

UL 5

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Surface Metal Raceways and Fittings



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UL Standard for Safety
for
Surface Metal Raceways and Fittings, UL 5

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A change is indicated by a note following the affected item. The note is preceded and followed by an asterisk.

The revised requirements are substantially in accordance with UL's Bulletin on this subject dated August 17, 1995. The bulletin is now obsolete and may be discarded.

As indicated on the title page (page 1), this UL Standard for Safety has been adopted by the Department of Defense.

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that have been revised and that have a future effective date are located after the Standard, and are preceded by a "SUPERSEDED REQUIREMENTS" notice.

New product submittals made prior to a specified future effective date will be judged under all of the requirements in this Standard including those requirements with a specified future effective date, unless the applicant specifically requests that the product be judged under the current requirements. However, if the applicant elects this option, it should be noted that compliance with all the requirements in this Standard will be required as a condition of continued Listing and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

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1

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An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc.

The Department of Defense (DoD) has adopted UL 5 on July 9, 1984. The publication of revised pages or a new edition of this standard will not invalidate the DoD adoption.

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.

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No Text on This Page

CONTENTS**FOREWORD****INTRODUCTION**

1 Scope	5
2 General	5
3 Glossary	6

CONSTRUCTION

4 General	7
5 Fittings	8
6 Wiring Devices	8
7 Grounding and Bonding	8
8 Specific Materials and Dimensional Limits	10
9 Corrosion Protection	13

PERFORMANCE

10 Fixture Support Test	13
11 Receptacle Secureness Test	13
12 Security of Knockout and Break-Away Tab Test	14
13 Electrical Resistance Test	14
14 Fault Current Test	15
15 Short Circuit Test	16

INSTALLATION INSTRUCTIONS

16 Details	17
------------------	----

MARKINGS

17 Details	17
------------------	----

APPENDIX A

Standards for Components	A1
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FOREWORD

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 differing from those detailed in the requirements of this Standard may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, 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.

INTRODUCTION

1 Scope

Section 1 effective March 31, 1998

1.1 These requirements cover surface metal raceways and fittings for use in accordance with the National Electrical Code, NFPA 70.

1.2 Raceways of the following thicknesses are intended to enclose circuits operating at potentials not exceeding 600 volts between conductors:

- a) Raceways that are entirely of metal at least 0.040 inch (1.02 mm) thick and
- b) Raceways consisting of nonmetallic covers on metal bases of the thickness indicated in (a).

Thinner all-metal raceways or raceways of thinner metal bases with nonmetallic covers are intended to enclose circuits operating at potentials lower than 300 volts between conductors.

1.3 These requirements do not cover cable trays, wireways or nonmetallic raceways.

1.4 A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this standard, and that involve a risk of fire, electric shock, or injury to persons shall be evaluated using the appropriate additional component and end-product requirements as determined necessary to maintain the intended level of safety as originally anticipated by the intent of this standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this standard cannot be judged to comply with this standard. Where considered appropriate, revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this standard.

2 General

Section 2 effective March 31, 1998

2.1 Components

2.1.1 Except as indicated in 2.1.2, a component of a product covered by this standard shall comply with the requirements for that component. See Appendix A for a list of standards covering components generally used in the products covered by this standard.

2.1.2 A component is not required to comply with a specific requirement that:

- a) Involves a feature or characteristic not needed in the application of the component in the product covered by this standard or
- b) Is superseded by a requirement in this standard.

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

2.1.4 Specific components are recognized as being 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 for which they have been recognized.

2.2 Units of measurement

2.2.1 When a value for measurement is followed by a value in other units in parentheses, the second value is only approximate. The first stated value is the requirement.

2.3 Undated references

2.3.1 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.

2.4 Installation

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

2.4.2 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, 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.

2.5 Nonmetallic parts

2.5.1 A nonmetallic cover, fitting or other part of a metal raceway shall comply with the applicable requirements in the Standard for Nonmetallic Surface Raceways and Fittings, UL 5A.

3 Glossary

Section 3 effective March 31, 1998

3.1 For the purposes of this standard, the following definitions apply:

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

3.3 BOX, FIXTURE – A box that has been evaluated and determined to be acceptable as the support of a lighting fixture, lampholder, or other equipment intended for similar installation.

3.4 FITTING – A part used to connect, change direction, or terminate a raceway (for example, a transition coupler, an end cap, a corner, a tee, an adapter, or a box).

3.5 NONMETALLIC – A polymeric part.

3.6 RACEWAY, SURFACE METAL – A raceway for surface or pendant mounting with a metal base and a metal or nonmetallic cover.

3.7 RACEWAY SYSTEM – A system consisting of a surface metal raceway, associated fittings and that possibly wiring devices and accessories.

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

CONSTRUCTION

4 General

Section 4 effective March 31, 1998

4.1 A raceway system shall be constructed to facilitate compliance with the requirements for the installation of insulated wires and cables as given in the National Electrical Code, NFPA 70.

4.2 Each element of a raceway system shall comply with the requirements for the construction, performance, and use of that element.

4.3 A raceway 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.

4.4 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 that exceed 1/16 inch (1.59 mm) in width on surfaces that are accessible following installation of the system.
- 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 inch (0.76 mm).
- c) Mounting holes having a maximum diameter of 9/32 inch (7.1 mm), or slotted openings for mounting of one dimension not larger than 5/8 inch (15.9 mm) and the other dimension not larger than 1/8 inch (3.2 mm), provided on the raceway base or fitting base surface that is installed flush with the mounting surface, are not prohibited.
- d) A partition in a raceway system shall not have any openings through which wires are capable of being passed, intentionally or otherwise, from one compartment to another.

Exception: A gap of 1/8 inch (3.2 mm) shall be used only when means is provided to completely contain conductors in their individual compartments, such as wire retaining clips.

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

4.6 A raceway shall be provided with means for securing it to the mounting surface at intervals of not more than 4 feet (1.2 m).

4.7 Where 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.

4.8 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. See 16.3.

4.9 An adhesive strip, when provided on the raceway, shall serve only as a positioning aid during the installation process. The raceway shall also have provisions for mechanical fastening as required in 4.6 – 4.8.

Exception: An adhesive strip provided on a raceway shall be used as the sole means of securement only when the raceway is marked for use with Class 2 circuits only, as defined in Article 725 of the National Electrical Code, NFPA 70.

4.10 Provision shall be made for securing the cover to the base of a two-piece raceway at intervals of not more than 4 feet (1.2 m). A cover shall be held in place by continuous grooves, flanges, or similar constructions only when it is securely fixed in place. See 4.12.

4.11 For raceways using conductors larger than No. 6 AWG (13.30 mm^2), the Short Circuit Test, Section 15, shall be performed on conductors in the raceway to determine whether the cover is secure.

4.12 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 required for their removal for gaining access to internal areas of the raceway after installation.

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

5 Fittings

Section 5 effective March 31, 1998

5.1 A fitting provided with means for the support of a fixture shall have strength and rigidity for the purpose as evaluated by means of the tests described in the Fixture Support Test, Section 10. A nipple intended only for the connection of a lampholder or similar item is not to be considered means for the support of a fixture.

6 Wiring Devices

Section 6 effective March 31, 1998

6.1 A receptacle shall be secured to the raceway base by a positive means such as a minimum of two screws or rivets.

Exception: A snap-fit or other non-positive securement means shall be used only when it complies with the Receptacle Secureness Test, Section 11.

6.2 A receptacle shall comply with all of the applicable requirements in the Standard for Attachment Plugs and Receptacles, UL 498. A flush switch shall comply with all of the applicable requirements in the Standard for General-Use Snap Switches, UL 20.

7 Grounding and Bonding

Section 7 effective March 31, 1998

7.1 Electrical continuity shall be provided between all metal parts of the raceway system when the parts are installed in the intended manner. See the Electrical Resistance Test, Section 13.

7.2 A supplemental set screw or other acceptable positive means of securement shall be provided for each connection between adjacent metal raceway section and between metal raceway sections and fittings of a metal raceway system.

Exception: Other methods of providing electrical continuity are to be used only when in compliance with the requirements in the Fault Current Test, Section 14.

7.3 A raceway system shall be provided with means for grounding at all points or with fittings intended for connection to another wiring system.

7.4 A metal raceway base or fitting intended for connection to a wiring system shall have a tapped hole adjacent to the wire entry point intended for use with a No. 10-32 or larger grounding screw. At least two full threads shall be provided in metal into which screws are to be threaded.

Exception: A metal raceway base or fitting is not required to have a tapped hole when it is provided with a fastening means such as a wire attached by a connector, clip, or other means that has been evaluated and determined to be suitable. A self-threading or factory-assembled screw shall be provided instead of a tapped hole only when it is identified for the purpose of securing the grounding conductor. A fastening means is not required when fastening methods are referenced in the instructions.

7.5 A grounding screw provided in the raceway base or fitting 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.

Only a plated steel or stainless steel grounding screw shall be provided in an aluminum raceway or fitting. A grounding screw shall engage at least two full threads and shall be used in conjunction with upturned lugs, a cupped washer, or an equivalent method that is capable of retaining a No. 10 AWG (5.3 mm²) conductor under the head of the screw. A sheet metal screw shall not be used as a grounding screw.

7.6 With regard to the requirements in 7.5, 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 a minimum of either solid copper not smaller than No. 14 AWG (2.1 mm²) or solid aluminum not smaller than No. 12 AWG (3.3 mm²), and shall be 5 – 6 inches (127 – 152 mm) long.

7.7 One end of a grounding wire shall be secured to the raceway or fitting by welding; by means of a copper, copper alloy, or stainless-steel rivet when the wire is of copper; or by means of an aluminum or stainless-steel rivet when the wire is of aluminum. When insulated, the insulation shall be rated for 600 volts and the color of the surface of the insulation shall be green, with or without one or more yellow stripes.

Exception: A screw shall be used to secure the grounding wire only when the screw complies with the requirements in 7.5.

8 Specific Materials and Dimensional Limits

Section 8 effective March 31, 1998

8.1 The base of a raceway or fitting shall be of metal that complies with Table 8.1, 8.2, 8.3, or 8.4; or be of metal that provides equivalent protection for the wiring. Sections of reduced thickness are suitable for facilitating break-offs. Break-offs shall not result in any edges protruding into the interior of the raceway or fitting. The cover of a raceway or fitting shall be of metal as indicated above or shall be of nonmetallic material.

Table 8.1
Dimensions of raceway and fitting bases and covers for seven
or fewer conductors not larger in cross-sectional area than
No. 12 AWG (3.31 mm²)

Material	Minimum thickness at knock-outs and other points of connection for a wiring system,		Minimum thickness elsewhere than in break-off areas and at points of connection for a wiring system,		Maximum width of raceway,	
	inch	(mm)	inch	(mm)	inches	(mm)
Steel	0.036	0.91	0.025	0.64	2-1/2	63.5
Aluminum	0.050	1.27	0.035	0.89	2-1/2	63.5

Table 8.2
Thickness of raceway and fitting bases and covers for conductors
not larger in cross-sectional area than No. 6 AWG (13.30 mm²)

Material	Minimum thickness,	
	inch	(mm)
Steel	0.036	0.91
Aluminum	0.050	1.27

Table 8.3
Thickness of raceway and fitting bases and covers for conductors
that are larger in cross-sectional area than No. 6 AWG (13.30 mm²)

Material	Part	Minimum thickness,	
		inch	(mm)
Steel	Base Cover	0.053	1.35
		0.036	0.91
Aluminum	Base	0.074	1.88
	Cover	0.050	1.27

Table 8.4
Minimum thickness of parts that are cast of metal

Material	inch	(mm)
Malleable iron	3/32	2.4
Iron other than malleable iron	1/8	3.2
Die-cast nonferrous:		
Part that is not ribbed or otherwise reinforced for mechanical strength	3/32	2.4
Part that is ribbed or otherwise reinforced for mechanical strength	1/16	1.6
Cast nonferrous other than die-cast	3/32	2.4

8.2 Inside and outside surfaces of each length of an iron or steel raceway or fitting shall be cleaned of all scale and rust and shall be in a condition that enables the protective coating to adhere firmly and have a smooth surface.

8.3 The thickness of the finished product is to be measured with a round-nose machinist's micrometer calibrated to read directly to at least 0.001 inch or 0.01 mm. Measurements are to be made at five different locations on each specimen examined.

8.4 Other than as noted in 8.5, a knockout provided in a raceway for a 1/2-inch 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 8.5.

Table 8.5
Diameter of knockout and width of surrounding flat surface

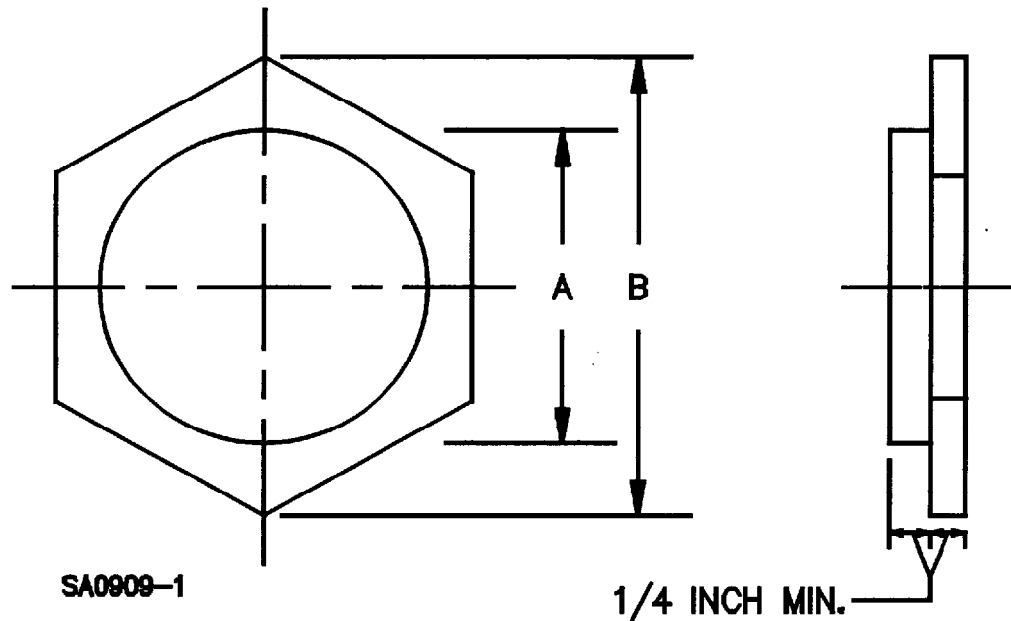
Trade size of conduit, inches	Knockout diameter,		Minimum width of flat surface surrounding knockout,	
	inches ^a	(mm)	inch	(mm)
1/2	0.875	22.23	0.133	3.38
3/4	1.109	28.17	0.156	3.96
1	1.375	34.93	0.198	5.03
1-1/4	1.734	44.04	0.274	6.96

^a A plus tolerance of 0.031 inch (0.79 mm) and a minus tolerance of 0.015 inch (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.

8.5 When the concentric flat surface required in 8.4 is not provided, the acceptability of the flat surface surrounding a knockout on both the inside and outside surfaces is able to be determined by application of a test gauge as illustrated in Figure 8.1 which has the dimensions specified in Table 8.6. 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 not prohibited 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 opposite side of the raceway with the same degree and position of offset from the center used on the other side, and 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 is not to be canted or tilted to make the required contact with the surface of the raceway.

Figure 8.1
Dimensions of test gauges for flat surfaces



A – Nominal diameter of conduit
B – Maximum diameter of locknut

Table 8.6
Dimensions of test gauges for flat surfaces surrounding knockouts

Trade size of inches	Nominal knockout diameter,		Nominal diameter of conduit,		Maximum diameter of locknut,	
	inches	(mm)	inches	(mm) ^a	inches	(mm) ^b
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 inch (0.03 mm).

^b Maximum diameter of locknut. Tolerances for test gauge: plus 0.001 inch, minus 0.000 inch.

8.6 When evaluating a raceway for compliance with the requirement in 8.4, consideration is to be given to the clearances from adjacent knockouts and the sides of the raceway, but it is not required that the raceway be constructed so that conduit can be installed simultaneously in adjacent knockouts.

9 Corrosion Protection

Section 9 effective March 31, 1998

9.1 Metal raceway and fittings shall be protected against corrosion on all inside and outside surfaces or the metal shall have been evaluated and determined to be inherently resistant to ordinary dry-locations indoor atmospheric corrosion. Such protection is not necessarily required on cut edges.

PERFORMANCE

10 Fixture Support Test

Section 10 effective March 31, 1998

10.1 A fitting or box identified for fixture support shall withstand, without pulling apart, a direct pull force equal to four times the manufacturer's identified maximum load to be supported by the fitting or box, when tested in accordance with 10.2. The manufacturer's identified maximum load to be supported by the fitting or box shall not exceed 50 lbf (223 N).

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

11 Receptacle Secureness Test

Section 11 effective March 31, 1998

11.1 A receptacle that is secured in place by a snap-fit or any means other than screws, rivets, or equivalent positive securement means, shall be tested as described in 11.2 – 11.3. The receptacle or fitting shall remain fully secured to the raceway.

11.2 The attachment plug of a power-supply cord is to be inserted into the receptacle and made mechanically secure. A weight exerting 25 lbf (111 N) is to be attached to the opposite end of the power-supply cord. The receptacle is to be attached in the intended manner to a length of raceway. With the raceway in the horizontal position (receptacle face directed towards the ground) and the weight initially resting on a horizontal surface, the raceway is to be gradually raised vertically until the weight is supported by the receptacle. The weight is to be supported for 60 seconds.

11.3 The test in 11.2 is then to be repeated with the raceway tilted so that a line perpendicular to the face of the receptacle makes an angle of 30 degrees with the vertical cord. The direction of the tilt relative to the receptacle is to be the direction most certain to cause separation.