UL 5A

STANDARD FOR SAFETY

Nonmetallic Surface Raceways and Fittings

UL Standard for Safety for Nonmetallic Surface Raceways and Fittings, UL 5A

Fourth Edition, Dated June 26, 2015

Summary of Topics

This revision of UL 5A dated April 18, 2024 is being issued to reaffirm approval as an American National Standard. No changes in requirements are involved.

As noted in the Commitment for Amendments statement located on the back side of the title page, UL and CSA are committed to updating this harmonized standard jointly. However, the revision pages dated April 18, 2024 will not be jointly issued by UL and CSA as these revision pages only address UL ANSI approval dates.

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

The requirements are substantially in accordance with Proposal(s) on this subject dated March 1, 2024.

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Second Edition

ULSE Inc.
UL 5A
Fourth Edition

Nonmetallic Surface Raceways and Fittings

June 26, 2015

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Approved American National Standard

ANSI/UL 5A-2015 (R2024)

Commitment for Amendments

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

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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 Fourth Edition including revisions through April 18, 2024. The most recent designation of ANSI/UL 5A as a Reaffirmed American National Standard (ANS) occurred on April 18, 2024. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page (front and back), or the Preface.

Comments or proposals for revisions on any part of the Standard may be submitted to ULSE at any time. Proposals should be submitted via a Proposal Request in ULSE's Collaborative Standards Development System (CSDS) at https://csds.ul.com

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PREFACE

This is the harmonized CSA Group and ULSE standard for Nonmetallic Surface Raceways and Fittings. It is the second edition of CSA C22.2 No. 62.1, and the fourth edition of UL 5A. This edition of CSA C22.2 No. 62.1 supersedes the previous edition(s) published in 2003. This edition of UL 5A supersedes the previous edition(s) published on July 18, 2003.

This harmonized standard was prepared by CSA Group and ULSE Inc. (ULSE). The efforts and support of the Technical Harmonization Subcommittee 23A SNR Working Group on the Harmonization of Electrotechnical Standards of the Nations of the Americas (CANENA), are gratefully acknowledged.

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

This standard was reviewed by the CSA Subcommittee ICCM05 – Surface Raceway Systems, 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 approved by the American National Standards Institute (ANSI) as an American National Standard.

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 CSA Group and ULSE. 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 THSC determined the safe use of electrical surface raceway and fittings is dependent on the design and performance of the raceway and cable 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 raceway and 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 surface raceway and 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.

Nonmetallic Surface Raceways and Fittings

1 Scope

1.1 These requirements cover nonmetallic raceways and fittings. These products are for use as surface wiring systems in accordance with the Rules of the Canadian Electrical Code, Part 1, and NFPA 70, National Electrical Code.

1.2 Raceways that are all nonmetallic and of any thickness are intended to enclose circuits operating at potentials not exceeding 600 V between conductors.

1.3 Nonmetallic raceways with metal covers are intended to enclose circuits operating at potentials in accordance with Table 1 or Table 1A.

1.4 These requirements do not cover surface metal raceways, cable trays, or wireways.

2 Definitions

2.1 For the purpose of this Standard, the following definitions apply:

ACCESSORY – a part that may be added to a raceway system for a special purpose (for example, guards, hangers, retainers).

FITTING, RACEWAY – a part used to connect, change direction, or terminate a surface raceway (for example, a transition coupler, an end cap, a corner, a tee, an adapter, or a box) or a system specific wiring device that completes the system.

FIXTURE BOX – a box used for the support of a lighting fixture, lampholder, or other equipment intended for similar installation.

GROUNDING/BONDING CONDUCTOR – a conductor that is defined in the National Electrical Code (NEC) as an Equipment Grounding Conductor, and a conductor that is defined in the Canadian Electrical Code (CE Code), Part I, as a Bonding Conductor.

NONMETALLIC – a polymeric part.

SURFACE NONMETALLIC RACEWAY – a raceway for surface or suspension mounting with a nonmetallic base and a nonmetallic or metal cover.

SURFACE RACEWAY SYSTEM – a system consisting of a surface raceway and associated fittings, which may include wiring devices and accessories.

WIRING DEVICE – a part of an electrical system intended to carry, provide a means of connection to, or provide control of electrical energy within a raceway system (for example, switches or receptacles).

3 General

3.1 General requirements

3.1.1 For products intended for use in Canada, general requirements are given in CSA Standard C22.2 No. 0, General Requirements – Canadian Electrical Code, Part II.

3.2 Components

3.2.1 A component of a product covered by this Standard shall comply with the requirements for that component. A component need not comply with a specific requirement that:

a) involves a feature or characteristic not needed in the application of that component in the product covered by this Standard, or

b) is superseded by a requirement in this Standard.

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

3.2.3 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

3.3 Units of measurement

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

3.4 Reference publications

3.4.1 Where reference is made to other publications, such reference shall be considered to refer to the latest edition and all amendments published to that edition up to the time when this Standard was approved.

CSA Group Standards

C22.1-12
Canadian Electrical Code, Part I

C22.2 No. 0.15-01
Adhesive Labels

C22.2 No. 0.17-00
Evaluation of Properties of Polymeric Materials

C22.2 No. 42-10
General Use Receptacles, Attachment Plugs, and Similar Wiring Devices

C22.2 No. 62-93 (R2013)
Surface Raceway Systems

C22.2 No. 111-10
General Use Snap Switches

C22.2 No. 211.0
General Requirements and Methods of Testing for Nonmetallic Conduit

UL Standards

UL 5
Surface Metal Raceways and Fittings

UL 20
General-Use Snap Switches

UL 94
Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

UL 498
Attachment Plugs and Receptacles

UL 746A
Polymeric Materials – Short Term Property Evaluations

UL 746C
Polymeric Materials – Use in Electrical Equipment Evaluations

UL 969
Marking and Labeling Systems

ANSI/NFPA[1] Standards

NFPA 70-2014
National Electrical Code®

ASTM[2] Standards

D 648-07
Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position

D 5025-12
Standard Specification for Laboratory Burner Used for Small-Scale Burning Tests on Plastic Materials

D 5207-09
Standard Practice for Confirmation of 20-mm (50-W) and 125-mm 500-W Test Flames for Small-Scale Burning Tests on Plastic Materials

NRCC[3] Publication

National Building Code of Canada, 2010

[1] American National Standards Institute / National Fire Protection Association
[2] American Society for Testing and Materials
[3] National Research Council Canada

3.5 Installation

3.5.1 The method of installation, as outlined in the instructions accompanying the raceway and fittings, shall be practical and feasible under the conditions likely to be met in practice.

3.5.2 The raceway, fittings, and any wiring devices or accessories are to be installed as intended and examined with regard to the feasibility of installation, as well as for compliance with the construction, test, and marking requirements in this Standard. Items that require particular care on the part of the installer shall be specifically mentioned in the installation instructions.

3.5.3 Nonmetallic surface raceways are not suitable for use as equipment grounding/bonding conductors.

3.6 Metal parts

3.6.1 A metal cover, fitting, or other metal part of a nonmetallic surface raceway shall comply with the applicable requirements in UL 5 or CSA C22.2 No. 62.

4 Construction

4.1 General

4.1.1 The thickness of a nonmetallic part is not specified. The suitability of a nonmetallic part shall be determined by the applicable tests.

4.1.2 In the United States, the minimum thickness of a metal cover of a raceway or fitting shall comply with Table 1.

In Canada, the minimum thickness of a metal cover of a raceway or fitting shall comply with Table 1A.

4.1.3 A surface raceway shall consist of one or more pieces formed and constructed to make the raceway distinguishable from electrical conduit, electrical nonmetallic tubing, and other raceway systems.

4.1.4 The surface raceway shall provide a complete enclosure that protects the wires installed therein against damage. To accomplish this, each of the following apply:

a) There shall not be any openings that exceed 1.59 mm (1/16 in) in width on surfaces that are accessible following installation of the system.

b) A knockout or breakaway tab shall completely cover the opening in which it is located, and the clearance between the knockout or breakaway tab and the opening shall not be more than 0.76 mm (0.030 in).

c) Mounting holes having a maximum diameter of 7.1 mm (9/32 in), or slotted openings of 25.4 mm (1 in) maximum length and 7.1 mm (9/32 in) maximum width, may be provided on the raceway base or fitting base surface installed flush with the mounting surface.

d) A partition in a multiple channel raceway system shall not permit accidental or unintentional passage of circuit conductors between channels. A gap of any length but not wider than 2.0 mm (0.080 in) shall be permitted. If the manufacturer provides mechanical wire retainers, the gap shall be permitted to exceed 2.0 mm (0.080 in) but shall not exceed 3.2 mm (0.125 in). The manufacturer's recommended installation interval for the wire retainers shall be provided in the installation instructions.

4.1.5 The interior surface of the raceway system shall have a smooth finish free from faults such as projections, sharp edges, burrs or fins likely to damage wires when installed as intended.

4.1.6 For raceways using conductors larger than 6 AWG (13.30 mm^2), the Short Circuit Test of Clause 5.16 shall be performed on conductors in the raceway to determine whether the cover is secure.

4.1.7 Raceway or fitting covers shall be constructed such that the use of a tool (such as the prying action of a screwdriver) or two simultaneous deliberate actions are necessary for their removal for gaining access to internal areas of the raceway after installation.

4.2 Mounting

4.2.1 Provision shall be made for attaching the raceway to the mounting surface. Such means shall provide for securing the raceway at intervals of not more than 1.22 m (4 ft). If the base is designed to be secured to the mounting surface by screws or bolts extending from the inside, the arrangement shall not result in damage to the conductors. This can be accomplished through the use of round-head or pan-head screws or bolts, washers that serve to protect the head of the screw or bolt, or other appropriate means.

4.2.2 Mounting hardware such as screws or bolts shall either be packaged with the raceway, or the installation instructions packaged with the raceway or fittings shall contain a statement that the mounting means shall be appropriate for the application.

4.2.3 An adhesive strip, if provided on the raceway, may serve only as a positioning aid during the installation process. The raceway shall also have provisions for mechanical fastening as required in Clauses 4.2.1 and 4.2.2. An adhesive strip provided on a raceway marked for use with Class 2 circuits only, as defined in Article 725 of the National Electrical Code or Section 16 of the Canadian Electrical Code, Part I, may be used as the sole means of securement.

4.2.4 Provision shall be made for securing the cover to the base of a two-piece raceway at intervals of not more than 1.22 m (4 ft). A cover that is held in place by continuous grooves, flanges, or the like shall securely fix the cover in place in accordance with Clause 4.1.7.

4.2.5 In the United States, a cover for a raceway or fitting shall be constructed and installed so it is capable of being removed or opened.

In Canada, this requirement does not apply.

4.3 Partitions

4.3.1 A partition provided in a raceway or fitting shall be secured in position. The partition shall have the strength necessary to support the maximum wire fill by weight.

4.3.2 A partition shall comply with the same requirements as the raceway. The compliance of the partition shall be determined with the base and cover assembled as intended in actual use.

4.4 Knockouts

4.4.1 A knockout shall have a diameter that accommodates the corresponding trade sizes of conduit specified in Table 2. The diameter of the knockout shall be measured at points other than where a tab remains after the knockout has been removed.

4.4.2 Other than as noted in Clause 4.4.3, a knockout intended for use with a locknut provided in a raceway or fitting for a 16 (1/2) or larger trade size conduit shall be surrounded on both the inside and

outside surfaces by a concentric flat surface to permit proper installation of the locknut. Flat surfaces surrounding a knockout on both the inside and outside of a raceway or fitting shall extend beyond the edge of the knockout in all directions for at least the distance given in Table 2 and shall comply with Clause 4.4.3. There shall be not be any projections or indentations in the flat surface area; however, holes shall not be prohibited. The flat surface areas of adjacent knockouts that partially or wholly overlap meet the intent of this requirement.

4.4.3 Compliance of the flat surface that surrounds the knockouts near a radius shall be determined using a test gauge, as shown in Figure 1. To apply the test gauge, a knockout shall be removed and, when required, the remaining tab shall be filed or ground flush with the inside and outside surface as well as at the edge surrounding the opening. An appropriate trade size test gauge shall be used, offset from the center of the knockout, in a direction opposite to the area to be tested. When testing knockouts located adjacent to a radius, a steel feeler gauge, 0.13 mm (0.005 in) thick and 2.5 mm (0.10 in) wide, shall be used to verify the space between the inner surface and the flat surface of the test gauge, as shown in Figure 2.The test gauge shall not be canted or tilted to make the required contact with the surface. Successful insertion of the steel feeler gauge between the surface and the test gauge surface verifies that the corner radius encroaches on the required flat surface and is not in compliance. When testing knockouts or portions of knockouts located away from any radius between two adjacent walls, the steel feeler gauge shall not be used.

4.4.4 For the requirement in Clause 4.4.2, a knockout shall effectively cover the opening in which it is located, and the clearance between the knockout and the opening shall not be greater than 0.40 mm (0.016 in). It is not necessary that the raceway be constructed so that conduit can be installed simultaneously in adjacent knockouts.

4.5 Materials

4.5.1 A nonmetallic part of a raceway or raceway fitting that serves as an enclosure or provides direct or indirect support for an uninsulated live part shall comply with the values specified in Table 3 in accordance with UL 746C or CAN/CSA C22.2 No. 0.17.

4.5.2 A nonmetallic material used in a raceway or fitting shall be subjected to the Infrared Spectroscopy (IR) test.

In the United States, the material shall additionally be subjected to the Thermogravimetry (TGA), and Differential Scanning Calorimetry (DSC) tests. These tests are specified in UL 746A or CAN/CSA C22.2 No. 0.17.

4.5.3 A nonmetallic material used in a part or feature that can be removed without affecting the integrity of the installed raceway or fittings need not comply with the requirement in Clause 4.5.2.

4.5.4 A nonmetallic part shall be electrically nonconductive but shall not be considered part of the insulation required on wiring or elsewhere in the raceway system.

4.6 Fittings

4.6.1 A fitting provided with means for the support of a fixture shall have strength and rigidity for the purpose as determined by the tests described in Clauses 5.2.1 – 5.2.6. A nipple intended only for the connection of a lampholder or the like shall not be a means for the support of the fixture.

4.7 Wiring devices

4.7.1 A wiring device or device assembly shall be secured to the raceway base by a positive means such as two screws or rivets. A snap-fit or other non-positive means of securement may be used if the

securement complies with the tests described in Clauses 5.3.1 – 5.3.4. A wiring device or device assembly may be mounted by the center screw if it is identified for the purpose.

4.7.2 A receptacle shall comply with all of the applicable requirements in UL 498 or CSA C22.2 No. 42. A flush switch shall comply with all of the applicable requirements in UL 20 or CSA C22.2 No. 111.

4.7.3 In the United States, a wiring device cover constructed to support a flush duplex receptacle shall be provided with more than one securement point for the receptacle.

In Canada, this requirement does not apply.

4.8 Electrical continuity

4.8.1 Electrical continuity shall be provided between all metal parts of a surface nonmetallic raceway system while the parts are installed in the intended manner. See Electrical resistance, Clause 5.7.

4.8.2 All metal parts of a nonmetallic surface raceway system that are likely to become energized shall be bonded to ground. Mounting hardware that is not exposed after installation need not comply with this requirement.

4.9 Grounding/Bonding

4.9.1 A grounding/bonding screw provided in a metal raceway cover or fitting cover shall:

a) be No. 10 or larger,

b) have a green-colored head that is slotted or hexagonal, or both, and

c) be plated steel, stainless steel, copper, or copper alloy.

4.9.2 A grounding/bonding screw shall engage the metal cover specified in Clause 4.9.1 at least two full threads and shall be used in conjunction with upturned lugs, a cupped washer, or an equivalent method capable of retaining a 10 AWG (5.3 mm^2) conductor under the head of the screw.

4.9.3 A sheet metal screw shall not be used for the connection of a grounding/bonding conductor.

4.9.4 With respect to the requirement in Clause 4.9.1 and 4.9.2, a grounding/bonding wire provided in lieu of a grounding/bonding screw shall be sized in accordance with the maximum size of wire for which the raceway is intended to be used and shall be solid copper not smaller than 14 AWG (2.1 mm^2).

In the United States, a solid aluminum grounding/bonding wire not smaller than 12 AWG (3.3 mm^2), and 127 – 152 mm (5 – 6 in) long may be optionally used.

4.9.5 One end of a grounding/bonding wire shall be secured to the metal raceway cover or fitting by a screw complying with Clause 4.9.1 or by a permanent means, such as welding, or by means of a copper, copper alloy, or stainless-steel rivet if the wire is copper. If insulated, the color of the surface of the insulation shall be green, with or without one or more yellow stripes.

In the United States, securement of the grounding/bonding wire may be optionally achieved by means of an aluminum or stainless-steel rivet if the wire is aluminum.

5 Tests

5.1 General

5.1.1 Unless otherwise specified, all tests shall be conducted at a room temperature of 23 ±2°C (73 ±4°F).

5.2 Fixture box support

5.2.1 Screws used to secure the cross bar to the box shall not require a torque greater than 2.3 N·m (20 lbf-in) for removal and shall not pull out more than 6.3 mm (0.25 in) when subject to each of the following:

a) a direct pull force equal to 4 times the manufacturer's recommended maximum load to be supported by the fixture box, when tested in accordance with Clauses 5.2.3 and 5.2.4;

b) a direct pull force equal to the manufacturer's recommended maximum load to be supported by the fixture box, when tested in accordance with Clause 5.2.5; and

c) a bending force equal to the manufacturer's rated loading, when tested in accordance with Clause 5.2.6.

5.2.2 Each test shall be performed on a separate fixture assembly. The manufacturer's recommended maximum load to be supported by the fixture box shall not exceed 223 N (50 lbf).

5.2.3 The fixture box shall be mounted as intended for service, and a direct pull shall be applied to a rigid steel bracket attached to the fixture-support studs on the fixture box. A weight that equals 4 times the maximum load recommended by the manufacturer shall be suspended from the bracket at a point midway between the fixture-support studs for a period of 5 min.

5.2.4 The nonmetallic fixture box shall be mounted as intended, and a rigid steel bracket shall be secured to the fixture-support studs on the fitting. The assembly of the fixture box and bracket shall then be conditioned for 7 h in a full-draft circulating-air oven maintained at a temperature of 105.0 ±1.0°C (221.0 ±1.8°F). With the assembly maintained at this temperature, a weight that equals 4 times the maximum load recommended by the manufacturer shall be suspended for 5 min from the center of the bracket.

5.2.5 The nonmetallic fixture box shall be mounted as intended, and a rigid steel bracket shall be installed on the fitting as indicated in Clause 5.2.3. The assembly of the nonmetallic fixture box and the bracket shall be supported in the oven described in Clause 5.2.4, and a weight that equals the maximum load recommended by the manufacturer, up to 223 N (50 lbf), shall be suspended from the center of the bracket. The complete assembly shall then be maintained for 24 h at a temperature of 105.0 ±1.0°C (221.0 ±1.8°F).

5.2.6 The nonmetallic fixture box shall be mounted as intended, and a 500 mm (20 in) rigid stem shall be secured to the fixture-support studs on the fitting. The assembly shall then be mounted to the underside of a platform that is at an angle of 30° with the horizontal and can be rotated about the axis of the rigid stem. The bending force shall be applied to the end of the rigid stem, and the fixture shall be rotated for six complete revolutions during the test period of 1 min. See Figure 3.

5.3 Receptacle secureness

5.3.1 A receptacle that is secured in place directly or indirectly to the raceway by a snap-fit or any means other than screws, rivets, or equivalent positive securement shall be tested as described in Clauses 5.3.2 – 5.3.4.

5.3.2 Three test assemblies, as detailed below, shall be prepared for this test. A power-supply cord attachment plug shall be inserted into the receptacle and made mechanically secure. A weight exerting 111 N (25 lbf) shall be attached to the opposite end of the power-supply cord. The receptacle shall be attached in the intended manner to the raceway system. With the raceway in the horizontal position (receptacle face directed towards the ground) and the weight initially resting on a horizontal surface, the raceway shall be gradually raised vertically until the weight is supported by the receptacle. The weight shall be supported for 60 s.

5.3.3 Following the 60 s application of the weight perpendicular to the receptacle face as noted in Clause 5.3.2, the procedure shall be repeated with the raceway tilted so that a line perpendicular to the face of the receptacle makes an angle of 30° with the vertical cord. The direction of the tilt relative to the receptacle shall be the direction most likely to cause separation.

5.3.4 As a result of the tests in Clauses 5.3.2 and 5.3.3, the receptacle or fitting shall remain fully secured to the raceway.

5.4 Security of knockout and breakaway tab

5.4.1 A force of 44.5 N (10 lbf) shall be applied to three external knockouts or breakaway tabs for 60 s by means of a 6.4 mm (0.25 in) diameter mandrel with a flat end. The force shall be applied with the mandrel's flat end in a direction perpendicular to the plane of the knockout or breakaway tab and at the point most likely to cause movement. The knockout or breakaway tab shall remain in place, and the clearance between the knockout or breakaway tab and the opening shall not be more than 0.76 mm (0.030 in) when measured 60 min after the force has been removed.

5.4.2 All knockouts or breakaway tabs shall be capable of being removed by following the manufacturer's instructions without leaving sharp edges and without damage to the part from which the knockout or tab was removed.

5.4.3 For multiple-stage knockouts or breakaway tabs, there shall not be any displacement of a larger stage when any smaller stage is removed as described in Clause 5.4.1.

5.5 Temperature

5.5.1 The maximum temperature attained on an interior surface of a nonmetallic raceway part shall not exceed the Relative Thermal Index (Mechanical with Impact) of the material. The maximum temperature attained on an interior surface of a nonmetallic raceway may exceed the Relative Thermal Index (Mechanical with Impact) of the material if it complies with Clause 5.6.

5.5.2 A length of the raceway approximately 2 m (6 ft) long shall be mounted in a horizontal position on a vertical wall. The raceway shall be filled with the maximum number of conductors of the wire size and type recommended by the manufacturer. The wires shall then be tightly bundled at each end of the raceway and in the center of the raceway length. The raceway cover shall be installed as intended, and the open space at each end of the raceway shall be plugged with cotton to prevent through ventilation. If the manufacturer's installation instructions specify that the conductors are not to be bundled, they shall be placed loosely in the raceway.

5.5.3 The raceway shall be operated continuously with the current de-rating indicated by the National Electrical Code or the maximum current rating indicated by the Canadian Electrical Code, Part I, for that wire fill, until thermal equilibrium is attained. Thermal equilibrium is defined as three consecutive readings taken 10 min apart with no change in temperature greater than ±2°C (±4°F).

For Canada, see Annex A.

For the United States, see Annex B.

5.5.4 The temperatures shall be measured by thermocouples located on the interior surface of the raceway base, on the interior surface of the raceway side at the top and bottom, and on the interior surface of the raceway cover, placed in the center of the raceway length. The test shall be repeated for each wire fill for which the raceway is intended.

5.6 Deflection under heat and load

5.6.1 The maximum temperature attained on an interior surface of a nonmetallic raceway may exceed the Relative Thermal Index (Mechanical with Impact) of the material employed if it complies with the requirements in Clauses 5.6.2 – 5.6.12. A nonmetallic material used in a part or feature that can be removed without affecting the integrity of the installed raceway or fittings need not comply with this requirement.

5.6.2 The average temperature at which simply-supported, center-loaded bar specimens machined from the finished nonmetallic part deflect under a stress of 455 kPa (66 lbf/in^2) shall be determined. The resulting deflection temperature establishes the maximum interior temperature for the material during normal operation as determined during the Temperature Test described in Clause 5.5, according to the following equation:

Maximum Interior Temperature in °C = Deflection Temperature in °C – 10°C

In no case shall the material's deflection temperature be less than 70°C (158°F).

5.6.3 At least three rectangular specimens that are 3.2 mm (1/8 in) thick, 12.7 mm (0.50 in) high, and 127 mm (5.0 in) long shall be machined from the finished nonmetallic part. All adjacent surfaces of the specimens shall be mutually perpendicular and smooth, flat, and free of scratches and other visible imperfections. If bar specimens of the size required cannot be machined from the finished nonmetallic part, bar specimens can be fabricated from the same material in accordance with ASTM D 648. Lamination of specimens shall not be permitted.

5.6.4 The apparatus shall consist of a container in which a specimen can be supported and loaded as shown in Figure 4 while immersed in a liquid heat-transfer medium as shown in Figure 5. The coefficients of linear thermal expansion of the rod through which the load is applied and the vertical members that connect the specimen supports to the upper plate shall be equal. A dial micrometer, with a scale upon which the smallest division represents 0.01 mm (0.0005 in) shall be coupled to the loading rod for the purpose of measuring the deflection at the center of the specimen.

5.6.5 The liquid used as the heat-transfer medium shall be one that does not affect the rigidity of the specimen at room or elevated temperatures.

5.6.6 An immersion or other heater whose output can be adjusted by a rheostat, variable transformer, or other means shall be provided for heating the liquid at the rate of 2.00 ±0.20°C (3.60 ±0.36°F) per minute. A means shall be provided for stirring or otherwise circulating the liquid continuously during the heating period.

5.6.7 A mercury or other accurate thermometer covering a range of at least 20 – 75°C (68 – 167°F) shall be mounted where its bulb is close to, but not touching, the top surface of a specimen whenever a specimen is in place. The bulb shall not be farther away from a specimen than 3.2 mm (1/8 in).

5.6.8 If desired, and if the load on a specimen is not affected, devices may be included in the apparatus to disconnect the heater and energize a lamp, bell, or other indicator as a deflection of 0.25 mm (0.010 in) occurs.

5.6.9 A specimen shall be put in place as indicated in Figure 4 and Figure 5 with the presser foot not touching the specimen. The liquid shall be admitted to the container to cover the thermometer to the level specified in its calibration. The stirring or circulating device shall be started and the temperature shall be noted. The apparatus, specimen, and liquid shall be in thermal equilibrium with one another and with the surrounding air before proceeding further.

5.6.10 The total force, F, to be exerted by the presser foot on a specimen shall be determined from whichever of the following formulas is applicable. In each case, the weight, W, that is to be added to the loading rod to make the presser foot bear on a specimen with force F, is equal to F minus the weight of the loading rod minus the force of the spring in the dial micrometer.

$$F_{66} = 19{,}968\frac{T_{\text{in}}\,H_{\text{in}}{}^{2}}{L_{\text{in}}}$$

in which:

F_{66} is the force in grams to stress the specimen to 66 lbf/in^2, T_{in} is the measured thickness of the specimen in inches, H_{in} is the measured height of the specimen in inches, and L_{in} is the measured distance between the centers of the specimen supports in inches.

$$F_{455} = 303{,}030{,}303\frac{T_{\text{mm}}\,H_{\text{mm}}{}^{2}}{L_{\text{mm}}}$$

in which:

F_{455} is the force in newtons to stress the specimen to 455 kN/m^2, T_{mm} is the measured thickness of the specimen in millimeters, H_{mm} is the measured height of the specimen in millimeters, and L_{mm} is the measured distance between the centers of the specimen supports in millimeters.

5.6.11 The presser foot shall be lowered gently and left to bear on the specimen for 5 min (no waiting period is necessary if it is known that the material the specimen is made of does not creep appreciably in 5 min). The scale on the dial micrometer shall then be adjusted to zero and the heater shall be energized to raise the temperature of the liquid at the rate of 2.00 ±0.20°C (3.60 ±0.36°F) per minute. The heating shall continue until the micrometer indicates that the specimen has been deflected 0.25 mm (0.010 in), at which point the temperature shall be noted and recorded.

5.6.12 The procedure in Clauses 5.6.9 – 5.6.11 shall be repeated on two more specimens. The material shall not be acceptable if the average of the three temperatures is lower than 70°C (158°F).

5.7 Electrical resistance

5.7.1 Measured on individual pieces

5.7.1.1 The electrical resistance per unit length of a complete (cover in place) individual section of nonmetallic raceway provided with a metal cover, and of each complete (cover in place) metal coupling or other fitting, shall not be greater than indicated in Table 4.

5.7.2 Measured across joints

5.7.2.1 The electrical resistance of the connection between adjacent sections of a nonmetallic surface raceway provided with a metal cover, and the connection between a raceway cover and any metal fitting, internal or external to the raceway, shall not exceed 0.005 ohm.

5.7.2.2 The raceway and fittings shall be installed in the intended manner and a direct current of 30 A shall be passed between adjacent sections of raceway cover, and between raceway cover and fittings. The resulting voltage drop shall be measured between a point (file mark) on the raceway 2 mm (1/16 in) from the connection and a similar point on the far end of an adjacent piece of raceway or on the fitting if it is of the end-fitting type. In the case of a feed-through type fitting, the resulting voltage drop shall be measured between points on the two adjacent pieces of raceway cover 2 mm (1/16 in) from the connections. The resistance shall be calculated by dividing the measured voltage drop by the current passing through the raceway.

5.8 Resistance to thermal degradation

5.8.1 The material of which a nonmetallic part is made shall be resistant to thermal degradation at the highest temperature to which the finished part is exposed in the normal intended use of the raceway. One of the procedures indicated in Table 5 shall be used in judging the acceptability of the thermal-aging characteristics of the material.

5.8.2 A nonmetallic material used in a part or feature that can be removed without affecting the integrity of the installed raceway or fittings need not comply with the requirement in Clause 5.8.1.

5.9 Mold stress

5.9.1 A finished nonmetallic part shall not develop any holes, cracks, or other openings to permit entrance of the probe illustrated in Figure 6 to a depth greater than 3.2 mm (1/8 in), and cover secureness shall not be adversely affected when tested as described in Clause 5.9.2.

5.9.2 Three 460-mm (18-in) lengths of the complete raceway or three complete fittings installed as intended onto 150-mm (6-in) lengths of raceway shall cool to room temperature in still air after being aged in a full-draft circulating-air oven for 7 h at a temperature equal to the highest temperature to which the nonmetallic part is exposed in the normal intended use of the raceway system (this temperature shall be determined as described in Clause 5.5) plus 10°C (18°F), but not less than 70.0 ±1.0°C (158.0 ±1.8°F). The test specimens shall be secured to a mounting surface during this test.

5.10 Crush

5.10.1 A finished nonmetallic part of a raceway system shall be capable of withstanding a static load of 1334 N (300 lbf) when tested as described in Clauses 5.10.2 – 5.10.5.

5.10.2 One 460-mm (18-in) length of the raceway cover and base, or one fitting cover and base, installed as intended onto a 150-mm (6-in) length of raceway, lacking any internal devices or removable partitions, shall be mounted onto a piece of plywood that is nominally 19 mm (3/4 in) thick. Device boxes shall be tested with a blank face-plate in place. Three of these assemblies shall be prepared and tested.

5.10.3 If the raceway or fitting is provided with removable partitions, three additional assemblies, with the partitions in place, shall be prepared and tested.

5.10.4 Each of the assemblies shall be tested by being crushed between two flat, horizontal steel plates in the jaws of a compression machine. The plates shall be 150 mm (6 in) long and wide enough to cover the raceway or fitting under test. The crushing force shall be applied perpendicular to the mounting surface at the rate of 12.5 ±2.5 mm/min (0.50 ±0.10 in/min) until a load of 1334 N (300 lbf) is reached, held at that level for 60 s, and then reduced to zero at the same rate.

5.10.5 The nonmetallic raceway cover and/or base or the nonmetallic fitting cover and/or base do not conform with the requirements in Clauses 5.10.1 – 5.10.4 if, for any of the three assemblies tested:

a) there is more than 10% permanent change in any dimension when measured 5 min after removal of the load,

b) the integrity of the assembly does not remain intact, or

c) cracks and openings develop that permit the probe illustrated in Figure 6 to be inserted more than 3.2 mm (1/8 in) when evaluated 5 min after removal of the load.

5.11 Cold impact

5.11.1 A finished nonmetallic part of a raceway system shall be capable of withstanding the impact applied as described in Clauses 5.11.2 and 5.11.3. The probe illustrated in Figure 6 shall not be capable of being inserted more than 3.2 mm (1/8 in) into any crack or other opening.

5.11.2 Each of six specimens for this test shall consist of one 460-mm (18-in) length of the raceway cover and base, or one fitting cover and base installed as intended onto 150 mm (6 in) minimum sections of raceway. Partitions, if provided, shall be in place in each specimen. In each case, the specimen shall be mounted on a piece of plywood that is nominally 19 mm (3/4 in) thick. The six assemblies shall be cooled in circulating air to a temperature of 0.0 ±2.0°C (32.0 ±3.6°F) and shall be maintained at that temperature for 3 h.

5.11.3 The chilled assemblies shall then be removed from the cold chamber and placed on a concrete floor with the plywood horizontal for three of the assemblies and vertical for the three remaining assemblies. Within 15 s after removal from the cold chamber, each of the six assemblies shall be subjected separately to an impact directed vertically downward onto the center of the uppermost surface. The impact shall be delivered by a solid steel sphere falling through a distance of 1.3 m (51 in). The sphere shall be smooth, shall be 50.8 mm (2 in) in diameter, and shall weigh 535 g (1.18 lb).

5.11.4 An assembly that, with the plywood in the vertical orientation, cannot be impacted on the center of its uppermost surface, shall be impacted with the steel sphere positioned tangential to the mounting surface. See Figure 7.

5.11.5 For an outlet box or switch box fitting, the three assemblies to be impacted with the plywood in the horizontal orientation shall be impacted on the exposed area of the box in the vicinity of the device mounting holes. Knockouts or breakaway tabs shall not be subjected to the impact.

5.11.6 A raceway or fitting that is provided with removable partitions shall have an additional three samples impacted in the horizontal orientation with the partitions removed.

5.12 Low temperature handling

5.12.1 Assembled nonmetallic raceways or nonmetallic covers shall not crack or shatter when tested in accordance with Clause 5.12.2.

5.12.2 After being conditioned for 3 h at minus 34 ±1°C (minus 29 ±1.8°F), and within 15 s of removal from the conditioning chamber, three assembled sections of raceway base and covers, 762 mm (30 in) in length, shall be dropped from 1.5 m (5 ft), with the cover down, onto a concrete floor without being damaged. For the first drop, the raceway shall be approximately 45° to the horizontal so that the edge of the raceway strikes the floor first. For the second drop, the raceway shall be approximately parallel to the floor so that the face strikes the floor first.

5.13 Flammability

5.13.1 A nonmetallic part shall be tested as described in Clauses 5.13.4 – 5.13.10. As a result of the tests, the finished nonmetallic part shall not:

a) develop one or more openings or be completely consumed at any time during the test,

b) emit flaming or glowing particles or flaming drops at any time that ignite the cotton on the burner wedge or floor of the enclosure. Flameless charring of the cotton is to be ignored, or

c) continue to flame longer than 10 s following the final application of the test flame.

5.13.2 A nonmetallic part need not be subjected to the flame test described if it:

a) is of a nonmetallic material classified as 5VA. This rating shall be in accordance with UL 94 or CAN/CSA C22.2 No. 0.17, and

b) is of at least the same thickness in which the material qualified with the flammability rating specified in Item a).

5.13.3 If the minimum thickness of the nonmetallic part is 3.2 mm (1/8 in) or less, the classification at a thickness of 3.2 mm may be used.

5.13.4 Three 305 mm (12 in) lengths of the complete finished nonmetallic part shall cool to room temperature in still air after being aged in a full-draft circulating-air oven for 168 h at 70.0 ±1.0°C (158.0 ±1.8°F). The specimens need not be aged if it is determined that the nonmetallic material of which the part is made does not increase in flammability as a result of long-term thermal aging. In the case of a small molded part such as a raceway fitting, the test may be conducted with the part assembled onto the raceway section.

5.13.5 The test shall be conducted in a three-sided metal enclosure in an exhaust hood or cabinet. The metal enclosure shall be 305 mm (12 in) wide, 355 mm (14 in) deep, 610 mm (24 in) high, and the top and front shall be open. A specimen as mentioned in Clause 5.12.2 shall be secured with its longitudinal axis vertical in the center of the enclosure, its transverse axis parallel to the rear of the enclosure, and the inside surface of the part facing the front of the enclosure. A flat horizontal layer of untreated surgical cotton 6 – 25 mm (1/4 – 1 in) thick shall cover the floor of the enclosure. The upper surface of the cotton shall be 229 – 241 mm (9 – 9-1/2 in) below point B, which is the point at which the tip of the blue inner cone of the test flame touches the specimen. See Figure 8.

5.13.6 A burner conforming to ASTM D 5025 having a bore of 9.5 mm (3/8 in) and a length of 100 mm (4 in) from the top of the air-inlet openings to the top of the mixing tube, or an equivalent which meets the calibration of ASTM D 5207 shall supply the flame. While the barrel is vertical and the burner is well away from the specimen, the overall height of the flame shall be adjusted to approximately 100 – 125 mm (4 – 5 in) The blue inner cone shall be 38 mm (1-1/2 in) high and the temperature at its tip shall be 816°C (1500°F) or higher as measured using a chromel-alumel (nickel-chromium and nickel-manganese-aluminum) thermocouple. Without disturbing the adjustments for the height of the flame, the valve supplying gas to the burner flame and the separate valve supplying gas to any pilot flame shall be closed.

5.13.7 A wedge (acceptable dimensions are shown in Figure 9) to which the base of the burner can be secured (see Figure 8) shall be provided for tilting the barrel 20° 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 support jig. A layer of untreated surgical cotton 6 – 25 mm (1/4 – 1 in) thick shall be placed on the wedge and around the base of the burner. The jig shall be adjusted toward one side or the other of the enclosure to place the longitudinal axis of the barrel in the vertical plane that contains the longitudinal axis of the specimen. The plane shall be parallel to the sides of the enclosure. The jig shall

also be adjusted toward the rear or front of the enclosure to position the point A, which is the intersection of the longitudinal axis of the barrel with the plane of the tip of the barrel, 38 mm (1-1/2 in) from the point B at which the extended longitudinal axis of the barrel meets the interior surface of the specimen. Point B is the point at which the tip of the blue inner cone shall touch the center of the inside back surface of the specimen. The specimen shall be adjusted vertically to keep point B from being any closer than 76 mm (3 in) to the support for the specimen.

5.13.8 In the absence of a gas pilot light on the burner, the support for the burner and wedge shall be arranged to enable the burner to be quickly removed from and precisely returned to the position described in Clause 5.13.7 without disturbing the layer of cotton on the floor of the enclosure or the cotton on the wedge and around the base of the burner.

5.13.9 If the burner has a gas pilot light, the valve supplying gas to the pilot shall be opened and the pilot lit. If the burner does not have a gas pilot light, the burner shall be supported as indicated in Clause 5.13.8 in a position away from the specimen and shall then be lit. This operation and the remainder of the test shall be conducted under a forced-draft exhaust hood or cabinet operating to provide removal of smoke and fumes, but not having drafts that affect the flame.

5.13.10 If the burner has a gas pilot light, the valve supplying gas to the burner shall be opened to apply the flame to the specimen automatically. This valve shall be held open for 5 s, closed for 5 s, and so forth for a total of five 5 s applications of the gas flame to the specimen, with 5 s between applications. If the burner does not have a gas pilot light, the burner shall be moved into position to apply the gas flame to the specimen, kept there for 5 s, removed for 5 s, and so forth for a total of five 5 s applications of the gas flame to the specimen, with 5 s between applications.

5.13.11 Gas supply

5.13.11.1 A supply of technical grade methane gas (minimum 98% pure) with regulator and meter for uniform gas flow, or natural gas, having a heat content of approximately 37 ±1 MJ/m^3 (993 ±27 Btu/ft^3), shall be used.

5.14 Flame test in cable trays – FT4 (optional)

5.14.1 For this optional test, specimens of surface raceway shall be tested in accordance with the Vertical Flame Test (FT4) – Conduit or Tubing on Cable Tray in CSA C22.2 No. 211.0.

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

5.15 Hinge cycling

5.15.1 A nonmetallic surface raceway provided with a hinged cover shall be capable of withstanding the test in Clause 5.15.2 without functional damage to the hinge.

5.15.2 One 0.3-m (1-ft) length of raceway, in the as-received condition, shall be mounted in accordance with the manufacturer's installation instructions. The raceway shall then be opened 90° from its initial position and closed, without latching, for a total of 100 cycles.

5.16 Short circuit

5.16.1 The cover of a nonmetallic surface raceway system intended for use with conductors larger than 6 AWG (13.30 mm^2) shall not loosen from the raceway base after the system is subjected to the test specified in Clause 5.16.2. There shall not be any openings that exceed 1.59 mm (1/16 in) in width on accessible surfaces.

5.16.2 Two of the maximum size conductors with which the raceway system is intended to be used shall be connected in series with a fuse or circuit breaker and placed in a 6.1 m (20 ft) section of the raceway. The fuse or circuit breaker shall be of the appropriate rating for the conductor size and shall have a minimum 10,000 A-interrupting rating. The raceway shall be mounted in accordance with the manufacturer's installation instructions and the conductors shall be connected to a circuit capable of delivering 10,000 A at 600 Vac. The short circuit current shall then be passed through the conductors until the fuse or breaker opens.

5.16.3 The circuit specified in 5.16.2 shall be capable of delivering 10,000 A at 300 Vac if the raceway cover is marked in accordance with Clause 7.10.

5.17 Pendant-type raceway deflection

5.17.1 A nonmetallic surface raceway intended for pendant mounting shall not deflect at midspan more than 1/240 of the span when tested in accordance with Clause 5.17.2. See Clause 7.8.

5.17.2 A section of raceway of the manufacturer's designated span shall be mounted as a simple beam. A concentrated force equal to the manufacturer's maximum designated load shall then be applied and the deflection measured.

6 Installation Instructions

6.1 The smallest unit shipping container for raceways and raceway fittings (including fixture boxes, device boxes, and transition fittings that may be added to the raceway system independent of the raceway installation itself) shall be provided with instructions or a statement indicating where to find instructions on the manufacturer’s website so that proper installation of the raceway and/or fitting can be accomplished.

6.2 The instructions shall clearly indicate the method(s) of securing the raceway or raceway fittings to the mounting surface and to other fittings and raceway sections.

6.3 The instructions shall reference the appropriate type of hardware such as screws, bolts, or other means for securing the raceway or fitting or shall contain a statement that the mounting means shall be appropriate for the application.

6.4 The instructions shall indicate that an adhesive strip, if provided on the raceway, may serve only as a positioning aid during the installation process; the raceway shall be secured by mechanical fastening means.

6.5 An adhesive strip provided on a raceway marked for use only with Class 2 circuits, as defined in Article 725 of the National Electrical Code or Section 16 of the Canadian Electrical Code, Part I, may be used as the sole means of securement.

6.6 The instructions shall identify raceway fittings that effectively reduce the raceway-system wire fill capacity. The instructions shall provide necessary special installation recommendations for those fittings.

6.7 The instructions shall indicate the recommended installation interval for the mechanical wire retainers referenced in the exception to Clause 4.1.4, Item d), if these retainers are provided.

7 Markings

7.1 All markings shall be legible, durable, and visible on the inside after the base of the fitting and raceway is mounted.

7.2 A marking required to be durable shall be molded, die-stamped, paint-stencilled, indelibly printed, stamped, or etched metal that is secured, or shall be indelibly stamped lettering on a pressure sensitive label secured by adhesive that meets the requirements of Clause 7.3.

7.3 A pressure-sensitive label or a label that is secured by cement or adhesive and required to be durable shall comply with the applicable requirements in UL 969, or CSA C22.2 No. 0.15.

7.4 Each length of raceway, and each fitting intended for use with the raceway, shall be marked with:

a) the name of the manufacturer or the manufacturer's trade name for the raceway and fittings, or both, or

b) any other distinctive marking by means of which the organization responsible for the raceway and fittings can be readily identified, and

c) if practicable, the catalog number or its equivalent.

7.5 The raceway shall be marked, on its base or cover (whichever is not interchangeable with a raceway of another catalog number), or on the package or installation instruction sheets, with the number, type, and size of insulated conductors for which the raceway is intended.

7.6 A fixture box that has been evaluated for compliance with Clause 5.2 shall be marked with the following or the equivalent: "Suitable for a fixture not exceeding ____ kg (lb)". The specified fixture weight shall not exceed 22.7 kg (50 lb). The marking shall be readily visible after the fixture box has been mounted.

7.7 Each length of surface raceway intended for use only with Class 2 circuits, as defined in Article 725 of the National Electrical Code or Section 16 of the Canadian Electrical Code, Part I, shall be marked with the following or the equivalent: "For Class 2 Circuits Only".

7.8 Each length of a pendant-type raceway shall be marked with its maximum load and span.

7.9 In Canada, each length of surface nonmetallic raceway that is all nonmetallic or provided with a metal cover 1.02 mm (0.040 in) nominal thickness or greater shall be marked "600 V maximum" or equivalent.

In the United States, this requirement is optional.

7.10 In the United States, each length of raceway provided with a metal cover less than 1.02 mm (0.040 in) nominal thickness shall be marked "less than 300 V" or equivalent.

In Canada, each length of raceway provided with a metal cover less than 1.02 mm (0.040 in) nominal thickness may be marked "300 V maximum" or equivalent.

7.11 Each length of raceway shall be marked "FT4" if in compliance with Clause 5.14.

Table 1
For the United States
Minimum nominal thickness of a metal cover of a raceway or fitting

(See Clause 4.1.2)

Potential between conductors (volts)	Steel, mm (in)	Aluminum, mm (in)
< 300	0.64 (0.025)	0.89 (0.035)
300 ≤ V ≤ 600	1.02 (0.040)	1.02 (0.040)

Table 1A
For Canada
Minimum nominal thickness of a metal cover of a raceway or fitting

(See Clause 4.1.2)

Potential between conductors (volts)	Steel, mm (in)	Aluminum, mm (in)
≤ 300	0.64 (0.025)	0.89 (0.035)
300 < V ≤ 600	1.02 (0.040)	1.02 (0.040)

Table 2
Knockout diameters and width of surrounding flat surface

(See Clauses 4.4.1, 4.4.2, and Figure 1)

Metric designator (trade size) of conduit	Minimum width of flat surface surrounding knockout, mm (in)	Knockout diameters, mm (in)		
		Minimum	Nominal	Maximum
16 (1/2)	3.38 (0.133)	21.84[a] (0.860)	22.23 (0.875)	23.01 (0.906)
21 (3/4)	3.68 (0.145)	27.79[b] (1.094)	28.17 (1.109)	28.96 (1.140)
27 (1)	4.72 (0.186)	34.52 (1.359)	34.93 (1.375)	35.71 (1.406)
35 (1-1/4)	6.45 (0.254)	43.66 (1.719)	44.04 (1.734)	44.83 (1.765)

[a] In Canada, the diameter may be reduced to 21.46 mm (0.8 in) on a multiple knockout.

[b] In Canada, the diameter may be reduced to 27.05 mm (1.1 in) on a multiple knockout.

Table 3
Ratings of nonmetallic materials

(See Clause 4.5.1)

Flame class	Dielectric withstand	Maximum hot wire ignition (HWI) Performance level category (PLC)	Maximum high current arc resistance to ignition (HAI) (PLC)	Volume resistivity
See Clause 5.13	5000 V (rms) (dry and after 90% humidity)	PLC 4 or 15 s	PLC 1 or 60 cycles	50 x 10^6 Ohm-cm (dry) 10 x 10^6 Ohm-cm (after 90% humidity)

Table 4
Maximum acceptable resistance of individual sections and fittings

(See Clause 5.7.1.1)

Material	Thickness of metal cover		Electrical Resistance	
	mm	(in)	Ohms per meter	(Ohms per foot)
Steel	At least 0.64 but less than 0.91	(At least 0.025 but less than 0.036)	0.0272	(0.0083)
	At least 0.91	(At least 0.036)	0.0115	(0.0035)
Aluminum	At least 0.89 but less than 1.27	(At least 0.035 but less than 0.050)	0.0039	(0.0012)
	At least 1.27	(At least 0.050)	0.0020	(0.00060)

Table 5
Basis for thermal acceptability of nonmetallic materials

(See Clause 5.8.1)

Highest temperature to which the finished nonmetallic material is exposed in the normal intended use of the raceway	Means by which the acceptability of the thermal-aging characteristics of the nonmetallic material shall be determined
Not over 65°C (149°F)	No investigation required but Relative Thermal Index (mechanical with impact)[a] desirable
Over 65°C (149°F) but not over 75°C (167°F)	Relative Thermal Index (mechanical with impact)[a] or the compliance of specimens of the finished nonmetallic part with[b] Clauses 5.11 and 5.13 after aging in a full-draft circulating-air oven for 1000 h at 85.0 ± 1.0°C (185.0 ± 1.8°F) and then cooling in still air to room temperature
Over 75°C (167°F) but not over 80°C (176°F)	Relative Thermal Index (mechanical with impact)[a] or the compliance of specimens of the finished nonmetallic part with[b] Clauses 5.11 and 5.13 after aging in a full-draft circulating-air oven for 1000 h at 95.0 ± 1.0°C (203.0 ± 1.8°F) and then cooling in still air to room temperature
Over 80°C (176°F)	Relative Thermal Index (mechanical with impact)[a]

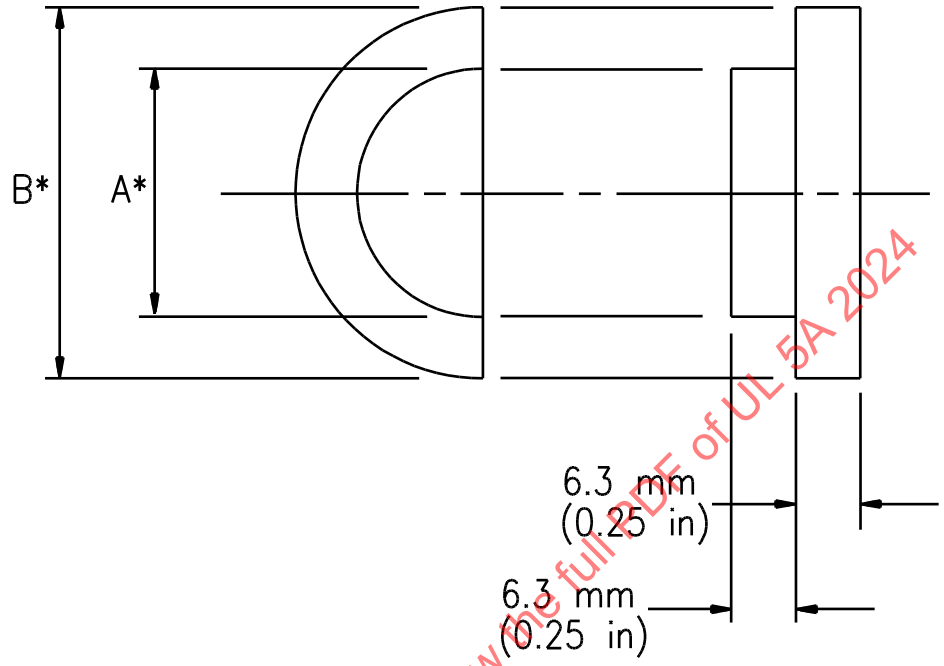
[a] The Relative Thermal Index (mechanical with impact) shall be determined from historical data or from a program of long-term thermal aging.

[b] Damage (distortion, and the like) to the nonmetallic part during, or as a result of, the heating is acceptable unless it keeps the part from performing its intended function.

Figure 1

Dimensions of test gauges for flat surface surrounding knockout

(See Clause 4.4.3 and Table 2)



*Tolerance ±0.013 mm

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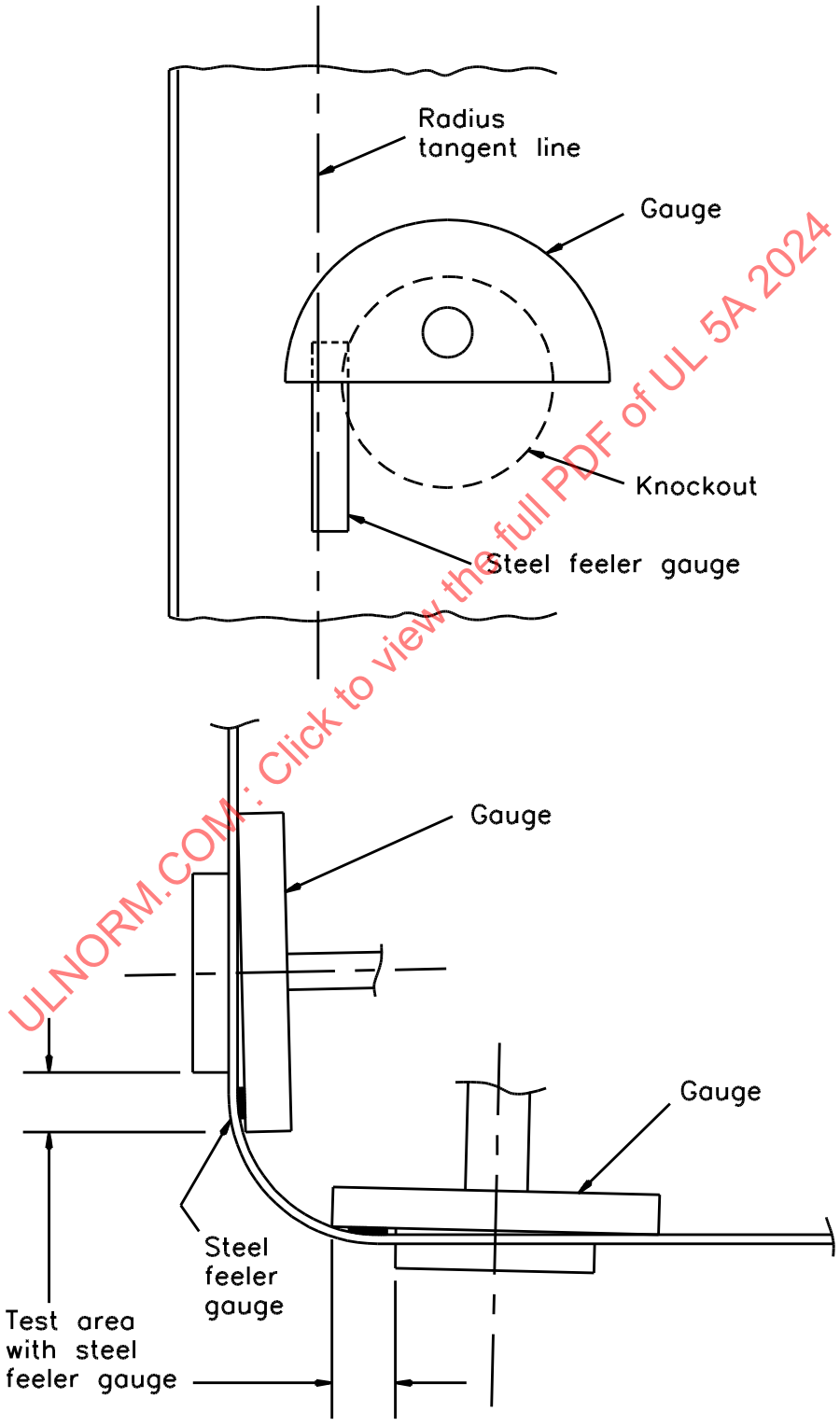
Metric designator (trade size) of conduit	Dimension A	Dimension B
	Nominal diameter of conduit mm (in)	Dimension A plus twice width of flat surface area of Table 2 mm (in)
16 (1/2)	21.34 (0.840)	28.1 (1.110)
21 (3/4)	26.67 (1.050)	34.0 (13.4)
27 (1)	33.40 (1.315)	42.8 (1.69)
35 (1-1/4)	42.16 (1.660)	55.1 (2.17)

Figure 2

Method of checking flat surfaces

(See Clause 4.4.3)



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