UL 5C

STANDARD FOR SAFETY

Surface Raceways and Fittings for Use with Data, Signal, and Control Circuits

UL Standard for Safety for Surface Raceways and Fittings for Use with Data, Signal, and Control Circuits, UL 5C

Third Edition, Dated April 22, 2016

Summary of Topics

This revision of ANSI/UL 5C dated April 18, 2024 is being issued to update the title page to reflect the most recent designation as a Reaffirmed American National Standard (ANS). No technical changes have been made.

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.

No Text on This Page

APRIL 22, 2016
(Title Page Reprinted: April 18, 2024)

ANSI/UL 5C-2016 (R2024)

UL 5C

Standard for Surface Raceways and Fittings for Use with Data, Signal, and Control Circuits

First Edition – April, 1998
Second Edition – August, 2004

Third Edition

April 22, 2016

This ANSI/UL Standard for Safety consists of the Third Edition including revisions through April 18, 2024.

The most recent designation of ANSI/UL 5C 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, and Title Page.

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 the Collaborative Standards Development System (CSDS) at https://csds.ul.com.

No Text on This Page

CONTENTS

INTRODUCTION

CONSTRUCTION

PERFORMANCE

MARKINGS

INSTALLATION INSTRUCTIONS

No Text on This Page

INTRODUCTION

1 Scope

1.1 These requirements cover surface raceways and fittings for use with Class 2 data, signal, control circuits, and optical fiber cable. These raceway systems are intended for mechanical protection and routing of circuits. They are not intended for applications which require the use of a raceway in accordance with the National Electrical Code, NFPA 70.

1.2 These requirements do not apply to cable trays, wireways, or metal or nonmetallic raceways that are intended for use on Class 1 circuits.

1.3 These requirements do not apply to the conductors, connectors, or similar items that are used as part of the circuit.

2 Components

2.1 A component of a product covered by this standard shall comply with the requirements for that component.

Exception: It is not required that a component comply with a specific requirement that:

a) Involves a feature or characteristic not required in the application of that component in the product covered by this standard or

b) Is superseded by a requirement in this standard.

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

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 Units of Measurement

3.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

4 Undated References

4.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

5 Installation

5.1 The method of installation, as outlined in the instructions accompanying the raceway and fittings or in a statement indicating where to find instructions on the manufacturer's website, shall be practical and feasible under probable conditions met in practice.

5.2 The raceway, fittings, and accessories are to be installed as intended and examined with regard to the feasibility of installation, as well as for compliance with the construction, performance, and marking

requirements in this standard. Attention is to be given to items that require particular care on the part of the raceway installer.

6 Glossary

6.1 For the purposes of this standard, the following definitions apply.

6.2 ACCESSORY – A part that is added to a raceway system for a special purpose (for example, guards, hangers, or retainers).

6.3 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).

6.4 NONMETALLIC – A polymeric part.

6.5 NONMETALLIC SURFACE RACEWAY – A raceway for surface or pendant mounting with a nonmetallic base and either a nonmetallic or metallic cover.

6.6 SURFACE METAL RACEWAY – A raceway for surface or pendant mounting with a metal base and either a metallic or nonmetallic cover.

6.7 SURFACE RACEWAY SYSTEM – A system consisting of a surface raceway, associated fittings, and accessories when applicable.

CONSTRUCTION

7 General

7.1 The thickness of a part is not specified. The acceptability of a part is to be determined by the applicable tests.

7.2 A component of a surface raceway system shall comply with the requirements for the construction, performance, and use of that component.

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

7.4 The interior surface of the raceway system shall have a smooth finish that is free from projections, sharp edges, burrs, fins, and other faults capable of causing damage to wires when installed as intended.

7.5 The requirements in Sections 9, 10, 11, 12, 13, 14, 15, 19, 20 and 21 cover surface raceway for optical fiber cable. The requirements in Sections 9, 10, 11, 12, 13, 14, 15, 18, 20 and 21 cover boxes and fittings.

8 Materials

8.1 A nonmetallic material used in raceway or fittings shall be subjected to the Infrared Spectroscopy (IR), Thermogravimetry (TGA), and Differential Scanning Calorimetry (DSC) Tests specified in the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A.

8.2 Metal raceway and fittings shall be protected against the risk of corrosion on all inside and outside surfaces. Such protection is not necessarily required on cut edges. Metal that has been evaluated and

determined to be inherently resistant to ordinary dry-locations indoor atmospheric corrosion is acceptable for this use.

9 Dimensional Limits

9.1 A raceway system shall provide a complete enclosure that protects the wires installed therein against damage. The complete system, when installed as intended, shall comply with the following:

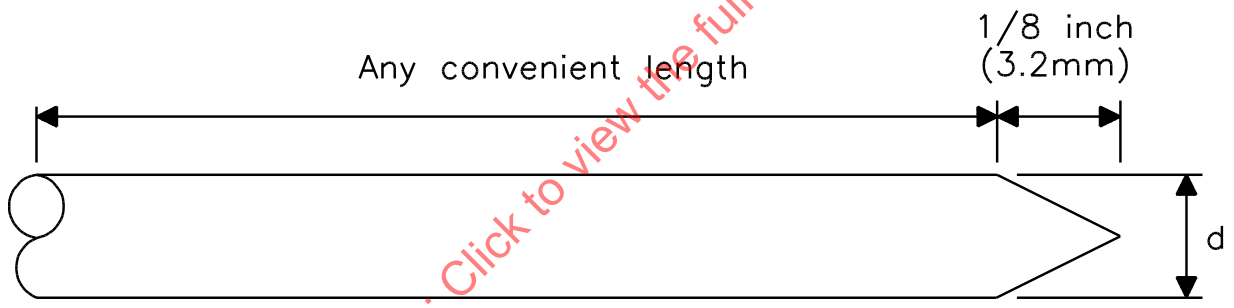
a) There shall not be any openings on surfaces that are accessible following installation of the system that permit the probe illustrated in Figure 9.1 to be inserted for a distance greater than 1/8 in (3.2 mm).

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

c) A multiple channel raceway system shall not permit accidental or unintentional passage of circuit conductors between channels.

Figure 9.1

Probe for judging accessibility of interior



NOTE: d = 1/8 in (3.2 mm)

9.2 Inside and outside surfaces of each length of a ferrous metal raceway or fitting shall be clean of all scale and rust and shall be in a condition that enables the protective coating to adhere firmly and have a smooth surface.

9.3 The bend radius of a raceway fitting intended for use in conjunction with a Category 5 cabling system shall not be less than that specified in the markings or installation instructions for the fitting. See 21.7 and 22.6. The minimum bend radius shall be verified using a gauge, circle template, or other means determined to be equivalent.

10 Knockouts

10.1 A knockout that is intended for use with a locknut for a 1/2-in or larger trade-size conduit shall be surrounded on both the inside and outside surfaces by a concentric flat surface to permit intended installation of a locknut. The flat surface shall extend in all directions beyond the edge of the knockout for a distance not less than that specified in Table 10.1.

Exception: It is not required that the specified concentric flat surface be provided when the raceway is determined to be acceptable in accordance with 10.2 and 10.3.

Table 10.1
Diameter of knockout and width of surrounding flat surface

Trade size of conduit,	Knockout diameter,[a]		Minimum width of flat surface surrounding knockout,	
in	in	(mm)	in	(mm)
1/2	0.875	(22.23)	0.133	(3.38)
3/4	1.109	(28.17)	0.156	(3.96)
1	1.375	(34.93)	0.198	(5.03)
1-1/4	1.734	(44.04)	0.274	(6.96)

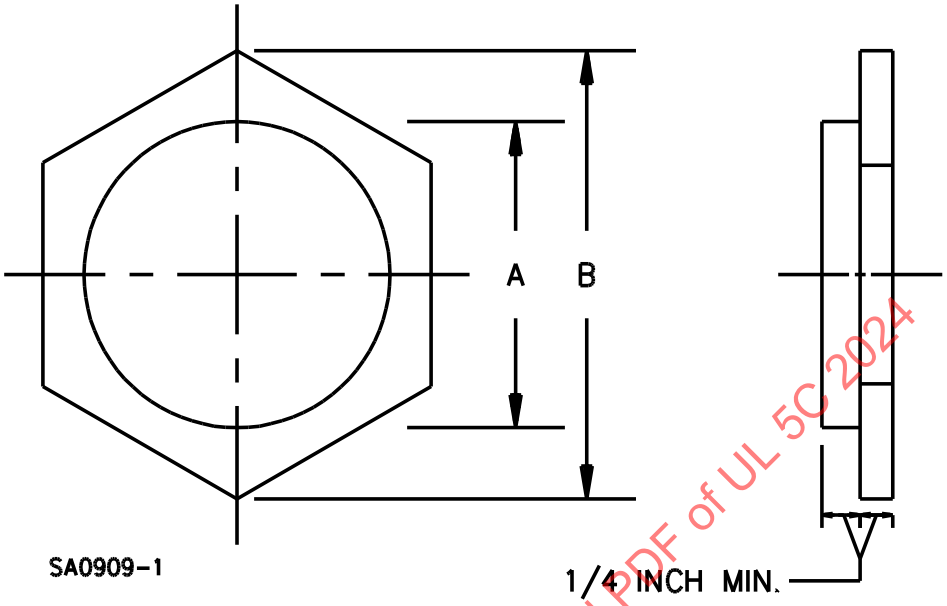
[a] A plus tolerance of 0.031 in (0.79 mm) and a minimum tolerance of 0.015 in (0.38 mm) applies to the knockout diameter. Knockout diameters are to be measured other than at points where a tab remains after removal of a knockout.

10.2 When the concentric flat surface required in 10.1 is not provided, the acceptability of the flat surface surrounding a knockout on both the inside and outside surfaces shall be determined by application of the test gauge illustrated in Figure 10.1 having the dimensions specified in Table 10.2. To use the gauge, the knockout is to be removed and the appropriate trade size of test gauge is to be inserted in the resulting opening from either side of the raceway. It is acceptable that the gauge be offset from the center of the opening and rotated so that the flat surface, including all points of the hexagonal portion of the gauge, will be in intimate contact with the surface of the raceway. The test gauge is then to be inserted in the resulting opening from the opposite side of the raceway with the same degree and position of offset from the center used on the other side. The flat surface, including all points of the hexagonal portion of the gauge is to be in intimate contact with the surface of the raceway as the gauge is rotated through an angle of at least 60 degrees. The test gauge shall not be canted or tilted to make contact with the surface of the raceway.

10.3 When evaluating a raceway for compliance with the requirement in 10.1, consideration is to be given to the clearances from adjacent knockouts, the sides of the raceway, and similar obstacles. It is not required that the raceway be constructed so that conduit can be installed simultaneously in adjacent knockouts.

Figure 10.1

Dimensions of test gauges for flat surfaces



A – Nominal diameter of conduit

B – Maximum diameter of locknut

Table 10.2
Dimensions of test gauges for flat surfaces surrounding knockouts

Trade size of conduit,	Nominal knockout diameter,		Nominal diameter of conduit,[a]		Maximum diameter of locknut,[b]	
in	in	(mm)	in	(mm)	in	(mm)
1/2	0.875	(22.23)	0.840	(21.34)	1.140	(28.96)
3/4	1.109	(28.17)	1.050	(26.67)	1.420	(36.07)
1	1.375	(34.93)	1.315	(33.40)	1.770	(44.96)
1-1/4	1.734	(44.04)	1.660	(42.16)	2.281	(57.94)

[a] Nominal outside diameter of rigid conduit. Tolerances for test gauge: 0.001 in (0.03 mm).

[b] Maximum diameter of locknut. Tolerances for test gauge: plus 0.001 in (0.03 mm), minus 0.000 in (0.00 mm).

11 Mounting

11.1 A raceway shall be provided with means for securing it to the mounting surface at intervals of not more than 4 ft (1.2 m). The securement means shall consist of mounting hardware such as screws or bolts or an adhesive strip or other method determined to be acceptable.

11.2 When the base is intended 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 shall be accomplished through the use of round-head or pan-head screws or bolts, or washers that serve to protect the head of the screw or bolt, or other means determined to be acceptable.

11.3 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 specify the appropriate mounting means.

12 Covers

12.1 Provision shall be made for securing the cover to the base of a two-piece raceway at intervals of not more than 4 ft (1.2 m). A cover shall be held in place by continuous grooves, flanges, or similar construction which assures that the cover is securely fixed in place.

PERFORMANCE

13 General

13.1 Unless otherwise specified, all tests are to be conducted at a room temperature of 23 ±5°C (73 ±9°F).

14 Security of Knockout and Break-Away Tab Test

14.1 A force of 10 lbf (44.5 N) is to be applied to a knockout or a break-away tab for 60 seconds by means of a 1/4-in (6.4-mm) diameter mandrel with a flat end. The force is to be applied with the mandrel's flat end in a direction perpendicular to the plane of the knockout or break-away tab and at the point most prone to result in movement. The knockout or break-away tab shall remain in place and the clearance between the knockout or break-away tab and the opening shall not be more than 0.030 in (0.76 mm) when measured 60 minutes after the force has been removed.

14.2 A knockout or break-away tab shall be capable of being removed by following the manufacturer's instructions for doing so without leaving sharp edges and without damage to the part from which the knockout or tab was removed.

14.3 For multiple-stage knockouts or break-away tabs, there shall not be any displacement of a larger stage when any smaller stage is removed as described in 14.2.

15 Mold Stress Test

15.1 A finished nonmetallic part shall not develop any holes, cracks, or other openings to permit entrance of the probe illustrated in Figure 9.1 for a depth greater than 1/8 in (3.2 mm), and cover secureness shall not be adversely affected when tested as described in 15.2.

15.2 Three 18-in (457-mm) lengths (axial) of the complete raceway or three complete fittings installed as intended onto 6-in (150-mm) lengths of raceway are to cool to room temperature in still air after being aged in a full-draft circulating-air oven for 7 hours at a temperature of 70.0 ±1.0°C (158.0 ±1.8°F). The test specimens are to be secured to a mounting surface during this test.

16 Crush Test

16.1 A finished part of a raceway system shall comply with each of the following when subjected to a static loading of 100 lbf (445 N) as described in 16.2 – 16.3.

a) The insulated conductors shall not be visibly damaged and shall not be short-circuited to one another or to a metal part of the raceway or fitting base as signalled by a buzzer, a lamp, or other indicator.

b) The probe illustrated in Figure 9.1 when inserted point first as far as possible into any crack or other opening that results from the crushing, shall not enter the opening for a distance greater than 1/8 in (3.2 mm) when evaluated 15 minutes after removal of the load.

c) The integrity of the assembly shall remain intact.

16.2 Six assemblies, each one consisting of an 18-in (457-mm) length of the raceway cover and base or one fitting cover and base, installed as intended onto a 6-in (150-mm) length of raceway are to be mounted onto a piece of plywood that is nominally 3/4 in (19 mm) thick. Insulated conductors are to fill the base as intended, and the cover is to be secured in place as intended on the base. Three of the assemblies are to contain the largest number of the largest size of conductor for which the raceway is intended. Three are to contain the largest number of the smallest size of conductor for which the raceway is intended with one of the smallest size conductors routed diagonally across the rest of the small conductors at an angle of approximately 30 degrees under the metal plate specified in 16.3.

16.3 Each of the six assemblies is to be tested by being crushed between two flat, horizontal steel plates in the jaws of a compression machine. The plates are to be 6 in (150 mm) long and wide enough to cover the raceway or fitting under test. The crushing force is to be applied perpendicular to the mounting surface at the rate of 0.50 ±0.05 in/minute or 12.7 ±1.27-mm/minute until a load of 100 lbf (445 N) is reached. The force is to be held at that level for 60 seconds, and then reduced to zero at the same rate.

17 Impact Test

17.1 The finished cover and the raceway or fitting base on which it is intended to be used shall be subjected to a single vertical impact as described in 17.2 and 17.3. The impact is to be applied by means of a solid smooth steel sphere 2.0 in (50.8 mm) in diameter and weighing 1.18 lb (0.535 kg), falling through a distance of 51 in (1.3 m). The insulated conductors shall not be visibly damaged and shall not be short-circuited to one another or to the raceway or fitting base (when constructed of metal) as signaled by a buzzer, a lamp, or other indicator.

17.2 Six assemblies, each one consisting of an 18-in (457-mm) length of the raceway cover and base, or one fitting cover and base, are to be installed as intended onto 6-in (150-mm) sections of raceway. In each case, the assembly is to be mounted on a piece of plywood that is nominally 3/4-in (19-mm) thick. Insulated conductors are to fill the base as intended, and the cover is to be secured in place on the base as intended. Three assemblies are to contain the largest number of the largest size conductor for which the raceway is intended. Three assemblies are to contain the largest number of the smallest size conductor for which the raceway is intended with one of the small conductors in each case routed diagonally across the rest of the small conductors at an angle of approximately 30 degrees and centered under the point on the cover that is to be struck by the impact sphere.

17.3 The assemblies are to be placed on a concrete floor with the plywood horizontal for three of the assemblies and vertical for the three remaining assemblies. The impact is to be directed vertically downward onto the center of the uppermost surface.

Exception: An assembly, with the plywood in the vertical orientation, that is incapable of being impacted on the center of its uppermost surface, is to be impacted with the steel sphere positioned tangential to the mounting surface.

18 Flammability Test

18.1 A finished nonmetallic part shall:

a) Be classified as V-0 or V-1 (small-scale flame-test rating) according to the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, and at least the same thickness in which the material qualified as V-0 or V-1 or

b) Not flame longer than 60 seconds following two 30-second applications of the test flame, the period between applications being 60 seconds. The part shall not emit flaming or glowing particles or flaming drops at any time that ignite the cotton layer. Flameless charring of the cotton is to be ignored. The part shall not be completely consumed. The test is to be conducted as described in 18.2 – 18.6.

18.2 Three 12-in (305-mm) lengths of raceway or three fittings are to be subjected to this test. The test specimens are to be conditioned in a full draft air-circulating oven for 7 days at 70.0 ±1.0°C (158 ±1.8°F) and then maintained at 23.0 ±2.0°C (73.4 ±3.6°F) and 50 ±5 percent relative humidity for a minimum of 4 hours prior to testing.

18.3 A laboratory type burner having a tube with a length of 3.94 ±0.39 in (100 ±10 mm) and an inside diameter of 0.374 ±0.012 in (9.5 ±0.3 mm) is to be used. The barrel is not to be equipped with any end attachments, such as stabilizers. The burner shall comply with Standard Specification for Laboratory Burner Used for Small-Scale Burning Tests on Plastic Materials, ASTM D 5025. Adjust the burner to produce a 3/4 in nominal (20 ±1 mm) yellow-tipped blue flame. Increase the air supply until the yellow tip just disappears. Measure the height of the flame again and readjust it as necessary. The test flame shall be calibrated in accordance with the Standard Practice for Confirmation of 20-mm (50-W) and 125-mm (500-W) Test Flames for Small-Scale Burning Tests on Plastic Materials, ASTM D 5207, at least once a week and when the gas supply is changed, test equipment is replaced, or when data is questioned.

18.4 The specimen is to be supported with its longitudinal axis vertical in a draft-free location. The test specimens are to be positioned 12 in (305 mm) above a horizontal layer of dry, absorbent 100 percent cotton. The flame shall be applied to the outside surface of the specimen.

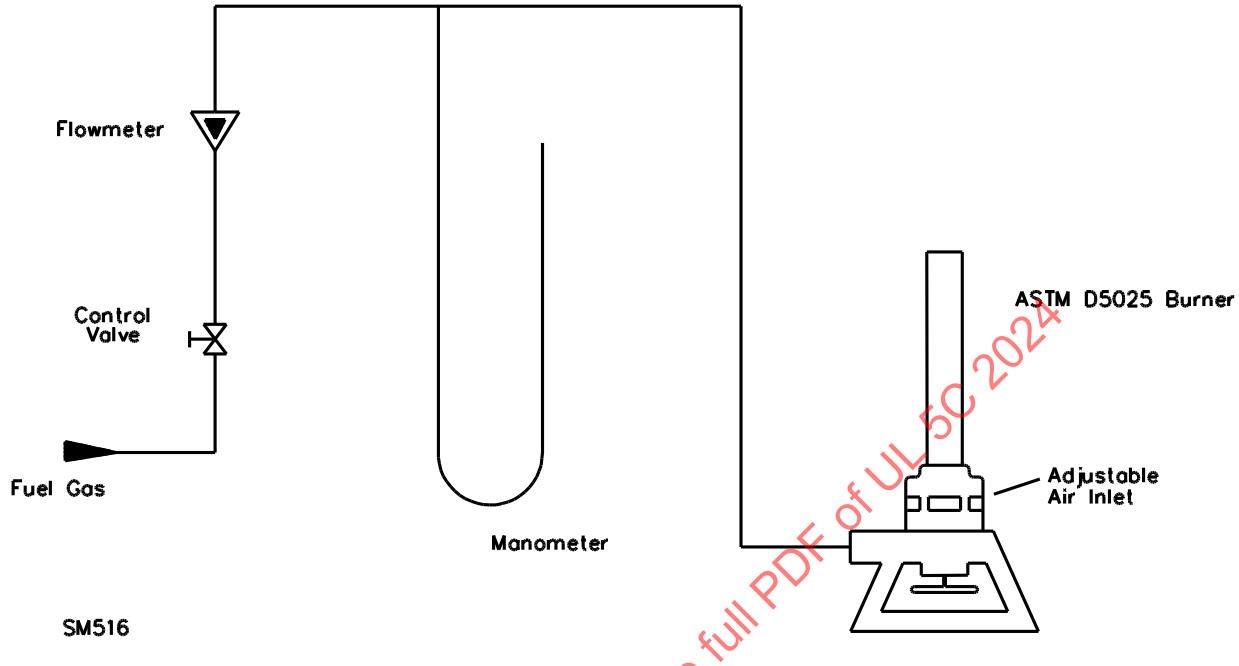
18.5 Two 30-second applications of the tip of the flame are to be made to each specimen with a 1-minute interval between the applications. A supply of technical-grade methane gas (minimum 98 percent pure) is to be used with a regulator and meter for uniform gas flow. The methane gas supply to the burner shall be arranged as in Figure 18.1 and adjusted to produce a gas flow rate of 105 ml/min with a back pressure less than 0.39 in (10 mm) of water. See Standard Practice for Confirmation of 20-mm (50-W) and 125-mm (500-W) Test Flames for Small-Scale Burning Tests on Plastic Materials, ASTM D 5207. The flow meter shall be a rotameter calibrated in accordance with the Standard Practice of Rotameter Calibration, ASTM D3195/D3195M, with correlation curves appropriate for the gas or a mass flow meter with ±2 percent accuracy.

Exception: Natural gas having a heat content of approximately 37 MJ/m^3 at 23°C (1000 Btu/ft^3 at 73.4°F) provides similar results. Technical grade methane shall be used in case of dispute.

18.6 When one specimen from a set of three does not comply with 18.1, an additional set of three specimens is to be tested. All specimens from the second set shall comply with 18.1.

Figure 18.1

Burner supply arrangement



19 VW-1 (vertical wire) flame test/ASTM D 2671 Method C (modified)

19.1 A vertical specimen of raceway shall not flame or glow longer than 60 seconds following any of the five 15-second applications of the test flame, the period between applications being:

a) 15 seconds if the specimen's flaming or glowing ceases within 15 seconds; or

b) The duration of the specimen's flaming or glowing, if it persists longer than 15 seconds. The specimen shall not ignite combustible materials in its vicinity or damage more than 25 percent of the indicator flag during, between, or after the five applications of the test flame. The test shall be conducted as described in Clauses 19.2 – 19.13.

19.2 This test shall be performed on unaged specimens of the raceway. The test is to be conducted in a three-sided metal enclosure in an exhaust hood or cabinet, as described in the VW-1 (Vertical-Specimen) Flame Test in the Reference Standard for Electrical Wires, Cables, and Flexible Cords, UL 1581. The metal enclosure is to be 12 in (305 mm) wide, 14 in (355 mm) deep, 24 in (610 mm) high, and the top and front are to be open. The enclosure shall be equipped with a means for supporting a 22 in (559 mm) straight length of raceway that is closed at one end to prevent a chimney effect and suspended vertically.

19.3 A 26-in (660-mm) length of raceway is to be mounted to a strip of metal representing the intended mounting surface. The metal strip shall be of length long enough to fit between the two supports 22 in (559 mm) apart and to facilitate clamping. The combination of the specimen and its supporting strip with its longitudinal axis vertical in the center of the enclosure is to be secured at one end to the middle of the upper support by clamping the end of the raceway (using a clamp) to provide a closed end to the specimen, thus preventing any chimney effects during the test. The lower end of the strip is to be passed over the middle of the lower support and secured.

19.4 A flat horizontal layer of untreated surgical cotton approximately 1/8 in (3 mm) thick shall cover the floor of the enclosure. The upper surface of the cotton shall be no more than 9-1/2 in (240 mm) 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 19.1.)

Figure 19.1

VW-1 flame test