UL 2515

STANDARD FOR SAFETY

Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings

UL Standard for Safety for Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings, UL 2515

Second Edition, Dated February 5, 2019

Summary of Topics

The revision of ANSI/UL 2515 dated March 22, 2022 includes clarification on where to measure the minimum inside diameter of socket specified in Table 5 – Table 8.

As noted in the Commitment for Amendments statement located on the back side of the title page, UL, CSA, and ANCE are committed to updating this harmonized standard jointly.

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

The revised requirements are substantially in accordance with Proposal(s) on this subject dated September 10, 2021.

No Text on This Page

Association of Standardization and Certification
NMX-J-765-ANCE
First Edition

CSA Group
CSA C22.2 No. 2515:19
Second Edition

Underwriters Laboratories Inc.
UL 2515
Second Edition

Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings

February 5, 2019

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Approved American National Standard

ANSI/UL 2515-2022

Commitment for Amendments

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

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

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This ANSI/UL Standard for Safety consists of the Second Edition including revisions through March 22, 2022. The most recent designation of ANSI/UL 2515 as an American National Standard (ANSI) occurred on March 22, 2022. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page (front and back), or the Preface.

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Preface

This is the harmonized ANCE, CSA Group, and UL standard for Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings. It is the first edition of NMX-J-765-ANCE, the second edition of CSA C22.2 No. 2515, and the second edition of UL 2515. This edition of NMX-J-765-ANCE is the first edition published. This edition of CSA C22.2 No. 2515 supersedes the previous edition(s) published on July 31, 2009. This edition of UL 2515 supersedes the previous edition(s) published on July 31, 2009. This harmonized standard has been jointly revised on March 22, 2022. For this purpose, CSA Group and UL are issuing revision pages dated March 22, 2022, and ANCE is issuing a new edition dated March 22, 2022.

This harmonized standard was prepared by the Association of Standardization and Certification, (ANCE), CSA Group and Underwriters Laboratories Inc. (UL). The efforts and support of the conduit manufacturing industry and the Technical Harmonization Subcommittee for Conduit and Tubing, of the Council of the Harmonization of Electrotechnical Standards for the Nations of the Americas (CANENA), are gratefully acknowledged.

This standard is considered suitable for use for conformity assessment within the stated scope of the standard.

The present Mexican standard was developed by the CT 23 Electrical Accessories (Wiring Devices) from the Comité de Normalización de la Asociación de Normalización y Certificación, A.C., CONANCE, with the collaboration of the electrical manufacturers and users.

This standard was reviewed by the CSA Integrated Committee on Nonmetallic Conduit, Tubing, and Fittings, 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 has been developed in compliance with Standards Council of Canada requirements for National Standards of Canada. It has been published as a National Standard of Canada by CSA Group.

Application of Standard

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

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

Level of harmonization

This standard uses the IEC format but is not based on, nor is it considered equivalent to, an IEC standard.

This standard is published as an equivalent standard for ANCE, CSA Group and UL.

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

Reasons for differences from IEC

The Technical Harmonization Subcommittee identified several IEC standards that address electrical conduit and tubing included in the scope of this standard. The IEC standards for electrical conduit and tubing are recognized as being generally system-specific, containing the requirements for the relevant conduits and cables and associated fittings in several discrete IEC standards.

The THSC determined the safe use of electrical conduit and tubing is dependent on the design and performance of the conduit and tubing systems with which they are intended to be installed. Significant investigation is required to assess safety and system compatibility issues that may lead to harmonization of traditional North American electrical conduit and tubing and associated fittings with those presently addressed in the known IEC standards. The THSC agreed such future investigation might be facilitated by completion of harmonization of the North American standards for electrical conduit and tubing and their 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.

Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings

1 Scope

1.1 This Standard specifies the requirements for low-halogen aboveground (Type AG) reinforced thermosetting resin conduit (RTRC) and fittings for installation and use in accordance with CSA C22.1, Canadian Electrical Code (CEC), Part I, NFPA 70, National Electrical Code (NEC) and NOM-001-SEDE, Standard for Electrical Installations (Mexico), in non-hazardous locations.

1.2 The products specified in this Standard are intended for use at -40°C (-40°F) to 110°C (230°F). The products are for use above ground in exposed and concealed locations. The products are also suitable for use below ground by direct burial or by encasement in concrete.

1.3 Type AG conduit has not been evaluated for directional boring applications.

1.4 This Standard covers ID (dimensions based on inside diameters) and IPS (dimensions based on outside diameters of iron pipe sizes) conduit and fittings. Trade sizes (metric designators) are 1/2 (16) to 6 (155).

Note: The values in parenthesis are metric size designations of conduits and fittings and do not necessarily reflect metric trade sizes.

1.5 ID and IPS conduit are designated as SW (Standard Wall) or HW (Heavy Wall), which refer to specific wall thicknesses.

1.6 Fittings specified in this Standard include, but are not limited to, straight couplings, 5° angle couplings, adapters, and elbows with plain ends or integral belled ends at one or both ends, expansion joints, and conduit bodies.

Note: In Canada, conduit bodies are not evaluated as outlet boxes – they are fittings. Requirements in this standard for conduit bodies intended for use as outlet boxes do not apply in Canada. In Mexico and the United States, a conduit body may be used as an outlet box for the splicing of conductors.

1.7 For products intended for use in Canada, general requirements are given in CSA-C22.2 No. 0.

2 Definitions

2.1 The following definitions apply in this Standard:

2.2 Conduit body – a separate portion of a conduit system that provides access through a removable cover(s) to the interior of the system at a junction of two or more sections of the system or at a terminal point of the system.

2.3 Integral belled end – a belled end installed at the factory, either integrally wound or a permanently attached coupling.

2.4 Low-halogen – a material having not more than 0.2% by weight of total halogen content.

2.5 Type AG – conduit and associated fittings that have been evaluated for use in exposed or concealed locations and/or for direct burial with or without being encased in concrete.

Note: For other definitions, refer to the CE Code, Part 1, the NEC and/or NOM-001-SEDE.

3 Reference publications and units of measurement

3.1 Reference publications

3.1.1 Where reference is made to any Standards, such reference shall be considered to refer to the latest editions and revisions thereto available at the time of printing, unless otherwise specified.

Product Standardization and Certification Center (CNCP)

NMX-E-186-CNCP
Plastic industry – Conduit and fittings – IZOD impact resistance of rigid materials – Test method

SCFI Standard**

NMX-E-003-SCFI
Plastic industry – Determination of thickness of plastic films and sheets by mechanical scanning – Test method

NMX-J-70-SCFI
Plastic industry – Pipes and fittings – Deflection temperature under load – Test method

SEDE* Standard**

NOM-001-SEDE
Standard for Electrical Installations

ANCE Standards

NMX-J-451-ANCE
Wires and cables – Thermoset insulated wires and cables – Specifications

NMX-J-511-ANCE
Cable tray – Metallic cable tray – Specifications and test methods

NMX-J-192-ANCE
Wires and cables – Flame test on electrical cables – Test methods

NMX-J-553-ANCE
Wires and Cables – Weather Resistance of Insulation or Jacket of Electrical Conductors – Test Method

CSA Group Standards

C22.1
Canadian Electrical Code (CE_Code), Part I

CSA C22.2 No. 0
General Requirements – Canadian Electrical Code, Part 1

C22.2 No. 38
Thermoset Insulated Wires and Cables

C22.2 No. 126.1
Metal Cable Tray Systems

UL Standard

UL 44
Thermoset-Insulated Wires and Cables

ANSI/NFPA† Standard

NFPA 70
National Electrical Code (NEC)

ASTM‡ Standards

D 256
Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics

D 638
Standard Test Method for Tensile Properties of Plastics

D 648
Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position

D 5025
Standard Specification for Laboratory Burner Used for Small-Scale Burning Tests on Plastic Materials

D 5207
Standard Practice for Calibration of 20-mm (50-W) and 125-mm (500-W) Test Flames for Small-Scale Burning Tests on Plastic Materials

G 151
Standard Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources

G 153-04
Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials

G 155
Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials

CAN/CGSB§ Standard

3.14-2006
Liquefied Petroleum Gas (Propane) for Fuel Purposes

National Research Council Canada Publication

National Building Code of Canada

NEMA* Standard

VE-1 2002
Metal Cable Tray Systems

† American National Standards Institute/National Fire Protection Association.

‡ American Society for Testing and Materials.

§ Canadian General Standards Board.

** National Electrical Manufacturers Association.*

*** Secretary of Commerce and Industrial Development (Mexico)*

**** Secretary of Energy (Mexico)*

3.2 Units of measurement

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

4 Construction

4.1 General

4.1.1 Conduit shall be fiber impregnated with a cured thermosetting resin compound. The conduit shall have a uniform wall, a smooth interior, and shall not contain any features that can damage wiring installed in the conduit.

4.1.2 Conduit shall be straight, and both ends of each length of conduit shall be perpendicular to the longitudinal axis of the conduit.

4.1.3 Integral and non-integral connections shall provide a mechanically secure and watertight joint.

4.2 Conduit with an integral belled end

4.2.1 The dimensions of conduit with an integral coupling on one end shall be in accordance with Table 1 to Table 4. They shall also meet the requirements of 5.7 and 5.8.

4.3 Couplings

4.3.1 Couplings shall be straight with belled ends, or 5° angle couplings. Dimensions of couplings shall be in accordance with Table 5 to Table 8. Couplings shall also meet the requirements of 5.7 and 5.8.

4.4 Elbows

4.4.1 Elbows shall be provided with plain ends or have an integral belled end at one or both ends. Elbows shall also meet the requirements of 5.7.

4.4.2 The radius and dimension of an elbow shall be as shown in Table 9 and Figure 1.

4.4.3 The straight-end portions (see dimension L_s on Figure 1) of an elbow shall be at least 13 mm (1/2 in) longer than the maximum socket depth.

4.5 Adapters

4.5.1 Threaded adapters and threaded box connectors

4.5.1.1 Adapters for joining conduit to other threaded systems shall be as specified in Table 10.

4.5.2 Other adapters

4.5.2.1 Other adapters shall meet the watertightness test specified in 5.7 and the joint separation requirements specified in 5.8.

4.5.3 Bore of conduit and elbows

4.5.3.1 The internal diameter of a finished elbow shall be such that a round ball or an equivalent mandrel will pass freely through the bore of the conduit and elbow. The diameter of the ball or equivalent mandrel shall be 90% of the original internal diameter for conduit and 85% of the original internal diameter for elbows.

Note: As an alternative to using a ball to check the bore of conduit and elbows, an inside micrometer gauge or a telescopic gauge and micrometer caliper may be used.

4.6 Conduit bodies

Note: In Canada, conduit bodies are not evaluated as outlet boxes – they are fittings. Requirements in this Standard for conduit bodies intended for use as outlet boxes do not apply in Canada. In Mexico and the United States, a conduit body may be used as an outlet box for the splicing of conductors.

4.6.1 General

4.6.1.1 Conduit bodies shall be of thermosetting resin material that provides flame and mechanical properties consistent with the conduit system.

4.6.1.2 A conduit body shall have a cross-sectional area not less than that specified in Table 11, based on the largest size raceway that is intended to be connected to it.

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

a) shall have a removable blank cover; and

b) shall comply with 4.6.2.1 and 4.6.2.3.

4.6.1.4 The requirement in 4.6.1.3 does not apply to a conduit body:

a) marked for use only with 6 AWG (13.30 mm^2) or smaller conductors;

b) having an internal length (measured as shown in Figure 2) that is equal to or greater than the dimensions specified in Table 12.

4.6.1.5 A conduit body having a raceway entry in the wall opposite the removable cover specified in 4.6.1.3(a) shall have a distance from the cover to the opposite wall not less than that specified in Table 13.

4.6.1.6 With reference to 4.6.1.5, 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 2.

4.6.1.7 A conduit body shall also comply with 6.6 and 6.7.

4.6.2 Capacity

4.6.2.1 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 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 2.

Note: Measurements expressed as multiples of trade sizes may 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 × 8 = 4 = 4 inches = 101.6 mm.

4.6.2.2 A conduit body that is shorter than the requirement specified in 4.6.1.5 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 6.7.

4.6.2.3 A conduit body constructed to enable a change in the direction of the axis of a conduit system (see Figure 2) shall have a distance inside the body between each 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 conduit entry and the opposite wall not less than the sum of (a) and (b) (see note to 4.6.2.1):

a) six times the trade size of the largest conduit for which the body is intended; and

b) the sum of the diameters of all other conduit entries in the same wall of the body.

4.6.2.4 A conduit body having smaller dimensions than those specified in 4.6.2.3 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 6.7.

4.6.3 Covers

4.6.3.1 Conduit bodies shall be furnished with a blank cover. Threaded inserts may be molded into or assembled on the body.

4.6.3.2 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.

4.6.3.3 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 Qualification tests

5.1 Conditioning

5.1.1 Unless specified otherwise in the description of the test, all specimens shall be preconditioned for at least 24 h in still air at a temperature of 23 ±2°C (73 ±4°F).

5.2 Compression

5.2.1 General

5.2.1.1 The internal diameter of conduit shall not decrease by more than 25% during application of the force specified in Table 14 and Table 15 when tested in accordance with 5.2.2 to 5.2.4. The conduit shall show no evidence of cracking or buckling after removal from the compression machine.

5.2.2 Apparatus

5.2.2.1 The apparatus for this test shall consist of:

a) an inside micrometer or telescopic gauges and a micrometer caliper; and

b) a compression machine having 2 steel platens at least 150 mm (6.0 in) long and 10 mm (0.4 in) thick, and capable of running at a speed within the range of 10 to 15 mm/min (0.4 to 0.6 in/min).

5.2.3 Specimens

5.2.3.1 The specimens shall consist of three 150 ±3 mm (6.0 ±0.125 in) lengths of conduit.

5.2.4 Procedure

5.2.4.1 The inside diameter of the specimen shall be measured and recorded. The specimen shall be placed between the plates of the compression machine such that the measured inside diameter is perpendicular to the platens. The machine shall be set in motion until the force specified in Table 14 and Table 15 has been applied to the specimen. The machine shall be stopped and the inside diameter re-measured. The percent decrease in the internal diameter shall be calculated and recorded.

5.3 Beam strength

5.3.1 General

5.3.1.1 The ultimate beam strength of conduit shall not be less than that specified in Table 16 when tested in accordance with 5.3.2 and 5.3.3.

5.3.2 Apparatus

5.3.2.1 The apparatus for this test shall consist of

a) two rigidly supported V-blocks carefully aligned on a free span (see Figure 3). The angle of the "V" shall be 120 ±3°;

b) a suitable testing machine having a speed of 10 to 15 mm/min (0.4 to 0.6 in/min); and

c) a flexible strap having a width of 50 ±3 mm (2.0 ±0.125 in).

5.3.3 Procedure

5.3.3.1 The flexible strap shall be placed around the conduit specimen at the center of the span and attached to the testing machine.

5.3.3.2 The testing machine shall be set in motion. The conduit shall not buckle.

5.4 Impact resistance at low temperature

5.4.1 When tested in accordance with 5.4.2 to 5.4.4, there shall not be any fracture or break in the laminate surface of seven out of ten 200 mm (8.0 in) long specimens of the finished conduit. A fracture or break shall be considered to have occurred where a broken section of the laminate forms a protrusion within the inside diameter or extends beyond the outside diameter of the conduit. The portions of the conduit within 50 mm (2.0 in) from the cut ends of the specimen shall not be examined.

5.4.2 The specimens shall be cut from finished lengths of each trade size of conduit. The specimens, the test apparatus, and the surrounding air shall be in thermal equilibrium with one another at a temperature of -40 ±1°C (-40 ±1°F) during the test. Each specimen shall be tested separately while resting on a solid, flat steel plate that is at least 13 mm (1/2 in) thick and shall be firmly anchored with its upper surface horizontal.

5.4.3 When it is necessary to remove the specimen from the low-temperature chamber due to handling difficulties, the impact test shall commence as soon as possible and shall be completed within 15 s of the time of removal.

5.4.4 The impact energy shall be provided by a weight of 9 kg (20 lbs) in the form of a 51 mm (2.0 in) solid, right-circular, steel cylinder with a flat impact face having rounded edges, as shown in Figure 4, falling freely through a vertical guide with the impact force as specified in Table 17 and Table 18. The flat face of the weight shall strike the center of the specimen. Provision shall be made for keeping the weight from striking the specimen more than once.

5.5 Water absorption

5.5.1 Conduit shall not absorb water more than 0.25 percent of its weight while immersed for 24 h in distilled water when tested in accordance with 5.5.2 to 5.5.4.

5.5.2 The cut edges of a specimen shall be sealed with epoxy cement. The cement shall cure at room temperature for 24 h. Specimens shall be preconditioned by drying in a full-draft circulating-air oven at a temperature of 50 ±3°C (122 ±5°F) for 24 h, after which they shall remain in still air at a temperature of 23 ±2°C (73 ±4°F) for 24 h.

5.5.3 Following conditioning, the weight of the specimen, W_1, shall be determined to within 5 mg of balance, and the specimen shall then be immersed in distilled water for 24 h at a temperature of 23 ±2°C (73 ±4°F). The specimen shall then be removed from the water, dried quickly inside and out with a clean piece of lint-free, absorbent material, and its weight, W_2, shall immediately be determined within 5 mg of balance. W_2/W_1 shall not be larger than 1.0025.

5.5.4 When a specimen is known to contain or is suspected of containing an appreciable amount of water-soluble material, two specimens shall be preconditioned by drying in a full-draft circulating-air oven at a temperature of 50 ±1°C (122 ±2°F) for 24 h and cooling in a desiccator for 24 h; then their weight, W_1, shall be immediately determined. The specimens shall then be immersed in distilled water for 24 h with the water at a temperature of 23 ±2°C (73 ±4°F). Immediately following this immersion, the specimens shall be reconditioned for 24 h in the oven at 50 ±3°C (122 ±5°F), cooled in a desiccator for 24 h, and their weight, W_2, immediately determined.

5.6 Chemical resistance (optional)

5.6.1 Conduit and any adhesive system used to bond lengths of conduit shall be subjected to the tests described in 5.6.2 to 5.6.10 if marked in accordance with 6.5. The results of the test on any trade size of conduit shall be considered representative of the performance of the whole size range.

5.6.2 After being exposed to the reagents indicated by the manufacturer at the intended concentration and temperature for 90 days, the crush strength of specimens of the finished conduit shall not be reduced by more than 15 percent, nor shall the specimens experience a change in weight of more than 2.5 percent. Where there is more than 1.0 percent change in weight after 90 days of exposure to the reagent, that change shall not be more than 1.65 times the change in weight measured after 30 days of exposure to the reagent. There shall not be any softening or disintegration of the specimens as a result of exposure to the reagents.

Note: A reagent is commonly understood to be a substance used to produce a characteristic reaction in chemical analysis. For the purpose of this Standard, however, term "reagent" is referred to in the less restrictive sense as any chemical, oil, or other substance that has a corrosive or degrading influence on conduit or conduit products.

5.6.3 Twelve 50 mm (2 in) long specimens shall be used for each reagent. Each specimen shall be cut from clean lengths of the finished conduit and cleaned of loose particles and ragged edges. The edges of all specimens shall be coated with the same resin used to fabricate the conduit. The weight of each specimen, W_1, shall be determined prior to immersing the specimen in the test solution. Six additional specimens shall be prepared and set aside for comparison purposes during the crush test.

5.6.4 The weighed specimens shall each be immersed in the reagents in separate, covered containers that do not react with the reagent. Each container shall be filled with the reagent at the intended concentration and temperature to the depth necessary to completely cover the specimens that are placed in it. When the liquid comes to rest in each container, the containers shall be closed and kept at the intended temperature for 30 days without agitation of the reagent.

5.6.5 After 30 days, half of the specimens shall be removed from the reagent, rinsed with clean cold water, and carefully wiped dry inside and out with a clean piece of lint-free, absorbent material. The weight of each of the six dried specimens, W_2, shall be determined to within 10 mg of balance and compared to the original weight, W_1, of the specimen. W_2 shall not be greater than 1.025 times W_1.

5.6.6 The six specimens immersed for 30 days and the specimens set aside for testing unaged shall be in thermal equilibrium with one another, the testing machine, and the surrounding air at a temperature of 23 ±2°C (73 ±3°F) throughout the test. The inside diameter of each specimen shall be measured and recorded. The specimens shall then be tested separately between a pair of rigid, flat steel plates that are at least 150 mm (6 in) long and that are horizontal and parallel to one another. The measured inside diameter shall be perpendicular to the platens. One plate shall be moved toward the other at the rate of 12.7 ±3.2 mm/min (0.5 ±0.125 in/min):

a) until the surface of the specimen pulls away from contact with either plate, that is, until the specimen buckles; or

b) until the minor axis measured inside the flattening specimen is 60 percent of the inside diameter measured before the test.

5.6.7 The crushing loads at the buckling and 60 percent points shall be noted on the dial on the machine and recorded for each specimen. The loads at each of these points for the aged specimens shall each be divided by the average loads at each of these points for the unaged specimens. The resulting ratios shall not be less than 0.85, and no conditioned specimen shall crack or collapse before buckling or the 60 percent point is reached.

5.6.8 The six remaining specimens shall remain immersed for an additional 60 days at the intended temperature. After the full 90 days, the specimens shall be removed from the reagent, rinsed, and dried as specified in 5.6.6 before being re-weighed. The weight of each of the dried specimens, W_3, shall be determined to within 10 mg of balance. The following requirements apply:

a) W_3 shall not be greater than 1.025 times W_1.

b) If W_3 is greater than 1.01 times W_1, the ratio of $(W_3 - W_1)$ to $(W_2 - W_1)$ shall not be greater than 1.65.

5.6.9 The specimens immersed for 90 days shall be in thermal equilibrium with the testing machine and the surrounding air at a temperature of 23 ±2°C (73 ±4°F). The inside diameter of each specimen shall be measured and recorded. The specimens shall be tested separately between a pair of rigid, flat steel plates that are at least 150 mm (6 in) long and that are horizontal and parallel to one another. The measured inside diameter shall be perpendicular to the platens. One plate shall be moved toward the other at the rate of 12.7 ±3.2 mm/min (0.5 ±0.125 in/min):

a) until the surface of the specimen pulls away from contact with either plate, that is, until the specimen buckles; or

b) until the minor axis measured inside the flattening specimen is 60 percent of the inside diameter measured before the test.

5.6.10 The crushing loads at the buckling and the 60 percent points shall be noted from the dial on the machine and recorded for each specimen. The loads at each of these points shall be averaged for the set of six specimens. The average loads at each of these points for the immersed specimens shall be divided by the average loads at each of these points for the unaged specimens. The resulting ratios shall not be less than 0.85, and no conditioned specimen shall crack or collapse before buckling or the 60 percent point is reached.

5.7 Watertightness

5.7.1 Coupled conduit and fittings shall not leak when tested in accordance with 5.7.2. Expansion joints marked in accordance with 6.3 do not require this test.

5.7.2 A 300 ±3 mm (12.0 ±0.125 in) length of conduit shall be inserted into the integral coupling of another length of conduit having a total length of 300 ±3 mm (12.0 ±0.125 in), according to the manufacturer's installation instructions.

5.7.3 In the case of an elbow or fitting, one or two 300 ±3 mm (12.0 ±0.125 in) lengths of conduit, as appropriate, shall be inserted into the coupling according to the manufacturer's instructions. One end of the assembly shall be capped with a suitable enclosure. The assembly shall be placed in the vertical position, with the sealed end at the bottom, and filled with tap water. After a minimum of 4 h, the specimen shall be visually examined to determine any evidence of leakage.

5.8 Joint separation

5.8.1 A joint (conduit and socket) shall not separate when tested in accordance with 5.8.2.

5.8.2 Two joints in each trade size shall be assembled as intended. A gasketed joint shall be subjected to an axial pull of 444 N (100 lbf), applied to the assembly for 5 min, intending to pull the conduit out of the socket. A mechanical or threaded joint shall be subjected to an axial pull of 4448 N (1000 lbf), applied to the assembly for 1 min, and tending to pull the conduit out of the socket. An adhesively secured joint shall be subjected to an axial pull of 6670 N (1500 lbf), applied to the assembly for 1 min, and tending to pull the conduit out of the socket.

5.9 Flattening resistance

5.9.1 The vertical inside diameter of conduit shall not decrease by more than the value indicated in Table 19 when tested in accordance with 5.9.2.

5.9.2 Two specimens shall be tested. Each specimen shall be 75 ±3 mm (3 ±0.125 in) long. The vertical inside diameter of each specimen shall be measured and the value recorded. The specimens shall be placed horizontally side by side between the 2 steel platens of a static load test as shown in Figure 5. The specimens shall be placed such that the measured vertical inside diameter is in the vertical position. No part of the specimen shall extend beyond either platen. A test mass of 45 kg (100 lb), including the mass of the upper platen, shall be symmetrically applied. This assembly shall be maintained at a temperature of 110 ±1°C (230 ±2°F) for a period of 24 h. The specimens shall be allowed to cool, with the test mass removed, at 23 ±2°C (73 ±4°F) for a minimum of 1 h. The vertical inside diameter shall be re-measured, recorded, and the actual decrease calculated and recorded.

5.10 Flame retardant properties

5.10.1 Apparatus

5.10.1.1 The apparatus for this test shall consist of the following:

a) a test shield of sheet metal approximately 300 mm (12 in) wide, 350 mm (14 in) deep, and 600 mm (24 in) high, open at the top and front, and 2 rigid support clamps for supporting the test specimen in a vertical position;

b) a burner conforming to ASTM D 5025 or NMX-J-192-ANCE having a bore of 9.5 ±0.3 mm (0.37 ±0.01 in) and a length of 100 ±10 mm (4 ±0.4 in) from the top of the air-inlet openings to the top of the mixing tube, or an equivalent which meets the calibration requirements of ASTM D 5207 or NMX-J-192-ANCE;

c) a supply of bottled, technical grade methane or natural gas of approximately 37 MJ/m^3 (1000 Btu/cu ft) at normal pressure with a suitable regulator and meter for uniform gas flow;

d) a stopwatch or other suitable timing device; and

e) surgical cotton.

5.10.2 Specimens

5.10.2.1 Test specimens shall be the actual conduit, or a plaque having a minimum size of 100 x 150 mm (4.0 x 6.0 in) and a wall thickness not greater than the minimum wall thickness of the conduit.

5.10.2.2 When the material is furnished in a range of colors, melt flows, or reinforcements, specimens representing these ranges shall also be provided. When the burning characteristics are not essentially the same for all specimens representing the range, evaluation shall be limited only to the material in the colors, melt flows, and reinforcement contents tested; or additional specimens in intermediate colors, melt flows, and reinforcement contents shall be provided for testing.

5.10.2.3 Three specimens of each type shall be available for testing.

5.10.3 Procedure

5.10.3.1 The test shall be made in a still-air test chamber.

5.10.3.2 A specimen of the material shall be supported in a vertical position in the test chamber, by 2 rigid support clamps at both vertical edges of the specimen (see Figure 6).

5.10.3.3 The height of the flame, with the burner vertical, shall be adjusted to approximately 127 mm (5.0 in) with an inner blue cone approximately 38 mm (1.5 in) high, producing a temperature of 816 ±50°C

(1500 ±90°F) at the tip of the inner blue cone at a gas pressure equivalent to the one exerted by a 76 mm (3.0 in) water column.

5.10.3.4 The burner shall be tilted to an angle of 20° from the vertical and the flame applied to the material under test so that the tip of the inner blue cone of the flame touches the specimen at a point approximately 70 mm (2.75 in) above its lower end. A stop shall be fixed in position as shown in Figure 6 to permit the burner to be returned to the same position, thereby maintaining the initial fixed distance between the forward edge of the barrel of the burner and the initial position of the test specimen.

5.10.3.5 The flame shall be brought up to the material so that the vertical plane containing the major axis of the burner barrel is at right angles to the line of approach.

5.10.3.6 The flame shall be applied for 15 s, and then removed for 15 s, until five such applications have been made. The flame shall not be reapplied while the material is still burning. If the material burns for more than 15 s but less than 30 s, the flame shall be immediately reapplied upon cessation of flaming.

5.10.3.7 The material shall not support combustion for more than 30 s after any of the first four flame applications or 60 s after the fifth application of the test flame.

5.10.4 Results

5.10.4.1 The following shall be observed and recorded for each specimen:

a) whether or not there is flaming for more than 30 s after the first, second, third, or fourth flame application; and

b) whether or not there is flaming for more than 60 s after the fifth flame application.

5.11 Vertical flame test (FT4) – conduit on cable tray (optional)

5.11.1 General

5.11.1.1 This test shall apply to nonmetallic conduit containing wire and cable, intended for installation inside buildings, and exposed, where permitted. The flame spread of conduit shall be determined in the same manner as any cable with combustible jacket used inside a building.

Note: The FT4 flame test is a National Building Code of Canada requirement in designated noncombustible construction buildings.

5.11.2 Type of insulated conductors and conduit fill

5.11.2.1 The conduit shall contain insulated conductors that do not meet the FT1/VW1 flame rating, such as Type RW90 unfilled cross-linked polyethylene meeting the requirements of CSA C22.2 No. 38 or Type RHH in accordance with UL 44 or NMX-J-451-ANCE. The conduit fill shall be 40%.

5.11.3 Enclosure

5.11.3.1 An enclosure shall be provided to eliminate any external influence on the normal upward draft of the burner flame.

5.11.3.2 The enclosure shall contain a window to permit observation of the fire test.

5.11.3.3 No point of the enclosure, above grade, shall be closer than 1 m (3.3 ft) to the in situ cable tray.

5.11.3.4 The intake fresh airflow shall be sufficient to maintain the oxygen content within the test enclosure, as evidenced by the clear visibility of the test flame through the observation window (see Annex A).

5.11.3.5 The maximum air movement within the enclosure, with only the intake and exhaust openings open, the exhaust fan on, where applicable, and the burner off, shall not exceed 1 m/s (3.3 ft/s), as measured by a vane-type anemometer in the following areas:

a) at the floor level where the burner will be positioned during the test; and

b) 1.5 m (5 ft) above the enclosure floor where the cable tray will be positioned during the test.

5.11.3.6 The temperature of the enclosure and the incoming air shall be at least 5°C (41°F) throughout the test.

5.11.4 Trays

5.11.4.1 A steel, ladder cable tray, conforming to CSA C22.2 No. 126.1; NEMA VE 1 or NMX-J-511-ANCE, approximately 0.46 m (18 in) wide, 75 mm (2.5 in) deep, and 3 m (10 ft) long, and with longitudinal openings of 0.2 m (8.0 in), shall be used. The rungs shall be arranged such that the burner flame will impinge on the conduit midway between rungs. (See Annex A.)

5.11.5 Burner

5.11.5.1 The burner shall be a 250 mm (100 in) ribbon-type propane gas burner, with an air/gas Venturi mixer.

Note: Carlisle Machine Works, Inc. (412 S. Wade Blvd, Millville, NJ 08332) manufactures the following equipment that complies with the test specifications: ribbon-type burner, catalog no. 55AGF001-0098, venturi mixer, catalog no. 55AGF001-0113, and a kit including both the burner and mixer, catalog no. 55AGF001-0091.

5.11.5.2 The burner shall be mounted on a stand and placed 20° from the horizontal, burner ports up, with the major axis of the burner ports 300 ±30 mm (12 ±1.2 in) above the enclosure floor during the fire test.

5.11.5.3 A guide shall be attached to the burner or stand to permit the leading edge of the burner face to be located quickly and accurately 75 ±5 mm (2.5 ±0.2 in) horizontally away from the nearest surface of the conduit during the burn period of the test.

5.11.6 Flowmeters

5.11.6.1 A flowmeter shall be inserted in each of the propane and air lines feeding the burner to measure the flow rates of these gases during the test.

5.11.6.2 The propane flowmeter shall be capable of measuring a flow rate of 2.3×10^{-4} m^3/s (3×10^{-4} yds^3/s) and the air flowmeter a rate of $13.3 \times 10^{-4} m^3/s$ (17.4×10^{-4} yds^3/s). Measurements shall be accurate to within 3%.

5.11.7 Air

5.11.7.1 The air supplied to the burner shall be compressed air, either bottled or supplied through a compressed air system.

5.11.7.2 The dew point of the air shall not be higher than 0°C (32°F) as measured by a dew point measuring device such as Alnor Model 7000U, No. 1999, or its equivalent.

5.11.8 Propane

5.11.8.1 The gas supplied to the burner shall be natural grade propane at a minimum 95% purity, having a heating value of 94 ±2 MJ/m^3 (2540 ±50 Btu/ft^3).

5.11.9 Gas flows

5.11.9.1 The propane flow shall be 2.3 × 10^{-4} m^3/s (3 × 10^{-4} yds^3/s) when corrected to standard temperature and pressure (20°C and 101 kPa or 68°F and 1 ATM). This propane flow will provide a potential heat output of approximately 20 kW. (The actual heat output will be less, due to incomplete combustion of the propane.)

5.11.9.2 The airflow shall be 13.3 × 10^{-4} m^3/s (17.4 × 10^{-4} yds^3/s) when corrected to standard temperature and pressure.

5.11.10 Mounting of conduit

5.11.10.1 The minimum length of each conduit specimen shall be 2.3 m (90.5 in). The specimens shall be positioned in a single layer within the center portion of the cable tray, with one end of each specimen not more than 100 mm (4.0 in) above the bottom end of the cable tray. Each individual specimen or group of specimens shall be separately attached to the rungs of the cable tray using metal wire ties of suitable size, such that the conductor specimens remain in position throughout the test. There shall be one attachment at 0.2 m (8.0 in) from the bottom end of the cable tray and other attachments at no more than 0.45 m (17.7 in) spacing.

5.11.10.2 The individual specimens shall be attached to the cable tray with spacing one half the diameter of the conduit, except that the spacing shall not exceed 15 mm (0.6 in). The tray loading shall be as specified in Table 20.

5.11.10.3 The prepared assembly shall not be subjected to temperatures below 15°C (60°F) for longer than 10 min immediately before the test.

5.11.11 Test procedure

5.11.11.1 The prepared tray shall be positioned vertically inside the enclosure with the open front of the tray facing the front of the enclosure. The upper portion of the tray shall be firmly fixed in position.

5.11.11.2 The burner shall be ignited and gas flows adjusted to the values in 5.11.9, with the burner positioned away from the specimen. The burner, at an angle of 20° from the horizontal, shall then be positioned in front of the tray and 75 ±5 mm (3 ±0.2 in) from the nearest conduit surface. The horizontal dimension shall be determined through the use of the guide specified in 5.11.5.3. The flame shall impinge on the specimens midway between the tray rungs.

5.11.11.3 The burner flame shall impinge on the specimens for a continuous period of 20 min.

5.11.11.4 At the end of the 20 min burn, the burner flame shall be extinguished and the conduit fire (if any) allowed to burn out.

5.11.11.5 The procedure shall be conducted the number of times specified by the testing authority. Each procedure (burn) shall be conducted on untested specimens.

5.11.12 Evaluation of damage

5.11.12.1 Conduit damage shall be determined by measuring the distance of char above the horizontal line from the lower edge of the burner face.

5.11.12.2 The limit of char shall be determined on the front face of the most centrally located conduit by pressing against the conduit surface with a sharp object. Where the surface of the conduit changes from a resilient surface to a brittle (crumbling) surface, the limit of char has been determined.

5.11.12.3 The conduit damage (char) shall be given to the nearest 50 mm (2.0 in).

5.11.13 Criterion

5.11.13.1 The length of the char after completion of the test shall not exceed 1.5 m (4.92 ft).

Note: See Annex A for overall guidance on this test procedure. See also the special marking procedures in 6.2 for this case.

5.12 Halogen content

5.12.1 The halogen content shall not exceed 0.2% by weight, using the calculation method described in Annex B.

5.13 Deflection under heat and load

5.13.1 The average temperature at which simply supported center-loaded bar specimens machined from finished conduit deflect 0.010 inch (0.25 mm) shall not be lower than 110°C (230°F) at a stress of 66 psi (0.455 MPa). The specimens shall be tested in accordance with Method B of ASTM D 648 or NMX-J-70-SCFI.

5.14 Weather resistance

5.14.1 Notched specimens prepared from unaged samples machined from the finished conduit shall have an average Izod impact strength of at least 27 J/m (0.5 ft-lbf/in) of notch width. Similar specimens prepared from samples conditioned for 1000 h, 1500 h and, if necessary, 2000 h to xenon-arc shall have average Izod impact strengths that comply with Table 21. The samples shall be cut and conditioned, and the specimens shall be prepared and tested as indicated in 5.14.2 to 5.14.13.

5.14.2 Longitudinal strips slightly wider than 12.7 mm (0.5 in) shall be cut from straight lengths of finished conduit of the 4 (103), 5 (129), or 6 (155) trade size. To keep the resulting specimens to the same nominal thickness, all of the strips shall be cut from the same trade size of conduit. Each cut shall be made in a plane parallel to the longitudinal axis of the conduit. Each strip shall be cut into samples that are slightly longer than 63.5 mm (2.5 in), with each cut made in a plane perpendicular to the longitudinal axis of the strip. At least 60 such samples shall be required.

5.14.3 Each specimen shall be machined to the dimensions indicated in Figure 7, with the machining done only on the four cut surfaces. The end surfaces shall be flat, parallel, and in planes perpendicular to the longitudinal axis of the conduit. The longitudinal surfaces shall be flat, parallel, and in planes parallel to the longitudinal axis of the conduit. A specimen shall be discarded after this preparation when one or both of its curved surfaces show any scratches or other defects that are visible to normal or corrected-to-normal vision.

5.14.4 Fifteen of the machined specimens shall be set aside to be notched and then tested unaged. Forty-five of the machined specimens shall be mounted in the specimen rack of the light-exposure

apparatus with water spray employing a xenon-arc light source as described in ASTM G 151 and ASTM G 155 or NMX-J-553-ANCE. The specimens shall be mounted with their longitudinal axis vertical and with the convex surface (outside surface of the conduit) facing the arc.

5.14.5 The continuous exposure to light and the intermittent exposure to water spray shall be performed in accordance with or ASTM G 151 and ASTM G 155 or NMX-J-553-ANCE. A cycle shall consist of 102 min of light followed by 18 min of light and water spray. This sequence shall be repeated until a total elapsed operating time as specified in 5.14.6 is achieved.

5.14.6 Fifteen of the specimens shall be removed after 1000 h, another 15 specimens shall be removed after 1500 h, and the remaining 15 specimens shall be removed after 2000 h. The apparatus shall be turned off for removing each set of 15 specimens.

5.14.7 Each unaged and conditioned specimen shall be notched to the dimensions indicated in Figure 8 on a milling machine, engine lathe, or similar machine tool having an accuracy of at least 0.025 mm (0.001 in). The cutter and feed speeds and the cutting action shall produce the notch without alteration of the conduit. Under 60-power magnification, each completed notch shall show:

a) as a cut that is clean and sharp without any nicks, cracks, or thermal deformation; and

b) as having the angle and radius indicated in Figure 8.

5.14.8 A micrometer having an anvil contoured to fit in the notch shall be used to verify that the depth of conduit under the notch is within the limits indicated in Figure 8. The notched surface shall be within 0.025 mm (0.001 in) of being parallel to the other long machined surface and shall have less than 0.050 mm (0.002 in) of twist. The plane bisecting the notch shall be within 2° of being perpendicular to the notched surface. A specimen that departs from one or more of these requirements may be machined further to make it comply. A specimen shall be discarded after this preparation when either or both of its curved surfaces (the original inside and outside surfaces of the conduit) show any scratches or other defects. The width of each specimen retained shall be measured at the notch and recorded to the nearest 0.01 mm or 0.001 in.

5.14.9 The notched specimens shall rest in still air at a temperature of 23 ±2°C (73 ±4°F) for 40 h or longer before being tested. The test shall be made within this range of temperatures.

5.14.10 The calibration and the A and B energy loss factors of the impact apparatus shall be in accordance with ASTM D 256 or NMX-E-186-CNCP.

5.14.11 At least 10 each of the unaged specimens and of the specimens prepared from samples conditioned for 1000 and 1500 h shall be tested in close succession after completion of the 1500 h conditioning, without waiting for completion of the conditioning of the 2000 h samples. When the results after 1500 h are in compliance with the requirements shown in Table 21, conditioning of the 2000 h samples shall be discontinued, and the samples shall be discarded.

5.14.12 Each specimen in turn shall be positioned precisely and clamped rigidly (tightly but not to the point of damaging the specimen) in the vise as shown in Figure 9, and the pendulum shall be released. The Izod impact strength of each specimen and the average Izod impact strength shall be determined as described in ASTM D 256 or NMX-E-186-CNCP for the following groups of specimens: unaged, 1000 h, 1500 h, and, if necessary, 2000 h.

5.14.13 The average Izod impact strength of the unaged specimens shall not be less than 27 J/m (0.5 ft-lbf/in) of notch width (see 5.14.1). The average Izod impact strengths of the specimens prepared from specimens conditioned longer than 1000 h shall comply with Table 21.

5.15 Infrared spectroscopy

5.15.1 General

5.15.1.1 Analysis shall be done with an infrared spectrophotometer, and the results shall be recorded as a plot of the transmittance (%) versus the frequency of the infrared radiation. The plot shall be recorded over the entire wavelength range of the infrared instrument, approximately 2.0 to 20.0 µm (wave number 5000 to 500 cm^{-1}). The scan shall be retained as a permanent record of the analysis.

5.15.2 Preparation

5.15.2.1 The general technique for preparing thermoset polymers for infrared analysis shall be to use a fine file to file a sample from the specimen. These filings may be ground in a mechanical vibrating ball mill. The sample shall be ground in short intervals to prevent heating of the sample. Liquid nitrogen may be used to cool the sample during grinding. Care shall be taken to reduce the particles to a size (approximately 2 µm) smaller than that of the shortest wavelength to be scanned, to minimize scattering effects. The ground specimen shall be thoroughly mixed with spectroscopic grade potassium bromide, and an amount of this mixture sufficient to produce a 1 mm (0.04 in) thick diameter disk shall be placed in an evacuable die. The die shall be placed under vacuum and a pressure of 69 to 103 MPa (10,000 to 15,000 lb ft/in^3) shall be applied. The pressed disk shall be removed from the die and mounted in a spectrophotometer and the infrared spectrum of the material recorded.

5.15.3 Report

5.15.3.1 The individual spectra shall be marked with each of the following:

a) the complete identification of the material tested, including type, source, manufacturer's code, and form;

b) specimen preparation procedure; and

c) spectrophotometer operating conditions.

5.16 Tensile strength

5.16.1 The minimum longitudinal tensile strength of the conduit shall not be less than 48.26 MPa (7,000 psi) when tested in accordance with ASTM D638 or NMX-J-003-SCFI, with no tolerance on relative humidity.

5.17 Durability of printing (all types with surface-applied markings of ink, dyes, etc.)

5.17.1 Specimen preparation

5.17.1.1 Two 300 mm (12.0 in) specimens of the finished conduit bearing the surface-applied markings shall be used.

5.17.2 Apparatus

5.17.2.1 The apparatus shall consist of a:

a) forced-air oven; and

b) a 450 ±5 g (1 ±0.01 lb.) weight having a layer of craft felt approximately 1.2 mm (0.05 in) thick securely attached to a machined flat surface with dimensions of 25 × 50 mm (1.0 × 2.0 in).

Note: For the purpose of this test, craft felt is defined as having not more than 30% wool content, the remainder being rayon.

5.17.3 Exposure

5.17.3.1 One specimen shall be heated in a forced-air oven at the temperature of 110 ±1°C (230 ±1.8°F) for 24 h. The second specimen shall be maintained at room temperature for a minimum of 24 h.

5.17.4 Procedure

5.17.4.1 Upon removal from the oven, the specimen shall be allowed to rest at room temperature for a period of 1 h. Following the rest period, the specimen shall be laid on a solid, flat surface with the printing up. The weight having the 50 mm (2 in) dimension with the attached felt shall be slid back and forth over the length of the specimen. This operation shall be repeated two more times. The time to perform the above operation shall be 5 to 10 s. The same procedure shall be performed on the "as received" specimen conditioned at room temperature.

5.17.5 Result

5.17.5.1 The printing on both specimens shall remain legible.

5.18 Hosedown (conduit bodies)

5.18.1 The conduit body and its external attachments shall be subjected to a stream of water from a base having a 25.4 mm (1 in) diameter nozzle which delivers 246 liters (65 gallons) per min. The water shall be directed to all connections from all angles from a distance of 3.05 to 3.65 m (10 to 12 ft) for a period of time equal to 48 (in seconds) times the test length [1.89 (H + W + D) mm or (H + W + D) inch] for 5 min. A conduit may be installed to equalize internal and external pressures but shall not serve as a drain.

5.18.2 At the end of the test, the inside of the conduit body shall be examined. Water shall not have entered the conduit body.

5.19 External icing (conduit bodies)

5.19.1 Method

5.19.1.1 The conduit body shall be mounted in a room that can be cooled to -7°C (20°F). A metal test bar, 25 mm (1.0 in) diameter and 610 mm (24 in) long, shall be mounted in a horizontal position in a location where it will receive the same general water spray as the enclosure under test.

5.19.1.2 Provision shall be made for spraying the entire conduit body from above with water at an angle of approximately 45° from the vertical. The water temperature shall be between 0°C (32°F) and 3°C (37°F). As a guide, spraying facilities which provide between 40.7 and 81.5 liters per hour per square meter (1 and 2 gallons per hour per square foot) of area to be sprayed have been found effective. The room temperature shall be lowered to 2°C (35°F). The spray of water shall be started and continued for at least 1 h, maintaining the room temperature between 1°C (33°F) and 3°C (37°F).

5.19.1.3 At the end of this time, the room temperature shall be lowered to between -7°C (20°F) and 3°C (37°F) without discontinuing the water spray. (The rate of change in the room temperature is not critical and shall be whatever is obtainable with the cooling means employed). The water spray shall be controlled so as to cause ice to build up on the bar at a rate of approximately 6.35 mm (1/4 in) per h and shall be continued until 19 mm (3/4 in) of ice has formed on the top surface of the bar. The spray shall then be discontinued, but the room temperature shall be maintained between -7°C (20°F) and 3°C (37°F) for 3 hours to assure that all parts of the enclosure and ice coatings have been equalized to a constant temperature.

5.19.2 Evaluation

5.19.2.1 The conduit body and its external mechanisms shall be considered to have met the requirements of this test when:

a) while ice laden, they can be manually operated by one person without any damage to the enclosure, the enclosed equipment, or mechanism. When an auxiliary mechanism is provided to break the ice, it shall be included and utilized in the test. A separate test shall be required for each maintained position of each external operator. When necessary, it shall be possible to gain access to the enclosure interior using an appropriate hand tool without causing functional damage to the enclosure; and

b) they are found to be undamaged after the ice has melted.

5.19.2.2 Conduit bodies without external cavities to trap water when mounted in the normal position do not require testing.

5.20 Wire pull test (conduit bodies)

5.20.1 Conductors shall be pulled through one sample of each trade size of a conduit body or short radius conduit body as described in 5.20.2 – 5.20.7. After the pull, the insulation of the conductors:

a) shall not show any visible damage, and

b) shall comply with 5.20.6 and 5.20.7.

5.20.2 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; and

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

If wire pulling compound is used, the product or smallest unit shipping carton shall be marked in accordance with 6.6. The conductors used for the test shall be of the most rigid type.

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

5.20.3 The size of conductor used shall be as specified in the respective national installation code for the trade size of conduit with which the fitting is intended to be used.

5.20.4 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 that the fitting is intended to be used with shall be secured to the fitting. The open end of the conduit shall be protected by a bushing. The wires shall be pulled through the conduit and the fitting into the outlet box. The use of blunt tools to direct the wires complies with this requirement.

5.20.5 A 457-mm (18-in) section of conduit shall be secured to each of two conduit openings of a fitting. 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.

5.20.6 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.

5.20.7 Compliance with 5.20.6 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.

5.21 Volume verification (conduit bodies)

5.21.1 A conduit body shall hold a volume of water equal to or greater than the marked volume when tested in accordance with 5.21.2 to 5.21.5. See 6.8 and 6.8.

5.21.2 Any projections that extend outside the plane of the open face of a conduit body, such as ears for mounting a cover, shall be ground flush with the face of the conduit body.

5.21.3 All large openings shall be closed by flat, rigid plates clamped in place across the openings. One of the plates shall contain two small holes, one for the entrance of a measuring fluid, the other for venting air.

5.21.4 Using modeling clay, putty, glazing compound, or similar material a conduit opening through the side or bottom of the specimen and a hole between the specimen and the plate mentioned in 5.21.3 shall be filled flush with the inside surface.

5.21.5 Using a clean, graduated vessel having a volume equal to or greater than the marked volume of the specimen and containing water at room temperature, water shall be transferred to the test specimen through the hole in the plate described in 5.21.3.

5.22 Extended support distance test (optional)

5.22.1 General

5.22.1.1 Conduit intended to be marked in accordance with 6.9, for use at support distances greater than those in the National Electrical Code, ANSI/NFPA 70, shall have a maximum deflection not greater than 15.9 mm (5/8 inch) after 7 days when tested in accordance with 5.22.2 – 5.22.5. The conduit under test shall have a center point load as shown in 5.22.2. Representative sample sizes shall be selected.

5.22.2 Center point load

5.22.2.1 The center point load shall be calculated by multiplying the wire fill from Table 22 or Table 23 as follows:

$$LC = \frac{(W \times D)}{2}$$

where:

LC = the center point load;

W = wire fill as noted above;

D = the extended support distance.

5.22.3 Specimen preparation

5.22.3.1 Two specimens for each conduit size and type shall be tested. Suitable lengths are joined at 1/4 of the extended support spacing distance using the manufacturer's recommended straight section connection method. Total length, including the connection joint, shall allow the joint to be placed at 1/4 of the extended support spacing with a minimum 600 mm (24 inch) overhang at each end.

5.22.3.2 All specimens shall be pre-conditioned for at least 24 hours in still air at a temperature of 10°C to 40°C (50°F to 104°F). Ambient temperature shall be in the range of 10°C to 40°C (50°F to 104°F).

5.22.4 Test fixture

5.22.4.1 The test apparatus shown in Figure 10 and Figure 11 shall be used for testing.

5.22.4.2 The test fixture shall have rigid bases, located at the correct extended support distance, at each end of the fixture. The bases shall be designed to prevent movement of the specimen for the duration of the test. The bases shall support V-block clamps fastened to each base and aligned to the extended support distance.

5.22.4.3 A flexible loading strap having a width of 50 ±3 mm (2.0 ±0.125 inches) shall be provided when center-point loading is to be employed. The load medium shall be sand, steel shot or equivalent. (See Figure 11).

5.22.5 Test procedure

5.22.5.1 The specimen shall be placed in the fixture and set up for the specified conduit and extended support distance.

5.22.5.2 Both ends of the specimen shall be securely tightened in the support clamps so that movement of the specimen is prevented during the test period.

5.22.5.3 The specimen shall be pre-loaded with the test load for 10 minutes. The test load shall be removed and measurements for zero deflection shall be recorded. The test load shall then be reapplied. The initial deflection measurement shall be recorded. Deflection shall then be recorded at 12 ±3 hour intervals for 168 hours (7 days).

6 Marking

Advisory Note: *In Canada, there are two official languages, English and French. All markings required by this Standard may be in other languages to conform to the language requirements where the product is to be used*

6.1 All of the markings mentioned in 6.2 to 6.9 shall be clearly legible and durable. Additional markings shall be allowed if they do not conflict and cannot be confused with the markings described in 6.2 to 6.9.

6.2 The outer surface of every straight length of conduit or fitting shall be marked with the following:

a) "Reinforced Thermosetting Resin Conduit", "RTRC", or equivalent wording;

b) the trade size (metric designator) of the conduit;

c) the name or trademark of the manufacturer or with any other distinctive marking by means of which the organization responsible for the product can readily be identified;

d) "IPS" or "ID" and "SW" or "HW" as applicable;

e) "For Use -40°C to 110°C";

f) "Type AG";

g) "FT4" when the conduit complies with the optional flame test in 5.12; and

h) In Canada, “SR”, “Sun Res”, or “Sunlight Resistant.”

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

6.3 Expansion joints that are not subjected to the test in 5.7 shall be marked, "FOR NON WATERTIGHT USAGE".

6.4 In the United States, where the manufacturer produces conduit, elbows, fittings or conduit bodies at more than one factory, the outer surface of each finished straight length of conduit and each elbow, fitting or conduit body shall be marked with a distinctive designation (which may be in code) by means of which the conduit, elbow, fitting or conduit body is identified as the product of a particular factory.

In Canada and Mexico, this requirement does not apply.

6.5 The outer surfaces of conduit, elbows, fittings, and conduit bodies that are intended for wetting by reagents in accordance with 5.6 shall be marked, "RESISTANT TO THE FOLLOWING REAGENTS" (name of the specific reagents and temperature limitations).

6.6 A conduit body that complies with the wire pull test described in 5.21 by using a wire pulling compound shall be marked "For Use With Wire-Pulling Lubricant" or with equivalent wording.

In Canada, this requirement does not apply.

6.7 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 4.6.1.5, 4.6.1.6 and 4.6.2.1 to 4.6.2.3.

In Canada, this requirement does not apply.

6.8 A conduit body shall be permanently and legibly marked with a volume that does not exceed its actual volume. The marking shall be visible after installation. The volume of a conduit body shall be indicated to the lower full integer or rounded up one decimal point. The marked volume shall be rounded to the nearest cm^3 or the nearest 1/4 cubic inch. Volumes of 1/4 cubic inch shall be marked as 0.3 cubic inch, and volumes of 3/4 cubic inch shall be marked as 0.8 cubic inch.

In Canada, this requirement does not apply.

In the United States, the volume markings shall be in cm^3 or cubic inches.

In Mexico, the volume markings shall be in cm^3.

6.9 Conduit straight lengths that comply with the Extended Support Distance Test described in 5.22 shall be marked "Suitable for use at a support distance of ____ meters" ("___ feet") or an equivalent wording

Table 1
Conduit dimensions – IPS SW

(See 4.2.1)

		Inside diameter, minimum	Wall thickness		Outside diameter	
			Minimum	Maximum	Nominal	Maximum
Trade size	Metric designator	Millimeters				
1/2	16	17.27	1.40	2.16	21.33	21.84
3/4	21	22.61	1.40	2.16	26.67	27.18
1	27	29.34	1.40	2.16	33.40	33.91
1-1/4	35	38.10	1.40	2.16	42.16	42.67
1-1/2	41	44.20	1.40	2.16	48.26	48.77
2	53	56.26	1.40	2.16	60.45	60.96
2-1/2	63	69.60	1.40	2.16	73.66	74.17
3	78	84.84	1.40	2.16	88.90	89.41
4	103	109.72	1.40	2.16	114.30	114.81
5	129	136.14	1.91	2.92	141.22	142.24
6	155	162.05	1.91	2.92	168.40	169.16
Trade size	Metric designator	(Inches)				
1/2	16	0.680	0.055	0.085	0.840	0.860
3/4	21	0.890	0.055	0.085	1.050	1.070
1	27	1.155	0.055	0.085	1.315	1.335
1-1/4	35	1.500	0.055	0.085	1.660	1.680
1-1/2	41	1.740	0.055	0.085	1.900	1.920
2	53	2.215	0.055	0.085	2.380	2.400
2-1/2	63	2.740	0.055	0.085	2.900	2.920
3	78	3.340	0.055	0.085	3.500	3.520
4	103	4.320	0.055	0.085	4.500	4.520
5	129	5.360	0.075	0.115	5.560	5.600
6	155	6.380	0.075	0.115	6.630	6.660

Table 2
Conduit dimensions – IPS HW

(See 4.2.1)

		Inside diameter, minimum	Wall thickness		Outside diameter	
			Minimum	Maximum	Nominal	Maximum
Trade size	Metric designator	Millimeters				
4HW	H103	109.72	1.91	2.92	115.32	115.82
5HW	H129	136.14	2.41	3.43	141.73	142.75
6HW	H155	162.05	2.41	3.43	168.91	169.67
Trade size	Metric designator	(Inches)				
4HW	H103	4.320	0.075	0.115	4.540	4.560
5HW	H129	5.360	0.095	0.135	5.580	5.620
6HW	H155	6.380	0.095	0.135	6.650	6.680

Table 3
Conduit dimensions – ID SW

(See 4.2.1)

		Inside diameter, minimum	Wall thickness		Outside diameter[a]	
			Minimum	Maximum	Nominal	Maximum
Trade size	**Metric designator**	**Millimeters**				
1/2	16	11.94	1.40	2.16	15.29	16.05
3/4	21	18.29	1.40	2.16	21.84	22.60
1	27	24.64	1.40	2.16	28.70	29.46
1-1/4	35	30.99	1.40	2.16	35.05	35.81
1-1/2	41	37.34	1.40	2.16	41.40	42.16
2	53	50.29	1.40	2.16	54.36	54.86
2-1/2	63	63.00	1.40	2.16	67.10	67.56
3	78	75.69	1.40	2.16	79.76	80.96
3-1/2	91	88.39	1.40	2.16	92.46	92.96
4	103	101.09	1.40	2.16	105.16	105.66
4-1/2	116	113.79	1.91	2.92	118.62	119.38
5	129	126.24	1.91	2.92	131.82	132.59
6	155	151.64	1.91	2.92	157.23	157.99
Trade size	**Metric designator**	**(Inches)**				
1/2	16	0.470	0.055	0.085	0.602	0.632
3/4	21	0.720	0.055	0.085	0.860	0.890
1	27	0.970	0.055	0.085	1.130	1.160
1-1/4	35	1.220	0.055	0.085	1.380	1.410
1-1/2	41	1.470	0.055	0.085	1.630	1.660
2	53	1.980	0.055	0.085	2.140	2.160
2-1/2	63	2.480	0.055	0.085	2.640	2.660
3	78	2.980	0.055	0.085	3.140	3.160
3-1/2	91	3.480	0.055	0.085	3.640	3.660
4	103	3.980	0.055	0.085	4.140	4.160
4-1/2	116	4.480	0.075	0.115	4.670	4.700
5	129	4.970	0.075	0.115	5.200	5.230
6	155	5.970	0.075	0.115	6.190	6.220

[a] Measured circumferentially.

Table 4
Conduit dimensions – ID HW

(See 4.2.1)

		Inside diameter, minimum	Wall thickness		Outside diameter[a]	
			Minimum	Maximum	Nominal	Maximum
Trade size	**Metric designator**	**Millimeters**				
4HW	H103	101.09	2.03	2.79	106.43	107.19
4-1/2HW	H116	113.79	2.54	3.18	119.89	120.65
5HW	H129	126.24	2.54	3.18	132.59	134.11
6HW	H155	151.64	2.54	3.18	157.99	159.11
Trade size	**Metric designator**	**(Inches)**				
4HW	H103	3.980	0.080	0.110	4.190	4.220
4-1/2HW	H116	4.480	0.100	0.125	4.720	4.750
5HW	H129	4.970	0.100	0.125	5.220	5.240
6HW	H155	5.970	0.100	0.125	6.220	6.240

[a] Measured circumferentially.

Table 5
Dimensions for couplings – IPS SW

(See 4.3.1)

Trade size	Metric designator	Socket depth				Inside diameter of socket at entrance, minimum		Socket wall thickness, minimum	
		Minimum		Maximum					
		mm	(in)	mm	(in)	mm	(in)	mm	(in)
1/2	16	50.80	(2.00)	101.6	(4.00)	22.10	(0.870)	1.40	(0.055)
3/4	21	50.80	(2.00)	101.6	(4.00)	27.43	(1.080)	1.40	(0.055)
1	27	50.80	(2.00)	101.6	(4.00)	34.16	(1.345)	1.40	(0.055)
1-1/4	35	50.80	(2.00)	101.6	(4.00)	42.93	(1.690)	1.40	(0.055)
1-1/2	41	50.80	(2.00)	101.6	(4.00)	49.02	(1.930)	1.40	(0.055)
2	53	50.80	(2.00)	127.00	(5.00)	60.96	(2.400)	1.40	(0.055)
2-1/2	63	50.80	(2.00)	127.00	(5.00)	74.42	(2.930)	1.40	(0.055)
3	78	50.80	(2.00)	127.00	(5.00)	89.66	(3.530)	1.40	(0.055)
4	103	76.20	(3.00)	127.00	(5.00)	115.06	(4.530)	1.40	(0.055)
5	129	76.20	(3.00)	127.00	(5.00)	142.49	(5.610)	1.91	(0.075)
6	155	76.20	(3.00)	127.00	(5.00)	169.04	(6.655)	1.91	(0.075)

Table 6
Dimensions for couplings – IPS HW

(See 4.3.1)

Trade size	Metric designator	Socket depth				Inside diameter of socket at entrance, minimum		Socket wall thickness, minimum	
		Minimum		Maximum					
		mm	(in)	mm	(in)	mm	(in)	mm	(in)
4HW	H103	76.20	(3.00)	127	(5.00)	115.06	(4.530)	1.91	(0.075)
5HW	H129	76.20	(3.00)	127	(5.00)	142.49	(5.610)	2.41	(0.095)
6HW	H155	76.20	(3.00)	127	(5.00)	169.16	(6.660)	2.41	(0.095)

Table 7
Dimensions for couplings – ID SW

(See 4.3.1)

Trade size	Metric designator	Socket depth, minimum				Inside diameter of socket at entrance, minimum		Socket wall thickness, minimum	
		Minimum		Maximum					
		mm	(in)	mm	(in)	mm	(in)	mm	(in)
1/2	16	50.80	(2.00)	101.6	(4.00)	16.05	(0.632)	1.40	(0.055)
3/4	21	50.80	(2.00)	101.6	(4.00)	22.40	(0.890)	1.40	(0.055)
1	27	50.80	(2.00)	101.6	(4.00)	29.46	(1.160)	1.40	(0.055)
1-1/4	35	50.80	(2.00)	101.6	(4.00)	35.81	(1.410)	1.40	(0.055)
1-1/2	41	50.80	(2.00)	101.6	(4.00)	42.16	(1.660)	1.40	(0.055)
2	53	50.80	(2.00)	127.00	(5.00)	55.12	(2.170)	1.40	(0.055)
2-1/2	63	50.80	(2.00)	127.00	(5.00)	66.29	(2.670)	1.40	(0.055)
3	78	50.80	(2.00)	127.00	(5.00)	80.52	(3.170)	1.40	(0.055)
3-1/2	91	50.80	(2.00)	127.00	(5.00)	93.22	(3.670)	1.40	(0.055)
4	103	76.20	(3.00)	127.00	(5.00)	105.92	(4.170)	1.40	(0.055)
4-1/2	116	76.20	(3.00)	127.00	(5.00)	119.63	(4.710)	1.91	(0.075)
5	129	76.20	(3.00)	127.00	(5.00)	132.84	(5.230)	1.91	(0.075)
6	155	76.20	(3.00)	127.00	(5.00)	158.24	(6.230)	1.91	(0.075)

Table 8
Dimensions for couplings – ID HW

(See 4.3.1)

Trade size	Metric designator	Socket depth				Inside diameter of socket at entrance, minimum		Socket wall thickness, minimum	
		Minimum		Maximum					
		mm	(in)	mm	(in)	mm	(in)	mm	(in)
4HW	H103	76.20	(3.00)	127	(5)	107.44	(4.230)	1.91	(0.075)
4-1/2HW	H116	76.20	(3.00)	127	(5)	120.90	(4.760)	2.29	(0.090)
5HW	H129	76.20	(3.00)	127	(5)	133.10	(5.240)	2.29	(0.090)
6HW	H155	76.20	(3.00)	127	(5)	158.24	(6.230)	2.29	(0.090)

Table 9
Radius of elbows

(See 4.4.2)

Conduit		Minimum radius R of elbow to centerline of conduit	
Trade size	Metric designator	mm	(in)
1/2	16	102	(4)
3/4	21	114	(4-1/2)
1	27	146	(5-3/4)
1-1/4	35	184	(7-1/4)
1-1/2	41	210	(8-1/4)
2	53	241	(9-1/2)
2-1/2	63	267	(10-1/2)
3	78	330	(13)
3-1/2	91	381	(15)
4	103	406	(16)
4-1/2	116	610	(24)
5	129	610	(24)
6	155	762	(30)

Table 10
Threaded adapter

(See 4.5.1.1 and Annex C)

Trade size	Metric designator	Socket depth				Minimum inside diameter	
		Minimum		Maximum			
		mm	(in)	mm	(in)	mm	(in)
1/2	16	50.8	(2)	101.6	(4)	12.2	(0.42)
3/4	21	50.8	(2)	101.6	(4)	18.5	(0.73)
1	27	50.8	(2)	101.6	(4)	24.9	(0.98)
1-1/4	35	50.8	(2)	101.6	(4)	31.2	(1.23)
1-1/2	41	50.8	(2)	101.6	(4)	36.8	(1.48)
2	53	50.8	(2)	127	(5)	50.3	(1.98)
2-1/2	63	50.8	(2)	127	(5)	63.0	(2.48)
3	78	50.8	(2)	127	(5)	75.7	(2.98)
3-1/2	91	50.8	(2)	127	(5)	88.4	(3.48)
4	103	76.2	(3)	127	(5)	101.1	(3.98)
4-1/2*	116	76.2	(3)	127	(5)	113.8	(4.48)
5	129	76.2	(3)	127	(5)	126.5	(4.98)
6	155	76.2	(3)	127	(5)	151.9	(5.98)

*See Annex C

Note: Threaded adapter includes both tapered threads (national pipe taper, NPT) and straight threads (national pipe straight, NPS).

Table 11
Cross-sectional area of conduit bodies

(See 4.6.1.2 and Annex C)

Trade size of conduit	Metric designator	Cross section	
		cm^2	(in^2)
1/2	16	3.92	(0.606)
3/4	21	6.88	(1.067)
1	27	11.15	(1.729)
1-1/4	35	19.30	(2.991)
1–1/2	41	26.27	(4.072)
2	53	43.30	(6.711)
2-1/2	63	61.78	(9.576)
3	78	95.39	(14.785)
3-1/2	91	127.57	(19.774)
4	103	164.26	(25.461)
4-1/2*	116	201.69	(31.527)
5	129	258.14	(40.012)
6	155	372.78	(57.781)

*See Annex C

Table 12
Minimum distance between conduit body hubs for three-conductor installation with no investigation

(See 4.6.1.4)

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]

Table 12 Continued on Next Page

Table 12 Continued

Wire size		Minimum distance, mm								Minimum distance, (in)
		Conduit body hub trade size (metric designator)								
AWG or kcmil	mm²	1 (27)	1-1/4 (35)	1-1/2 (41)	2 (53)	2-1/2 (63)	3 (78)	3-1/2 (91)	4 (103)	
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]
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	–	–	–	–	–	–	–	–	–
		–	–	–	–	–	–	–	–	–
		–	–	–	–	–	261.62[c]	261.62[c]	261.62[c]	10.30[c]
500	253.0	–	–	–	–	–	–	–	–	–
		–	–	–	–	–	–	–	–	–
		–	–	–	–	–	315.72[c]	315.72[c]	315.72[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 13
Space inside a conduit body

(See 4.6.1.5)

Maximum wire size		Minimum distance to cover	
AWG or kcmil	mm²	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

Table 13 Continued on Next Page

Table 13 Continued

Maximum wire size		Minimum distance to cover	
AWG or kcmil	mm^2	mm	in
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
1,000 – 1250	507 – 633	254	10
1500 – 2000	760 – 1013	305	12

Table 14
Force for compression test – SW

(See 5.2.1.1 and 5.2.4.1)

Trade size	Metric designator	Force	
		N	(lbf)
1/2	16	4450	(1000)
3/4	21	4450	(1000)
1	27	4450	(1000)
1-1/4	35	4450	(1000)
1-1/2	41	4450	(1000)
2	53	2670	(600)
2-1/2	63	2200	(500)
3	78	1555	(350)
3-1/2	91	1335	(300)
4	103	800	(180)
4-1/2	116	1780	(400)
5	129	1335	(300)
6	155	1160	(260)

Table 15
Force for compression test – HW

(See 5.2.1.1 and 5.2.4.1)

Trade size	Metric designator	Force	
		N	(lbf)
4HW	H103	2000	(450)
4-1/2HW	H116	1850	(415)
5HW	H129	3100	(695)
6HW	H155	2670	(600)

Table 16
Beam strength test

(See 5.3.1.1)

Trade size	Metric designator	Specimen length		Free span between blocks		Minimum initial yield force	
		mm	(in)	mm	(in)	N	(lbf)
1/2	16	500	(20)	305	(12.0)	200	(45)
3/4	21	500	(20)	305	(12.0)	400	(90)
1	27	500	(20)	305	(12.0)	600	(135)
1-1/4	35	500	(20)	305	(12.0)	800	(180)
1-1/2	41	500	(20)	305	(12.0)	1100	(247)
2	53	500	(20)	305	(12.0)	2110	(474)
2-1/2	63	500	(20)	305	(12.0)	2225	(500)
3	78	750	(29.5)	610	(24.0)	1625	(365)
3-1/2	91	750	(29.5)	610	(24.0)	2560	(575)
4	103	750	(29.5)	610	(24.0)	2445	(549)
4 HW	H103	750	(29.5)	610	(24.0)	3115	(700)
4-1/2	116	750	(29.5)	610	(24.0)	3115	(700)
4-1/2 HW	H116	750	(29.5)	610	(24.0)	3500	(786)
5	129	750	(29.5)	610	(24.0)	4000	(899)
5 HW	H129	750	(29.5)	610	(24.0)	5080	(1141)
6	155	750	(29.5)	610	(24.0)	4450	(1000)
6 HW	H155	750	(29.5)	610	(24.0)	5651	(1270)

Table 17
Impact resistance – SW

(See 5.4.4)

Trade size	Metric designator	Impact Force	
		J	(ft-lbf)
1/2	16	20	(15)
3/4	21	20	(15)
1	27	20	(15)
1-1/4	35	20	(15)
1-1/2	41	27	(20)
2	53	47	(35)
2-1/2	63	61	(45)
3	78	80	(60)
3-1/2	91	80	(60)
4	103	80	(60)
4-1/2	116	110	(80)
5	129	140	(100)
6	155	140	(100)

Table 18
Impact resistance – HW

(See 5.4.4)

Trade size	Metric designator	Impact Force	
		J	(ft-lbf)
4HW	H103	110	(80)
4-1/2HW	H116	140	(100)
5HW	H129	240	(180)
6HW	H155	270	(200)

Table 19
Maximum vertical deflection of the diameter on the resistance to flattening test

(See 5.9.1)

Trade size	Metric designator	Maximum vertical deflection of diameter	
		mm	(in)
1/2	16	1.28	(0.050)
3/4	21	1.53	(0.060)
1	27	1.78	(0.070)
1-1/4	35	2.16	(0.080)
1-1/2	41	2.55	(0.100)
2	53	2.93	(0.150)
2-1/2	63	6.61	(0.260)
3	78	9.83	(0.387)
3-1/2	91	15.62	(0.615)
4	103	25.63	(1.010)
4 HW	H103	11.43	(0.450)
4-1/2	116	11.43	(0.450)
4-1/2 HW	H116	12.70	(0.500)
5	129	15.24	(0.600)
5 HW	H129	15.24	(0.600)
6	155	24.38	(0.960)
6 HW	H155	24.38	(0.960)

Table 20
Tray Loading

(See 5.11.10.2)

Conduit outside diameter				Number of conduits in tray
From		To		
mm	(in)	mm	(in)	
0.00	(0.00)	15.0	(0.59)	11
15.1	(0.59)	19.0	(0.75)	9
19.1	(0.75)	21.0	(0.83)	8
21.1	(0.83)	26.0	(1.02)	7
26.1	(1.03)	28.0	(1.10)	6
28.1	(1.11)	39.0	(1.54)	5
39.1	(1.54)	52.0	(2.05)	4
52.1	(2.05)	73.0	(2.87)	3
73.1	(2.88)	175.0[a]	(6.89)	2

[a] The tray flame test provides some indication of the performance of grouped conduits. Therefore, even with larger specimens, there shall be at least two conduits to allow for heat reflection and interaction between specimens.

Table 21
Weather resistance

(See 5.14.1, 5.14.11, and 5.14.13)

Average Izod impact strength of unaged specimens	Xenon arc conditioning period in hours	Percent decrease in average Izod impact strength at the end of the conditioning period	Acceptability
27 – 81 J/m of notch width (0.5 – 1.5 ft·lbf/in of notch width)	0 – 1000	–	No requirement[a]
	1000 – 1500	0 – 5	Acceptable
		Over 5 but under 7.5	Not acceptable unless specimens comply after 2000 h
		7.5 or more	Not acceptable
	1500 – 2000	0 – 5	Acceptable
		Over 5	Not acceptable
Over 81 J/m of notch width (Over 1.5 ft·lbf/in of notch width)	0 – 1000	–	No requirement[a]
	1000 – 1500	0 – 10	Acceptable
		Over 10 but under 15	Not acceptable unless specimens comply after 2000 h
		15 or more	Not acceptable
	1500 – 2000[b]	0 – 10	Acceptable
		Over 10	Not acceptable

[a] The average Izod impact strength after conditioning for 1000 h to xenon arc shall be used as the basis against which the average Izod impact strength after longer conditioning is compared.

[b] Completion of the conditioning of specimens for test after the 500 h period of 1500 – 2000 h xenon-arc exposure may be discontinued if the percentage decrease in the average Izod impact strength is acceptable for specimens conditioned for 1000 – 1500 h.

Table 22
Wire fill loading for extended support distances – IPS sizes

(See 5.22.1)

Metric designator	Trade size	Wire fill 40% maximum fill	
		lbs/ft	kg/m
21	3/4	0.475	0.707
27	1	1.012	1.506
35	1-1/4	1.655	2.463
41	1-1/2	2.348	3.494
53	2	3.590	5.342
63	2-1/2	5.961	8.870
78	3	8.275	12.31
103	4	14.90	22.17
129	5	23.17	34.48
155	6	33.10	49.25

Table 23
Wire fill loading for extended support distances – ID sizes

(See 5.22.1)

Metric designator	Trade size	Wire fill 40% maximum fill	
		lbs/ft	kg/m
53	2	2.872	4.274
63	2-1/2	4.965	7.388
78	3	6.670	9.925
91	3-1/2	9.392	13.98
103	4	12.00	17.86
116	4-1/2	15.90	23.66
129	5	19.86	29.55
155	6	28.14	41.87

Figure 1

Conduit elbows

(See 4.4.2 and 4.4.3)

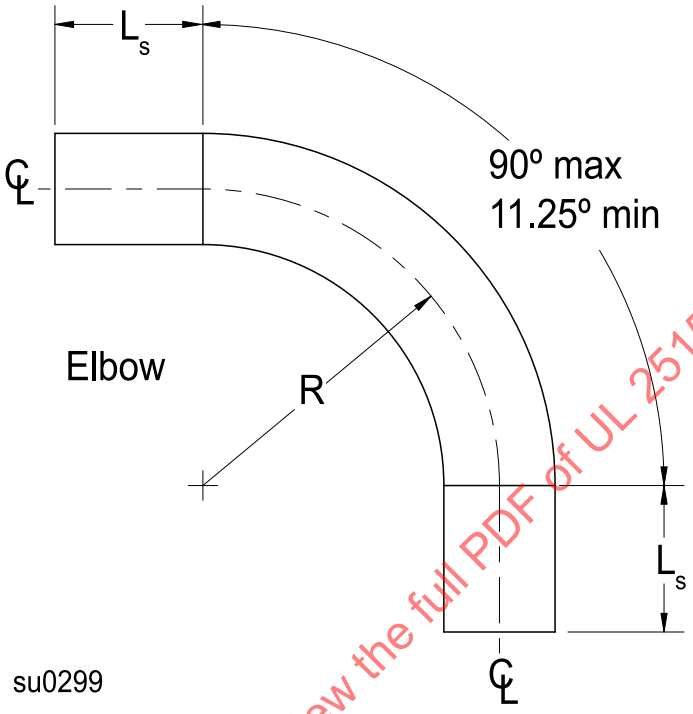


Figure 2

Capacity of conduit body

(See 4.6.1.4, 4.6.1.6, 4.6.2.1, and 4.6.2.3)

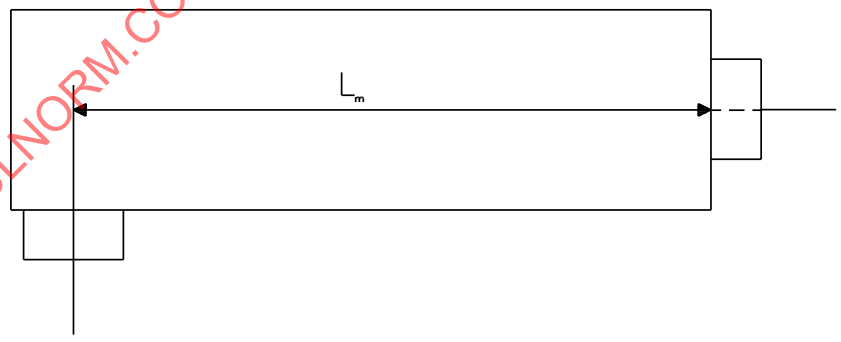


Figure 3

Beam strength test apparatus

(See 5.3.2.1)

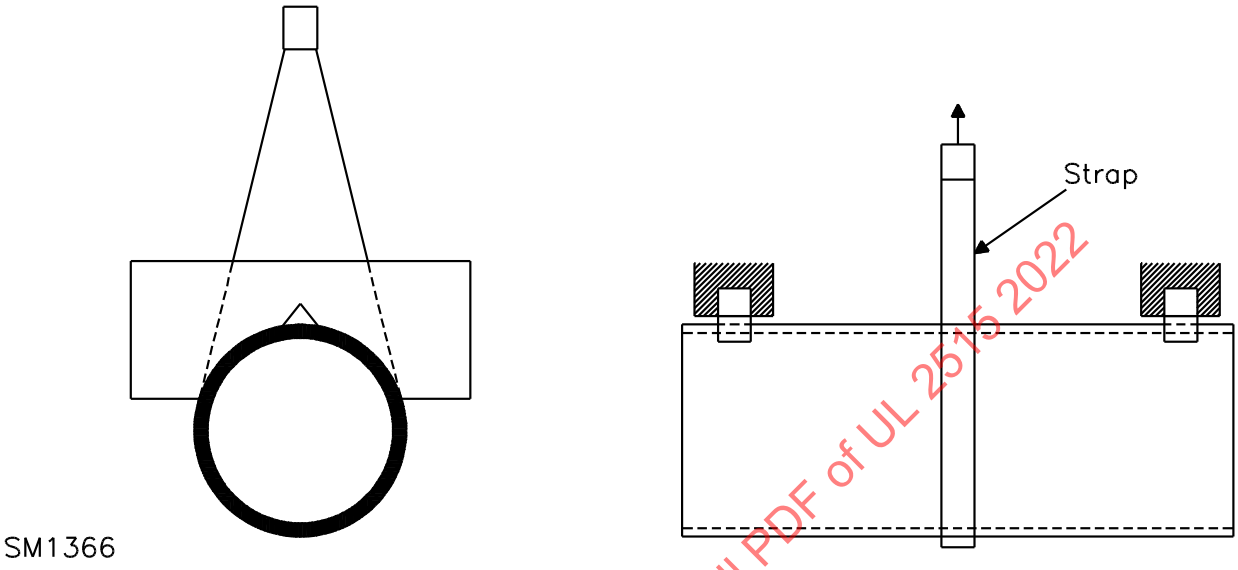


Figure 4

Impact – tup geometry

(See 5.4.4)

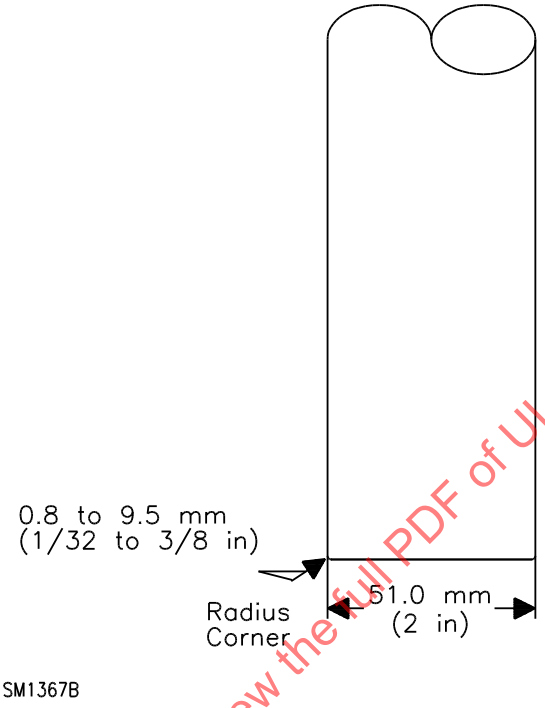


Figure 5

Static load test bed for flattening resistance test

(See 5.9.2)

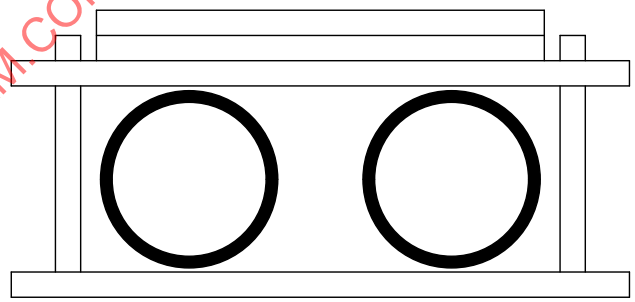
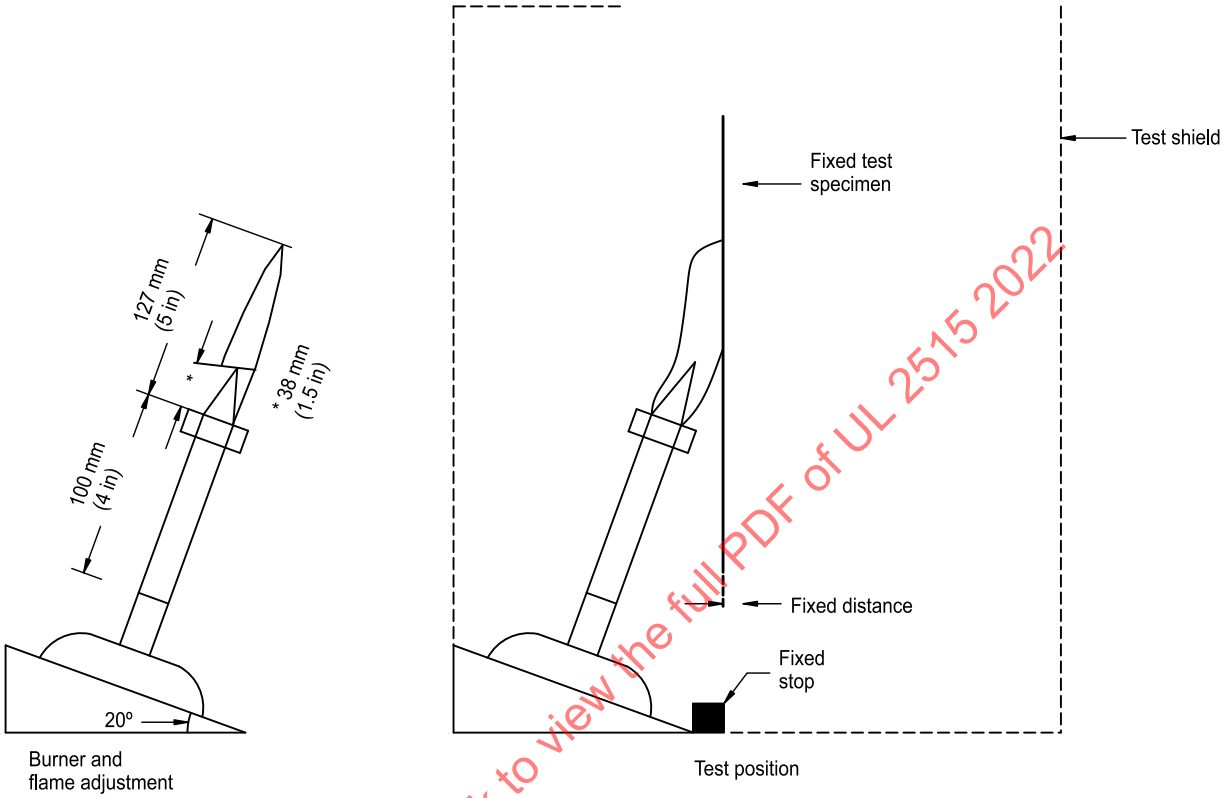


Figure 6

Mandatory flame test

(See 5.10.3.2 and 5.10.3.4)



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