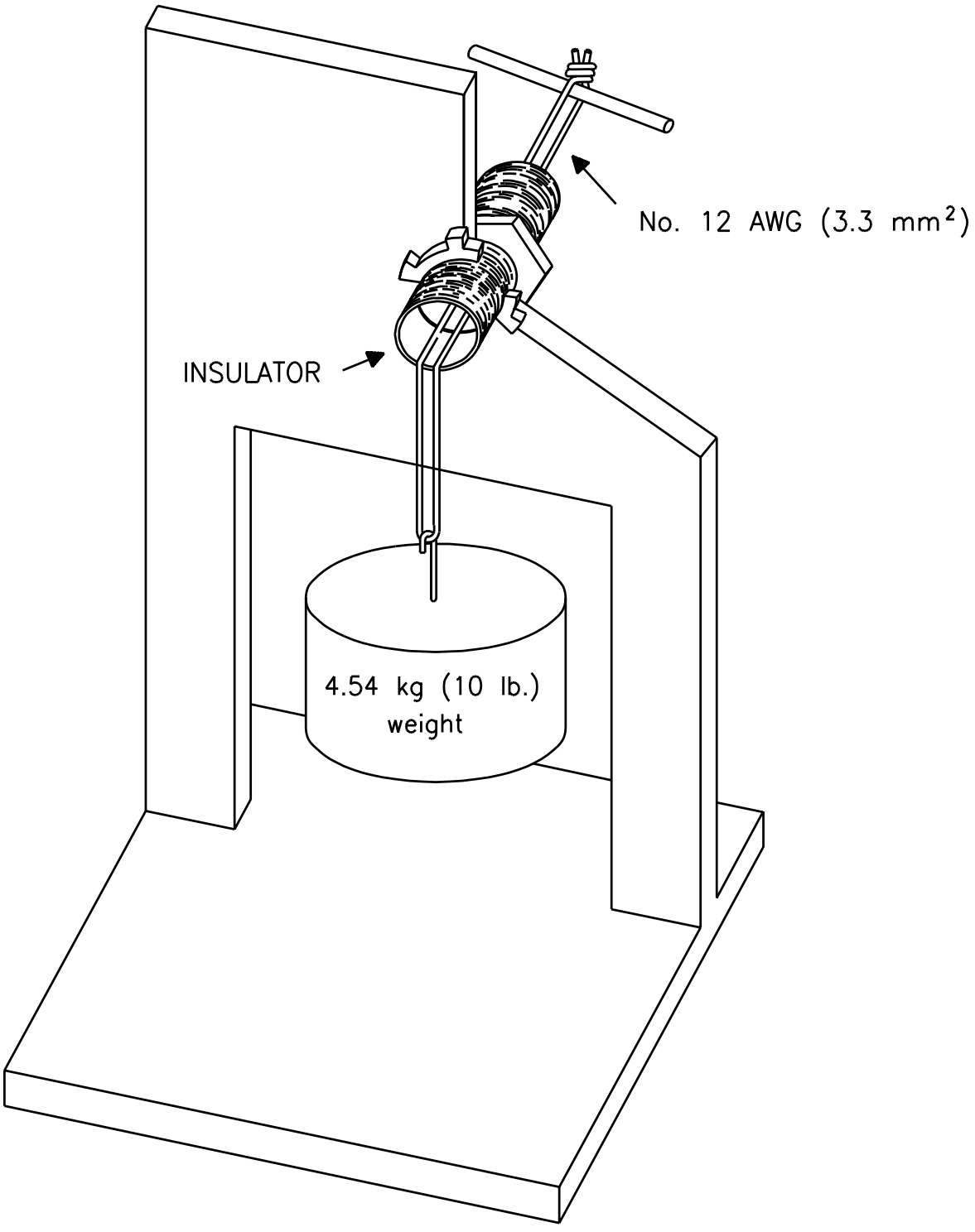
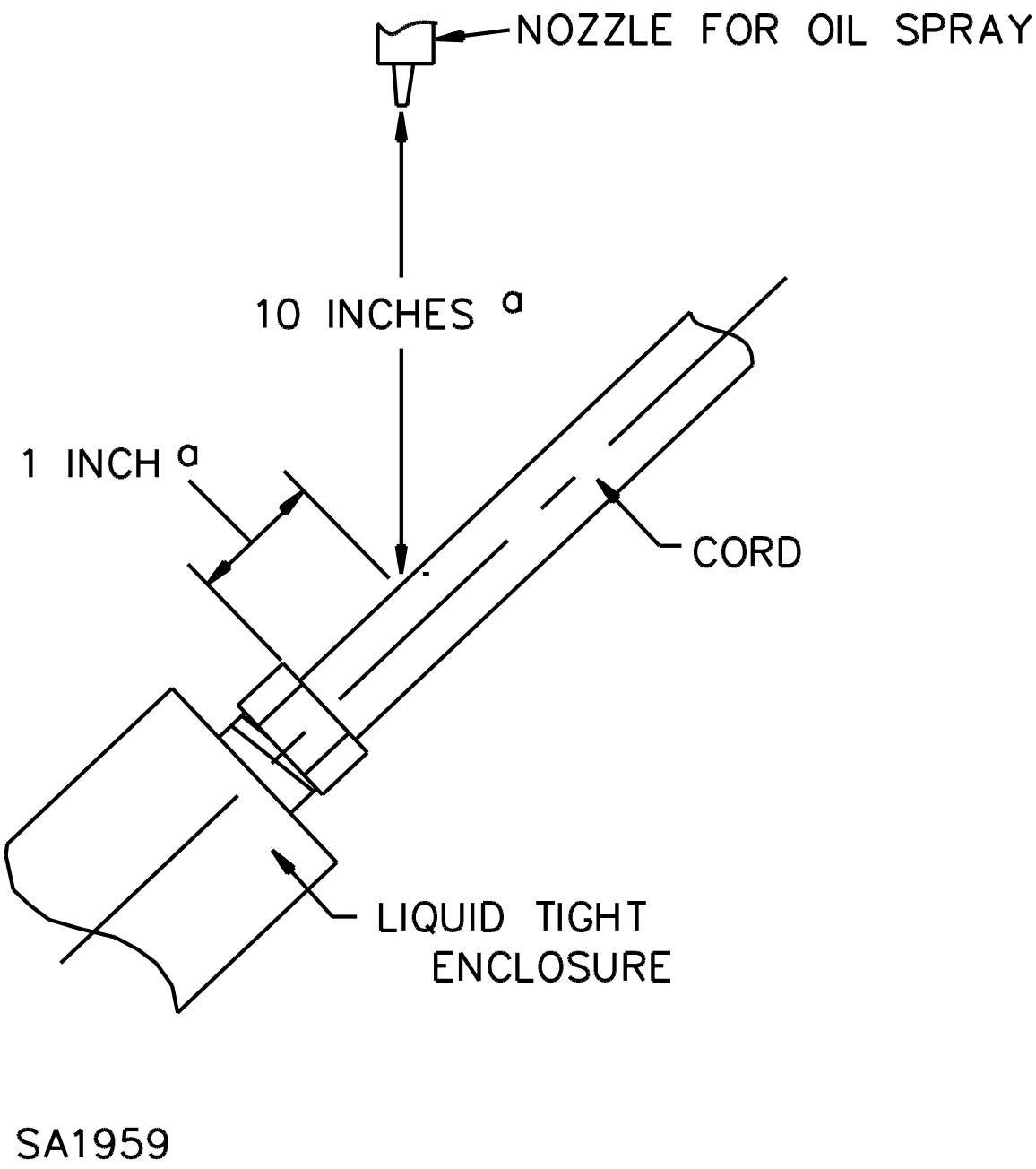


Figure 15
Oil spray test fixture
(See Clause 8.26.4.2.)

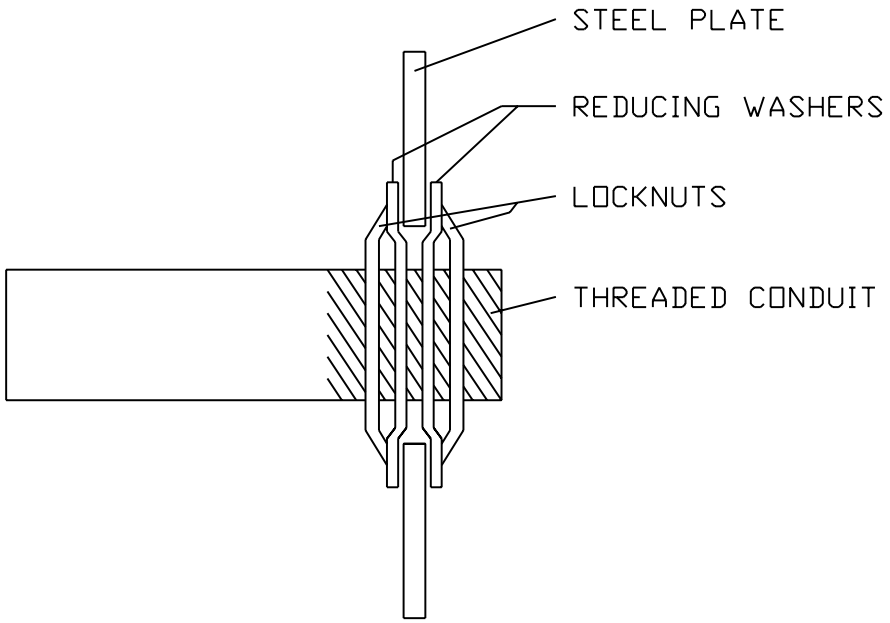


[a] SI units for the dimensions in this figure are:

1 in = 25.4 mm

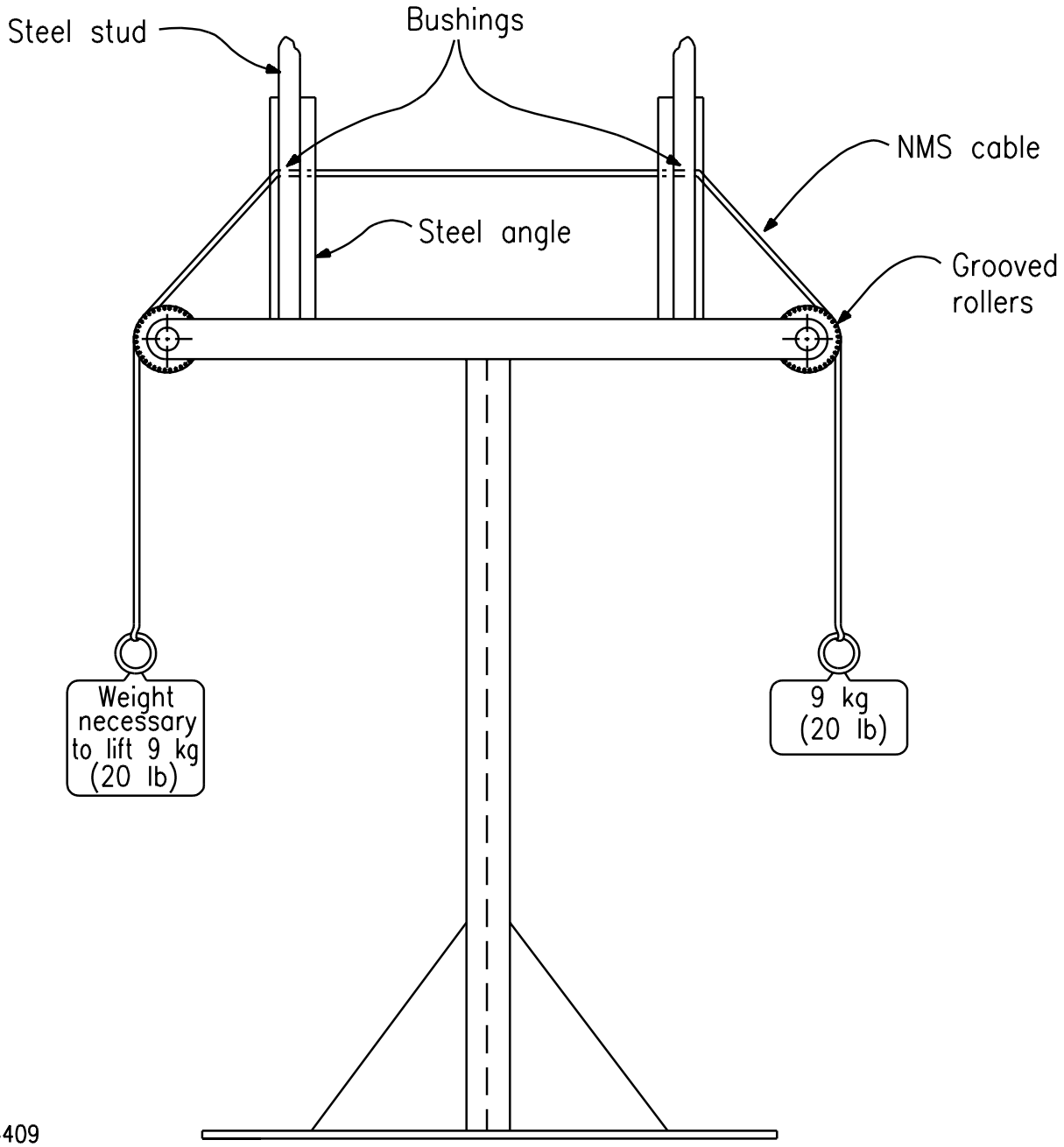
10 in = 254 mm

Figure 16
Reducing washer current and resistance test setup
(See Clause 8.33.1.)



SM1155

Figure 17
Conditioning fixture for metal BUSHINGS for use with metal studs
(See Clause 8.34.4.2.)



Annex A (Normative)
Component Standards
(See Clause 4.1.)

A.1 The ANCE, CSA, and UL standards listed below are used for evaluation of components and features of products covered by this standard. Components need only comply with the applicable component standard acceptable in the country where the product is to be used. These standards shall be considered to refer to the latest edition and all amendments published to that edition.

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-H-146-SCFI,
Unified Screw Threads – Specifications

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

CSA Standards

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

CAN/CSA-C22.2 No. 0-M91 (R 2001),
General Requirements Canadian Electrical Code, Part II

C22.2 No. 0.3-01,
Test Methods for Electrical Wires and Cables

C22.2 No. 0.5-1982 (R1999),
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. 40-M1989 (R1999),
Cutout, Junction, and Pull Boxes

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

C22.2 No. 56-1977 (R1999),
Flexible Metal Conduit and Liquid-Tight Flexible 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 486A-UL 486B,
Wire Connectors

UL 746A,
Polymeric Materials B Short Term Property Evaluations

UL 746B,
Polymeric Materials B Long Term Property Evaluations

Annex B (Normative)
Ultraviolet Light and Water Test
(See Clause 8.26.7.4.)

B.1 Apparatus

B.1.1 Samples shall be exposed to ultraviolet light and water spray by using the following apparatus:

Twin enclosed carbon-arc, Type D, in accordance with ASTM G 152 and ASTM G 153. Exposure Method 1, continuous exposure to light and intermittent exposure to water spray, with a programmed cycle of 20 minutes consisting of a 17-minute light exposure and a 3-minute exposure to water spray with light, shall be used. The apparatus shall operate with a black-panel temperature of 63 ±3°C.

B.2 Method

B.2.1 Samples shall be mounted vertically on the inside of the cylinder in the ultraviolet light apparatus, with the width of the samples facing the arc, and so that the samples do not touch each other.

B.2.2 Two sets of samples for each test shall be exposed. One set shall be exposed for a total of 360 hours and the second set for a total of 720 hours. After the test exposure, the samples shall be removed from the test apparatus, examined for signs of deterioration, such as crazing and cracking, and retained under conditions of ambient room temperature for not less than 16, nor more than 96 hours, before being subjected to mechanical strength tests.

Annex C (Informative)
Armored Cable Bushing Dimensions
(See Table 13.)

Table C.1
BUSHING size for a range of armored cable
(See Table 13.)

BUSHING size no.	Diameter			
	Minimum		Maximum	
	mm	(in)	mm	(in)
0	5.33	0.21	8.89	0.35
1	7.78	0.31	11.68	0.46
2	10.92	0.43	14.99	0.59
3	14.22	0.56	18.80	0.74
4	18.03	0.71	24.38	0.96
5	22.86	0.90	30.48	1.20
6	28.45	1.12	38.35	1.51
7	36.07	1.42	47.24	1.86
8	43.94	1.73	59.18	2.33