UL 5A

Underwriters Laboratories Inc.

Standard for Safety

Nonmetallic Surface Raceways and Fittings

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

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

Third Edition, Dated July 18, 2003

Revisions: This Standard contains revisions through and including August 21, 2008.

Summary of Topics

Revisions to UL 5A are being issued:

1. To add new requirements (United States only) for flush duplex receptacle securement (4.7.3)

2. For the conduit identification marking in 7.4

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

Future Effective Date	References
July 1, 2010	Clause 4.7.3

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

Text that has been changed in any manner is marked with a vertical line in the margin.

The revised requirements are substantially in accordance with UL's Proposal(s) on this subject dated April 4, 2008.

The revisions dated August 21, 2008 include a reprinted title page (page1) for this Standard.

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

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

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

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

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that have been revised and that have a future effective date are located after the Standard, and are preceded by a ″SUPERSEDED REQUIREMENTS″ notice.

New product submittals made prior to a specified future effective date will be judged under all of the requirements in this Standard including those requirements with a specified future effective date, unless the applicant specifically requests that the product be judged under the current requirements. However, if

the applicant elects this option, it should be noted that compliance with all the requirements in this Standard will be required as a condition of continued Listing, Recognition, and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

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

No Text on This Page

Canadian Standards Association
CAN/CSA C22.2 No. 62.1-03
First Edition

Underwriters Laboratories Inc.
UL 5A
Third Edition

Nonmetallic Surface Raceways and Fittings

July 18, 2003

(Title Page Reprinted: August 21, 2008)

Approved
by
Standards Council
of Canada

ANSI/UL 5A-2008

Commitment for Amendments

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

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CONTENTS

Annex A (informative)

Annex B (informative)

Preface

This is the common CSA and UL standard for Nonmetallic Surface Raceways and Fittings. It is the first edition of CSA C22.2 No. 62.1 and the third edition of UL 5A. This edition of CSA C22.2 No. 62.1 supersedes the requirements of CSA standard C22.2 No. 62, published in 1993, for products covered in this standard, as indicated in the scope of this standard. This edition of UL 5A supersedes the previous edition(s) published on March 19, 1999. This common standard has been jointly revised on August 21, 2008. For this purpose CSA and UL are issuing revision pages dated August 21, 2008.

This common standard was prepared by the Canadian Standards Association (CSA) and Underwriters Laboratories Inc. (UL). The efforts and support of the CANENA Technical Harmonization Committee 23A SNR Working Group 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 on C22.2 No. 62, under the jurisdiction of the CSA Technical Committee on Wiring Products and the CSA Strategic Steering Committee on Requirements for Electrical Safety, and has been formally approved by the CSA Technical Committee.

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

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

A UL standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest set of revised requirements.

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

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

Level of harmonization

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

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

Reasons for differences from IEC

The 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.

CSA effective date

The effective date for CSA International will be announced through CSA Informs or a CSA certification notice.

UL effective date

As of August 21, 2008 all products Listed or Recognized by UL must comply with the requirements in this standard except for Clause 4.7.3, which is effective July 1, 2010.

Between August 21, 2008 and July 1, 2010, new product submittals to UL may be evaluated under all requirements in this Standard or, if requested in writing, evaluated under presently effective requirements only.

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

The most recent designation of ANSI/UL 5A as an American National Standard (ANSI) occurred on August 19, 2008. The ANSI approval for this standard does not include the Cover Page, Transmittal Pages, Title Page, or Preface. This ANSI/UL Standard for Safety, which consists of the third edition with revisions through August 21, 2008, is under continuous maintenance, whereby each revision is ANSI approved upon publication.

Revisions of this Standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest set of revised requirements. Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at http://csds.ul.com.

Foreword (CSA)

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

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

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

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

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

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

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

Foreword (UL)

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

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

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

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

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

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

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 National Electrical Code® (NEC) and Canadian Electrical Code (CEC), Part I.

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.

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 Components

3.1.1 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.

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

3.1.3 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.

3.2 Units of measurement

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

3.3 Reference publications

3.3.1 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 Standards

C22.1-02
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. 42-99
General Use Receptacles, Attachment Plugs, and Similar Wiring Devices

C22.2 No. 62-93
Surface Raceway Systems

C22.2 No. 111-00
General Use Switches

C22.2 No. 211.0-M1984 (R1999)
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 70-2002
National Electrical Code®

ASTM[2] Standards

D 648-01
Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position

D 5025-99
Standard Specification for Laboratory Burner Used for Small-Scale Burning Tests on Plastic Materials

D 5207-98
Standard Practice for Confirmation of 20 and 125 mm Test Flames for Small-Scale Burning Tests on Plastic Materials

NRCC[3] Publication

National Building Code of Canada, 1995

[1] American National Standards Institute / National Fire Protection Association

[2] American Society for Testing and Materials

[3] National Research Council Canada

3.4 Installation

3.4.1 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.

3.4.2 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.

3.4.3 Nonmetallic surface raceways are not suitable for use as equipment grounding conductors.

3.5 Metal parts

3.5.1 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 No. 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 fittings 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 CSA C22.2 No. 0.17.

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.

4.5.3 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 and bonding

4.9.1 A grounding 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.

A grounding screw shall engage the metal cover 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 No. 10 AWG (5.3 mm^2) conductor under the head of the screw.

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

4.9.2 With respect to the requirement in Clause 4.9.1, a grounding wire provided in lieu of a grounding screw shall be sized in accordance with the maximum size of wire for which the raceway is intended to be used and shall be either solid copper not smaller than No. 14 AWG (2.1 mm^2) or, in the United States, solid aluminum not smaller than No. 12 AWG (3.3 mm^2), and shall be 127 – 152 mm (5 – 6 in) long.

4.9.3 One end of a grounding 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, or, in the United States, by means of an aluminum or stainless-steel rivet if the wire is aluminum.

If insulated, the color of the surface of the insulation shall be green, with or without one or more yellow stripes.

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 15 min apart with no change in temperature. 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 following requirements.

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 Figures 4 and 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.

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

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.

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

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.

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.

5.9 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 The finished non-metallic 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.

The test shall be conducted as described in Clauses 5.13.4 – 5.13.10.

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 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 (min. 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 No. 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.

The circuit 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 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.

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.

6.5 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.

6.6 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 after the base 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	50×10^6 Ohm-cm (dry) 10×10^6 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

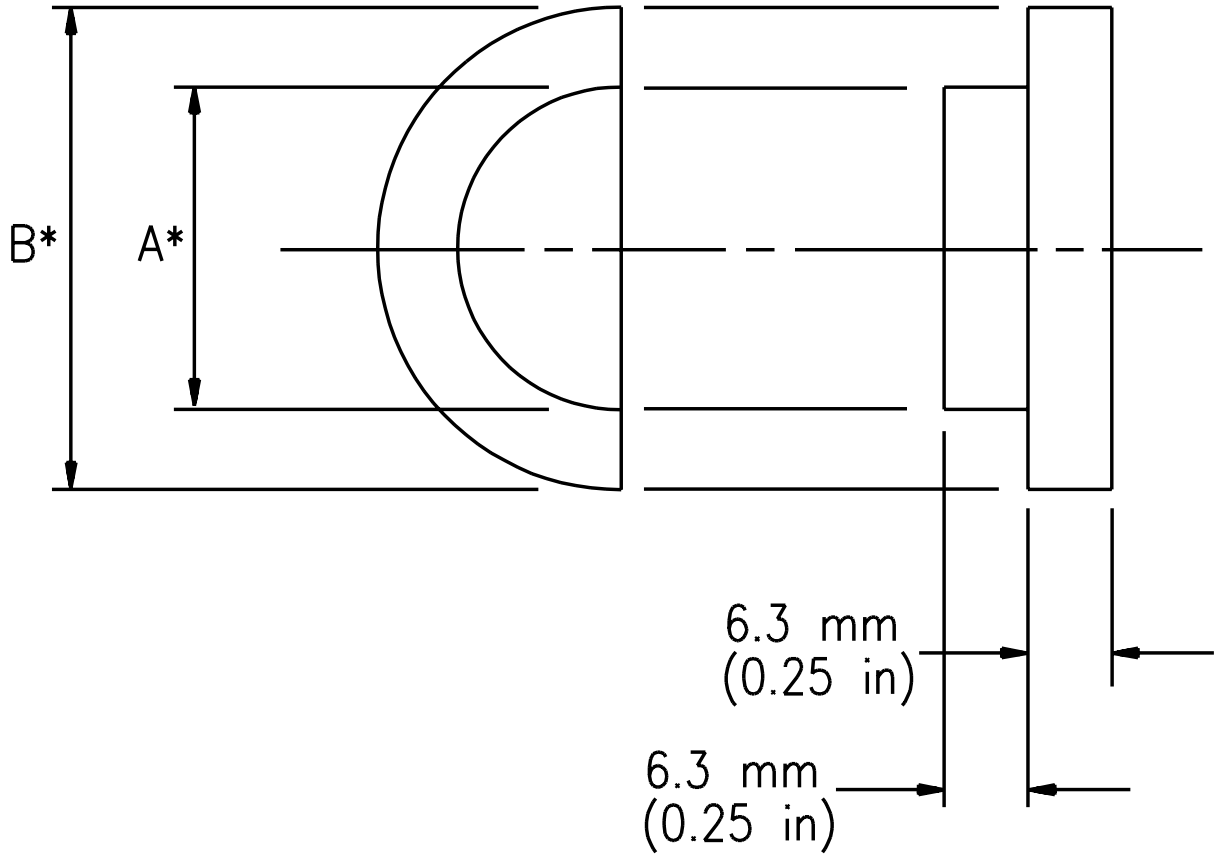
Table 5
Basis for thermal acceptability of nonmetallic materials
(See Clause 5.8.1)

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)

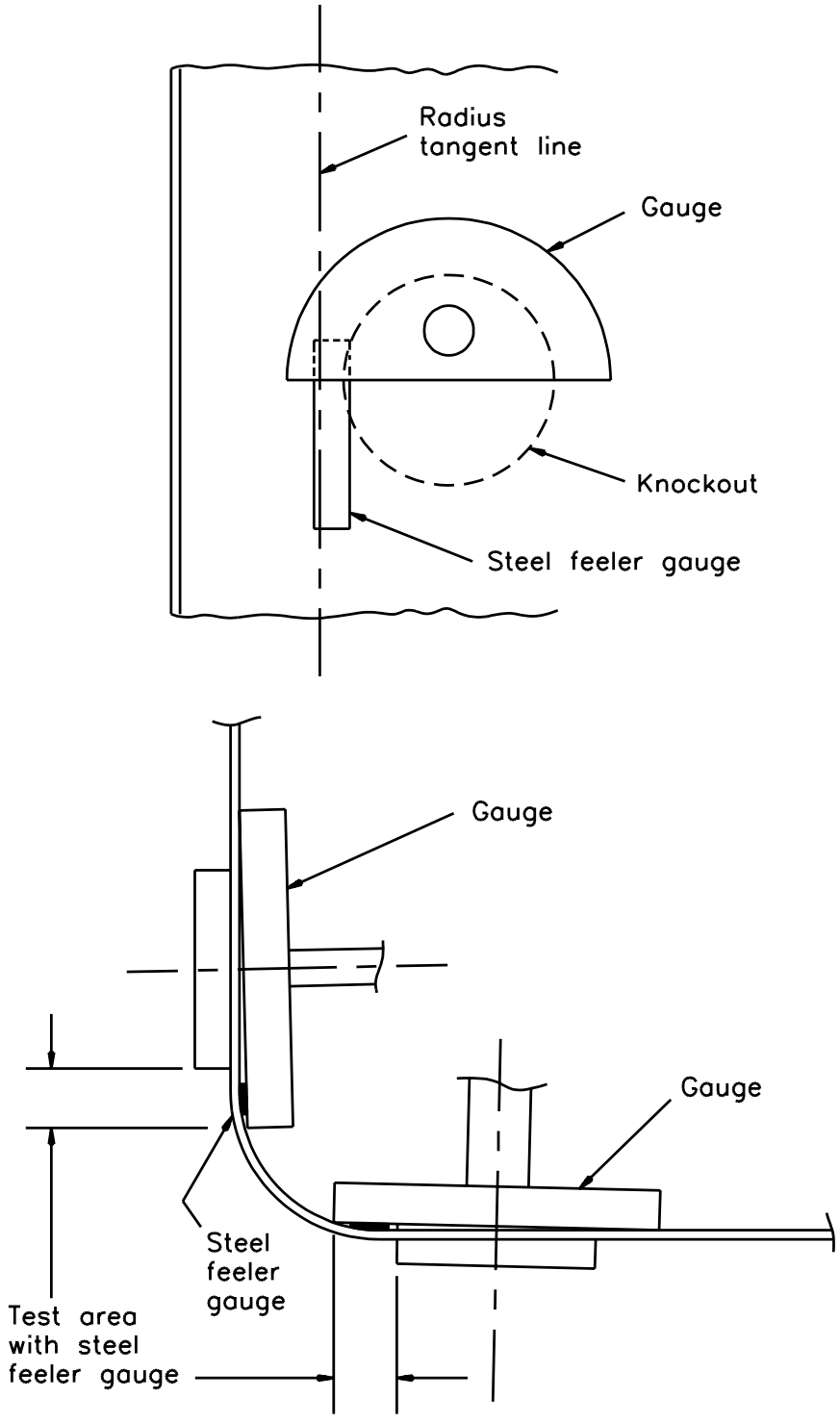

Figure 3
Bending force test setup
(See Clause 5.2.6)

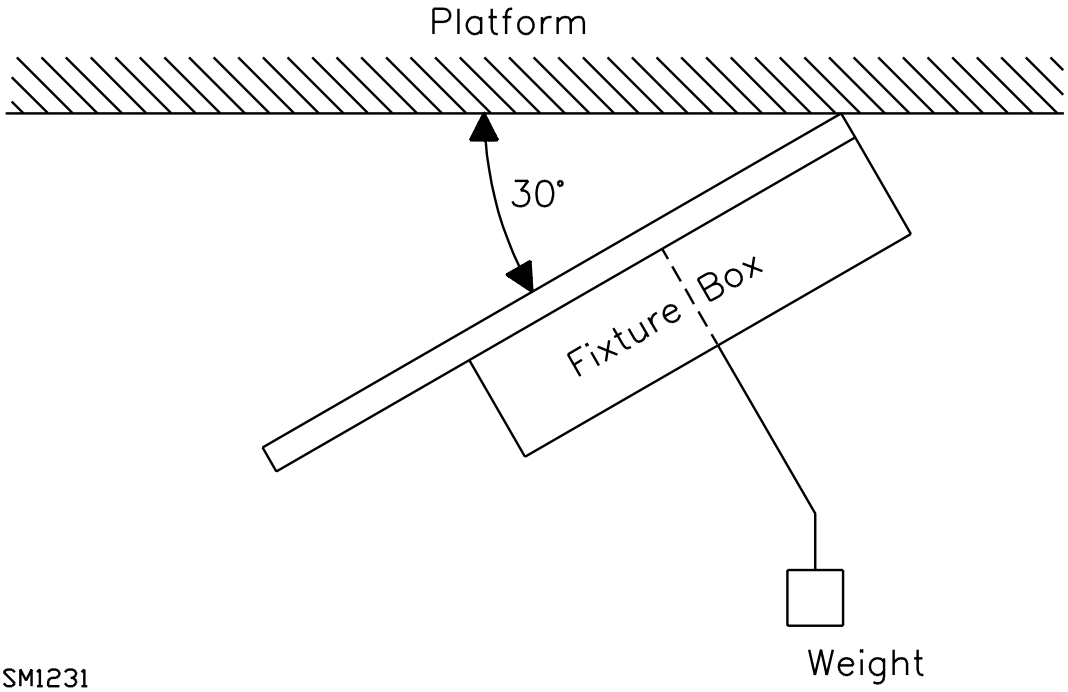

Figure 4
Details of support and loading of specimen
(See Clauses 5.6.4 and 5.6.9)
Note: All dimensions are in millimeters (inches)

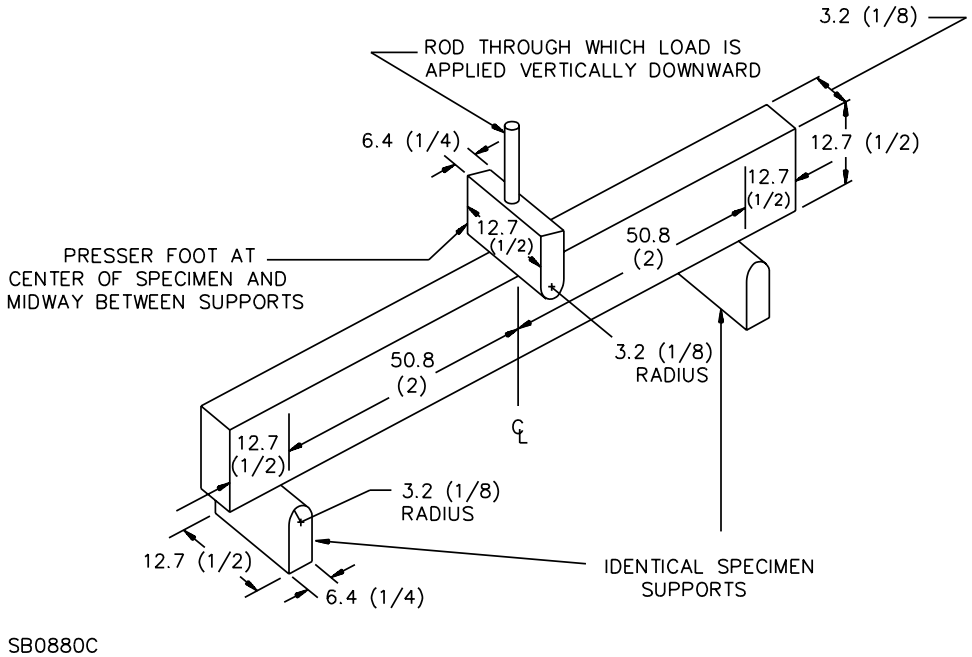

Figure 5
Apparatus
(See Clauses 5.6.4 and 5.6.9)

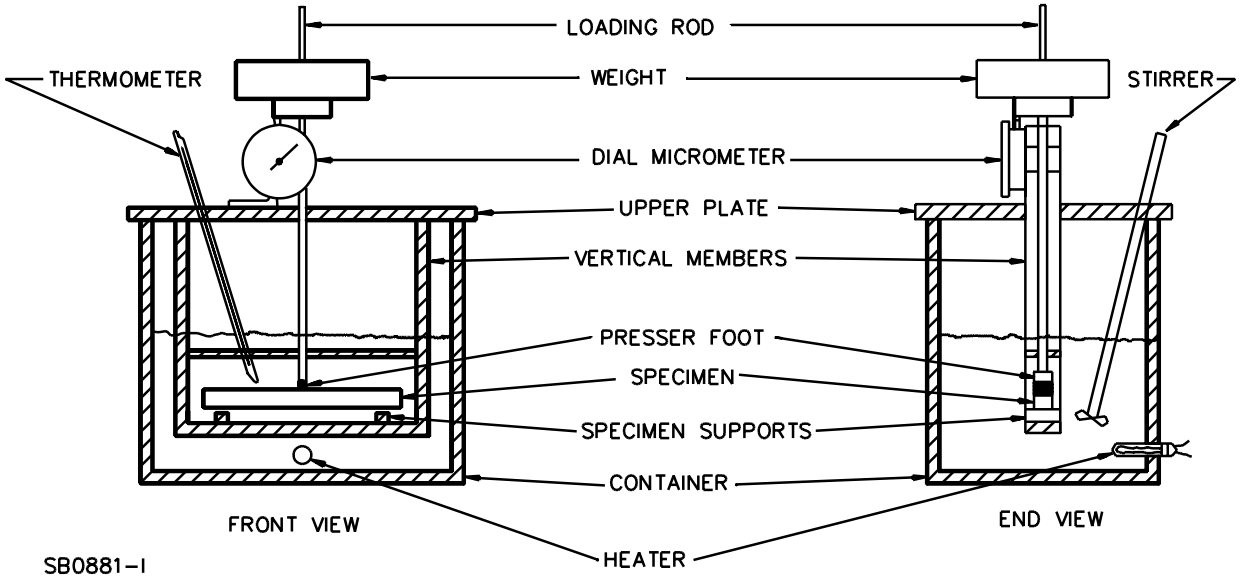

Figure 6
Probe for judging accessibility of interior
(See Clauses 5.9.1, 5.10.5(c), and 5.11.1)

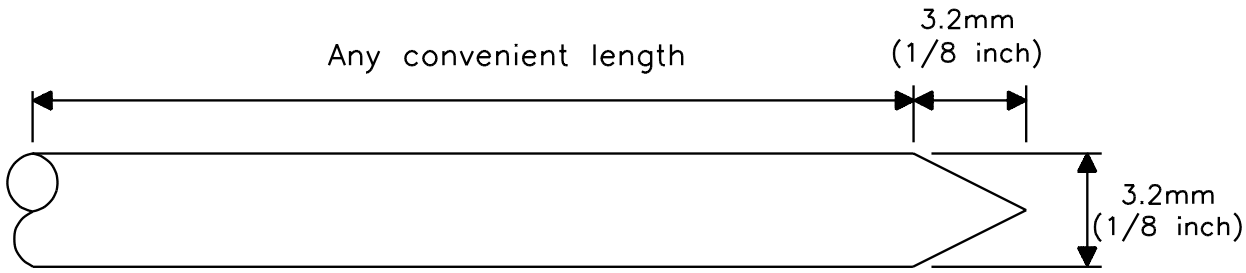

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Figure 7
Tangential impact
(See Clauses 5.11.4)

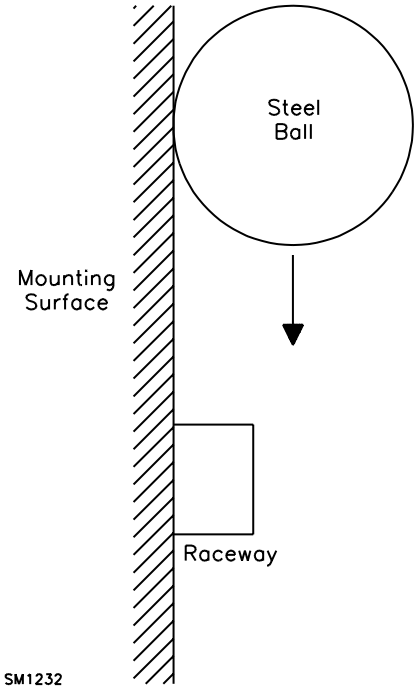
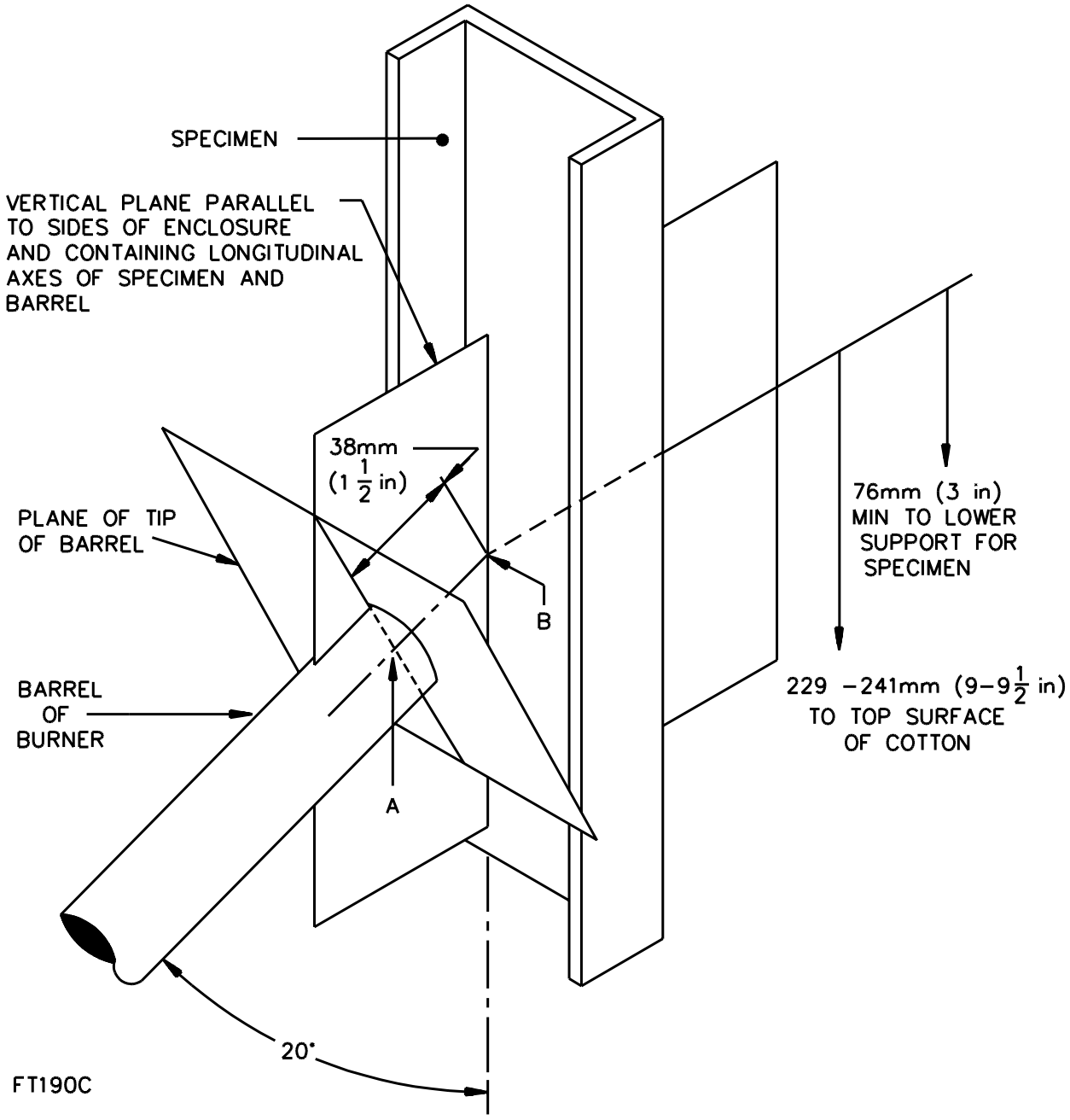
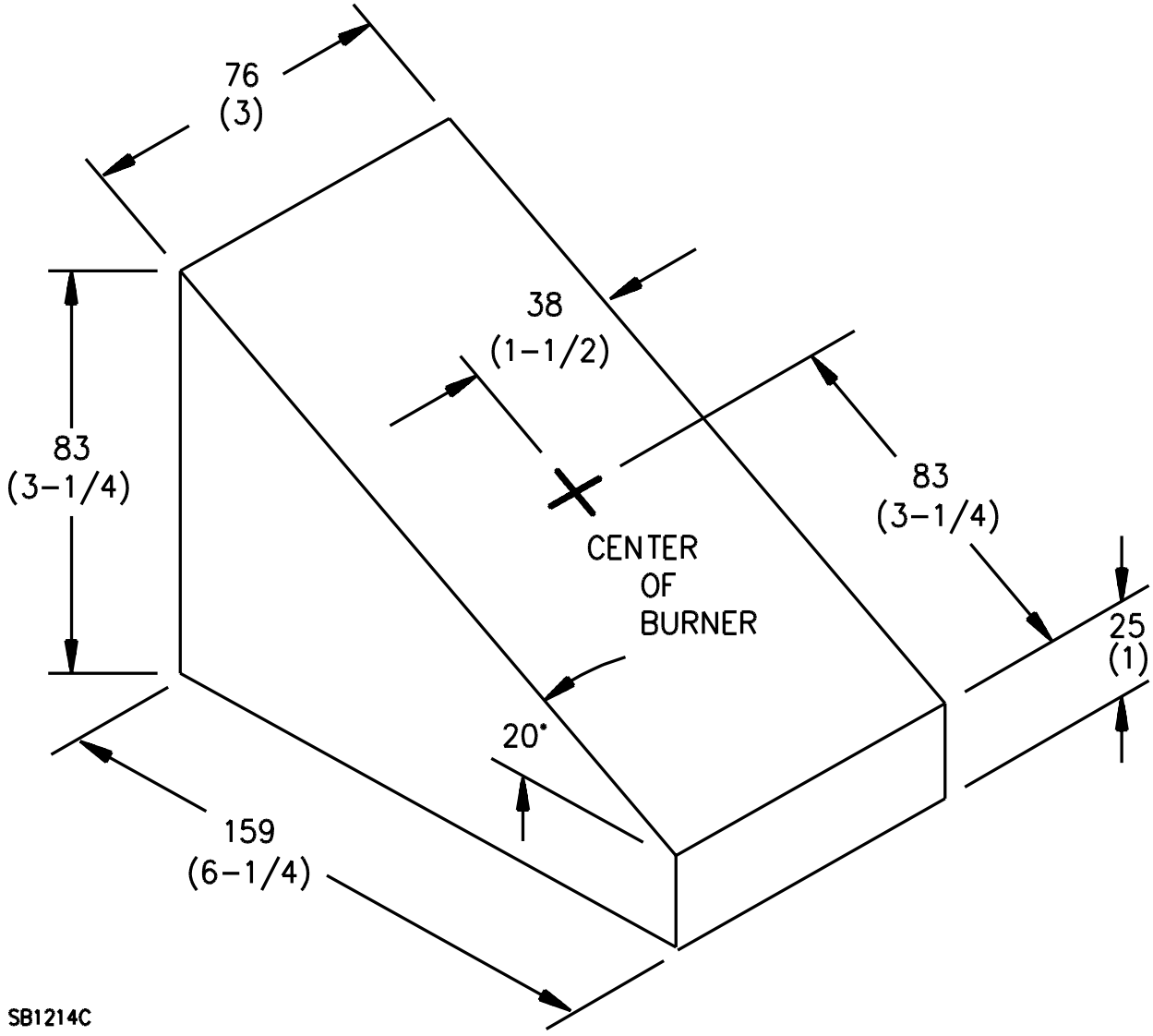


Figure 8
Essential dimensions for flammability test
(See Clauses 5.13.5 and 5.13.7)



Note – Proportions exaggerated for clarity of detail

Figure 9
Acceptable dimensions of wedge in millimeters (inches)
(See Clause 5.13.7)



Annex A (informative)

(See Clause 5.5.3)

A.1 Temperature test currents (for Canada only)

Note: *This annex is not a mandatory part of this Standard.*

Test currents for insulated copper conductors, rated 90°C, installed in a surface raceway (Canadian Electrical Code (CEC), Part 1, Tables 2 and 5C)

No. 14 AWG (2.1 mm^2)	No. 12 AWG (3.3 mm^2)	No. 10 AWG (5.3 mm^2)	No. 8 AWG (8.4 mm^2)	No. 6 AWG (13.3 mm^2)
1 – 3 15 A	1 – 3 20 A	1 – 3 30 A	1 – 3 45 A	1 – 3 65 A
4 – 6 12 A	4 – 6 16 A	4 – 6 24 A	4 – 6 36 A	4 – 6 52 A
7 – 24 10.5 A	7 – 24 14 A	7 – 24 21 A	7 – 24 31.5 A	7 – 24 45.5 A
25 – 42 9 A	25 – 42 12 A	25 – 42 18 A	25 – 42 27 A	25 – 42 39 A
43 and up 7.5 A	43 and up 10 A	43 and up 15 A	43 and up 22.5 A	43 and up 32.5 A

Note: *Test conducted at room temperature.*

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Annex B (informative)

(See Clause 5.5.3)

B.1 Temperature test currents (for United States only)

Note: *This annex is not a mandatory part of this Standard.*

Test currents for insulated copper conductors installed in a surface raceway – National Electrical Code (NEC)

No. 14 AWG (2.1 mm^2)	No. 12 AWG (3.3 mm^2)	No. 10 AWG (5.3 mm^2)	No. 8 AWG (8.4 mm^2)	No. 6 AWG (13.3 mm^2)
≤ 40 12 A	≤ 20 16 A	≤ 9 24 A	≤ 3 48 A	≤ 3 64 A
≥ 41 8 A	≥ 21 12 A	10 – 20 20 A	4 – 6 40 A	4 – 6 56 A
		21 – 40 16 A	7 – 9 32 A	7 – 9 48 A
		≥ 41 12 A	10 – 30 24 A	10 – 30 32 A
			31 – 40 20 A	31 – 40 28 A
			≥ 41 16 A	≥ 41 24 A

Note: *Test conducted at room temperature.*

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