

UL 66

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Fixture Wire

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Underwriters Laboratories Inc. (UL)
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UL Standard for Safety for Fixture Wire, UL 66

First Edition, Dated April 16, 2002

Revisions: This Standard contains revisions through and including June 7, 2005.

Summary of Topics:

These revisions are being issued to add Types PAF and PAFF, to make corrections, and to add a marking.

UL Standards for Safety are developed and maintained in the Standard Generalized Markup Language (SGML). SGML -- an international standard (ISO 8879-1986) -- is a descriptive markup language that describes a document's structure and purpose, rather than its physical appearance on a page. Due to formatting differences resulting from the use of UL's new electronic publishing system, please note that additional pages (on which no requirements have been changed) may be included in revision pages due to relocation of existing text and reformatting of the Standard.

Text that has been changed in any manner is marked with a vertical line in the margin. Changes in requirements are marked with a vertical line in the margin and are followed by an effective date note indicating the date of publication or the date on which the changed requirement becomes effective.

The new and revised requirements are substantially in accordance with UL's Proposal(s) on this subject dated March 11, 2005.

The revisions dated June 7, 2005 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.

Until the new edition of UL 62 is published, the Fixture Wire portion of UL 62 should be ignored.

The UL Foreword is no longer located within the UL Standard. For information concerning the use and application of the requirements contained in this Standard, the current version of the UL Foreword is located on ULStandardsInfoNet at: <http://ulstandardsinfo.net/ulforeword.html>

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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

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

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6-7	June 7, 2005
8-10	July 16, 2003
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12-14	July 16, 2003
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APRIL 16, 2002
(Title Page Reprinted: June 7, 2005)



ANSI/UL 66-2005

1

UL 66

Fixture Wire

First Edition

April 16, 2002

The most recent designation of ANSI/UL 66 as an American National Standard (ANSI) occurred on June 7, 2005.

This ANSI/UL Standard for Safety, which consists of the First Edition with revisions through June 7, 2005, is under continuous maintenance, whereby each revision is ANSI approved upon publication. 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>.

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

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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INTRODUCTION

1 Scope

1.1 This standard states basic construction, test, and marking requirements for fixture wires. Fixture wires are single conductor and are of the following types:

600 volt Types: PTF, PTFP, PAF, PAFF, KF-2, KFF-2, PF, PFF, PGF, PGFF, SF-2, SFF-2, ZF, ZFF, ZHF, TF, TFF, TFN, TFFN, RFH-2, FFH-2, RFHH-2, and RFHH-3

300 volt Types: KF-1, KFF-1, SF-1, SFF-1, XF, and XFF

These types are for use as specified in Article 402 and other applicable parts of the National Electrical Code (NEC), ANSI / NFPA 70. These types are as described individually in index Tables 4.1 – 4.9 of this standard.

1.1 revised June 7, 2005

2 Units of Measurement

2.1 In addition to being stated in inch/pound units, each numerical requirement in this standard is also stated in units that make the requirement conveniently usable in the various metric systems (practical SI and customary). Equivalent – although not necessarily exactly identical – results are to be expected from applying a requirement in inch/pound or metric terms. Equipment calibrated in metric units is to be used when a requirement is applied in metric terms.

3 References

3.1 Whenever the designation “UL 1581” is used in this wire standard, reference is to be made to the designated part(s) of the Reference Standard for Electrical Wires, Cables, and Flexible Cords, UL 1581.

4 Index Tables

4.1 Tables 4.1 – 4.8 each serve as an index to the requirements for construction details, test performance, and marking of the wire types described in the particular table. Each vertical column summarizes and references the requirements that apply to the particular wire whose type letters appear at the top of the column. The applicable paragraphs and tables in this standard (UL 66) are indicated in parenthesis. Square brackets [...] indicate the applicable parts of UL 1581.

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Table 4.1
PTFE insulated Types PTF and PTFF^a

Table 4.1 revised July 16, 2003

Type-letter designation		PTF	PTFF
Maximum temperature		250°C (482°F)	150°C (302°F)
Maximum voltage		600	
CONDUCTOR	Sizes	18, 16, and 14 AWG	
	Metal	Nickel-base alloy or nickel-coated copper (6.1.2)	Nickel-coated copper or silver-coated copper (6.1.2)
	Stranding	Solid or 7-strand (6.1.1, 6.2.2, and 6.3.1)	Flexible-stranded (6.1.1, 6.2.2, and 6.3.1)
	Size verification	(6.4.1, 6.4.2, and 6.4.3)	(6.4.1 and 6.4.3)
	Maximum length of lay of strands	48 x individual strand diameter (6.3.2)	(Table 6.2)
	General	Continuity, joints, metal coating, and separator (6.5.1 – 7.3)	
INSULATION	Material	PTFE [Table 50.219 of UL 1581] (8.1.1 – 8.1.4, 8.2.2.1, and 8.2.2.4)	
	Minimum average thickness	20.0 mils or 0.51 mm (8.3.1)	
	Minimum thickness at any point	18.0 mils or 0.46 mm (Table 8.1)	
Covering over the insulation		No covering	
TESTS ON FINISHED WIRE	Physical properties tests of insulation	PTFE [Table 50.219 of UL 1581] (8.2.2.1 and 8.2.2.4)	
	Continuity test of conductor	(6.5.1, 11.1, and 11.2)	
	D-C resistance test of conductor	(12.1 – 12.3)	
	Spark test	(13.1)	
	Deformation test	Not applicable	
	Cold bend test	(15.1 – 15.7)	
	Test for insulation resistance at 60°F	(16.1 and 16.2)	
	Flame tests for VW-1 wire (elective)	(17.1)	
	Vertical flame test (required)	(18.1)	
	Durability test of ink printing	(20.1)	
MARKINGS	Polarity ID	(21.1)	
	Legibility of printing	(22.1)	
	Sequence of printed markings	No sequence is specified (23.1)	
	Responsible organization and factory IDs	(24.1 – 24.3 and 24.5)	
	Temperature ID	(25.1 and 25.2)	
	ID of VW-1 wire	(27.1)	
	Tag, reel, and carton markings	(28.1)	
	Current designation	Prohibited (29.1)	
	Date of manufacture	(30.1)	

^a Index tables are explained in 4.1.

Table 4.2
Polyimide tape insulated Types KF-1, KF-2, KFF-1, and KFF-2^a

Table 4.2 revised July 16, 2003

Type-letter designation		KF-1	KF-2	KFF-1	KFF-2
Maximum temperature		200°C (392°F)			
Maximum voltage		300	600	300	600
CONDUCTOR	Sizes	18, 16, 14, 12, and 10 AWG			
	Metal	Nickel-base alloy or nickel- or silver-coated copper (6.1.2)			
	Stranding	Solid or 7-strand (6.1.1, 6.2.2, and 6.3.1)		Flexible-stranded (6.1.1, 6.2.2, and 6.3.1)	
	Size verification	(6.4.1, 6.4.2, and 6.4.3)		(6.4.1 and 6.4.3)	
	Maximum length of lay of strands	48 x individual strand diameter (6.3.2)		(Table 6.2)	
	General	Continuity, joints, metal coating, and separator (6.5.1 – 7.3)			
INSULATION	Material	Polyimide tape			
	Minimum average thickness	KF-1 and KFF-1: 5.5 mils or 0.14 mm KF-2 and KFF-2: 8.4 mils or 0.21 mm (8.3.1)			
	Minimum thickness at any point	KF-1 and KFF-1: 5.0 mils or 0.13 mm KF-2 and KFF-2: 7.6 mils or 0.19 mm (Table 8.1)			
Covering over the insulation		No covering			
TESTS ON FINISHED WIRE	Flexing test of insulation after conditioning	(8.2.1.1 – 8.2.1.6)			
	Continuity test of conductor	(6.5.1, 11.1, and 11.2)			
	D-C resistance test of conductor	(12.1 – 12.3)			
	Spark test	(13.1)			
	Deformation test	Not applicable			
	Cold bend test	(15.1 – 15.7)			
	Test for insulation resistance at 60°F	(16.1 and 16.2)			
	Flame tests for VW-1 wire (elective)	(17.1)			
	Vertical flame test (required)	(18.1)			
	Durability test of ink printing	(20.1)			
MARKINGS	Polarity ID	(21.1)			
	Legibility of printing	(22.1)			
	Sequence of printed markings	No sequence is specified (23.1)			
	Responsible organization and factory IDs	(24.1 – 24.3 and 24.5)			
	Temperature ID	(25.1 and 25.2)			
	ID of VW-1 wire	(27.1)			
	Tag, reel, and carton markings	(28.1)			
	Current designation	Prohibited (29.1)			
	Date of manufacture	(30.1)			

^a Index tables are explained in 4.1.

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^a Index tables are explained in 4.1.

Table 4.3
FEP insulated Types PF, PGF, PFF, and PGFF^a

Table 4.3 revised July 16, 2003

Type-letter designation		PF	PGF	PFF	PGFF
Maximum temperature		200°C (392°F)		150°C (302°F)	
Maximum voltage		600			
CONDUCTOR	Sizes	18, 16, and 14 AWG			
	Metal	Nickel-base alloy or nickel- or silver-coated copper (6.1.2)		Nickel-base alloy or uncoated or coated copper (6.1.1 and 6.1.2)	
	Stranding	Solid or 7-strand (6.1.1, 6.2.2, and 6.3.1)		Flexible-stranded (6.1.1, 6.2.2, and 6.3.1)	
	Size verification	(6.4.1, 6.4.2, and 6.4.3)		(6.4.1 and 6.4.3)	
	Maximum length of lay of strands	48 x individual strand diameter (6.3.2)		(Table 6.2)	
	General	Continuity, joints, metal coating, and separator (6.5.1 – 7.3)			
INSULATION	Material	FEP [Table 50.73 of UL 1581] (8.1.1 – 8.1.4, 8.2.2.1, and 8.2.2.4)			
	Minimum average thickness	PF and PFF: 20.0 mils or 0.51 mm PGF and PGFF: 14.0 mils or 0.36 mm (8.3.1)			
	Minimum thickness at any point	PF and PFF: 18.0 mils or 0.46 mm PGF and PGFF: 12.6 mils or 0.32 mm (Table 8.1)			
Covering over the insulation: Elective on Types PF and PFF Required on Types PGF and PGFF		Saturated glass or aramid-fiber braid (10.2.1, 10.2.2, and 10.2.4) Other covering (10.2.5)			
TESTS ON FINISHED WIRE	Physical properties tests of insulation	FEP [Table 50.73 of UL 1581] (8.2.2.1 and 8.2.2.4)			
	Conductor corrosion test (uncoated copper only)	No test		[500.1 of UL 1581] (6.7.1)	
	Continuity test of conductor	(6.5.1, 11.1, and 11.2)			
	D-C resistance test of conductor	(12.1 – 12.3)			
	Spark test	(13.1)			
	Deformation test	(14.1 – 14.3)			
	Cold bend test	(15.1 – 15.7)			
	Test for insulation resistance at 60°F	(16.1 and 16.2)			
	Flame tests for VW-1 wire (elective)	(17.1)			
	Vertical flame test (required)	(18.1)			
	Flexing test of covering	(10.2.4 and 10.2.5)			
	Durability test of ink printing	Not applicable			

Table 4.3 Continued

Type-letter designation		PF	PGF	PFF	PGFF
MARKINGS	Polarity ID	(21.2 and 21.3)			
	Legibility of printing	(22.1)			
	Sequence of printed markings	No sequence is specified (23.1)			
	Responsible organization and factory IDs	(24.1, 24.3, and 24.4)			
	Temperature ID	(25.1 and 25.2)			
	ID of VW-1 wire	(27.1)			
	Tag, reel, and carton markings	(28.1)			
	Current designation	Prohibited (29.1)			
	Date of manufacture	(30.1)			
^a Index tables are explained in 4.1.					

Table 4.4
Silicone rubber insulated Types SF-1, SFF-1, SF-2, and SFF-2^a

Table 4.4 revised June 7, 2005

Type-letter designation		SF-1	SF-2	SFF-1	SFF-2
Maximum temperature		200°C (392°F)		150°C (302°F)	
Maximum voltage		300	600	300	600
CONDUCTOR	Sizes	18 AWG	18, 16, 14, 12, and 10 AWG	18 AWG	18, 16, 14, 12, and 10 AWG
	Metal	Nickel-base alloy or copper coated with tin, nickel, or silver (6.1.1 and 6.1.2)			
	Stranding	Solid or 7-strand (6.1.1, 6.2.2, and 6.3.1)		Flexible-stranded (6.1.1, 6.2.2, and 6.3.1)	
	Size verification	(6.4.1 – 6.4.3)		(6.4.1 and 6.4.3)	
	Maximum length of lay of strands	48 x strand dia (6.3.2)		(Table 6.2)	
	General	Continuity, joints, metal coating, and separator (6.5.1 – 7.3)			
INSULATION	Material	Silicone rubber [Table 50.210 of UL 1581] (8.1.1 – 8.1.4, 8.2.2.1, 8.2.2.4)			
	Minimum average thickness	SF-1, SFF-1: 15.0 mils or 0.38 mm SF-2, SFF-2: 18, 16, 14, and 12 AWG – 30.0 mils or 0.76 mm 10 AWG – 45.0 mils or 1.14 mm (8.3.1)			
	Minimum thickness at any point	SF-1, SFF-1: 13.0 mils or 0.33 mm SF-2, SFF-2: 18, 16, 14, and 12 AWG – 27.0 mils or 0.69 mm 10 AWG – 40.0 mils or 1.02 mm (Table 8.1)			
Covering over the insulation		Lacquered or saturated glass or aramid-fiber braid (10.2.1 – 10.2.4) Other covering (10.2.5)			
TESTS ON FINISHED WIRE	Physical properties tests of insulation	Silicone rubber [Table 50.210 of UL 1581] (8.2.2.1 and 8.2.2.4)			
	Continuity test of conductor	(6.5.1, 10.1, and 11.2)			
	D-C resistance test of conductor	(12.1 – 12.3)			
	Spark test	(13.1)			
	Deformation test	Not applicable			

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Table 4.4 Continued on Next Page



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Table 4.4 Continued

Type-letter designation		SF-1	SF-2	SFF-1	SFF-2
	Flexibility of finished wire	[1560.1 of UL 1581]			
	Test for insulation resistance at 60°F	(16.1 and 16.2)			
	Flame tests for VW-1 wire (elective)	(17.1)			
	Vertical flame test (required)	(18.1)			
	Flexing test of covering	(10.2.4 and 10.2.5)			
	Durability test of ink printing	Not applicable			
MARKINGS	Polarity ID	(21.2 and 21.3)			
	Legibility of printing	(22.1)			
	Sequence of printed markings	No sequence is specified (23.1)			
	Responsible organization and factory IDs	(24.1, 24.3, and 24.4)			
	Temperature ID	(25.1 and 25.2)			
	ID of VW-1 wire	(27.1)			
	Tag, reel, and carton markings	(28.1)			
	Current designation	Prohibited (29.1)			
	Date of manufacture	(30.1)			
^a Index tables are explained in 4.1.					

Table 4.5
ETFE insulated Types ZHF, ZF, and ZFF^a

Table 4.5 revised July 16, 2003

Type-letter designation		ZHF	ZF	ZFF
Maximum temperature		200°C (392°F)	150°C (302°F)	
Maximum voltage		600		
CONDUCTOR	Sizes	18, 16, and 14 AWG		
	Metal	Nickel-base alloy or nickel- or silver-coated copper (6.1.2)	Nickel-base alloy or uncoated or coated copper (6.1.1 and 6.1.2)	
	Stranding	Solid or 7-strand (6.1.1, 6.2.2, and 6.3.1)		Flexible-stranded (6.1.1, 6.2.2, and 6.3.1)
	Size verification	(6.4.1, 6.4.2, and 6.4.3)		(6.4.1 and 6.4.3)
	Maximum length of lay of strands	48 x individual strand diameter (6.3.2)		(Table 6.2)
	General	Continuity, joints, metal coating, and separator (6.5.1 – 7.3)		
INSULATION	Material	ETFE [Tables 50.64 (200°C), 50.63 (150°C) of UL 1581] (8.1.1 – 8.1.4, 8.2.2.1, and 8.2.2.4)		
	Minimum average thickness	15.0 mils or 0.38 mm (8.3.1)		
	Minimum thickness at any point	13.0 mils or 0.33 mm (Table 8.1)		

Table 4.5 Continued

Type-letter designation		ZHF	ZF	ZFF
Covering over the insulation		No covering		
TESTS ON FINISHED WIRE	Physical properties tests of insulation	ETFE [Tables 50.64 (200°C), 50.63 (150°C) of UL 1581] (8.2.2.1, 8.2.2.3, and 8.2.2.4)		
	Conductor corrosion test (uncoated copper only)	No test	[500.1 of UL 1581] (6.7.1)	
	Continuity test of conductor	(6.5.1, 11.1, and 11.2)		
	D-C resistance test of conductor	(12.1 – 12.3)		
	Spark test	(13.1)		
	Deformation test	Not applicable		
	Cold bend test	(15.1 – 15.7)		
	Test for insulation resistance at 60°F	(16.1 and 16.2)		
	Flame tests for VW-1 wire (elective)	(17.1)		
	Vertical flame test (required)	(18.1)		
	Durability test of ink printing	(20.1)		
MARKINGS	Polarity ID	(21.1)		
	Legibility of printing	(22.1)		
	Sequence of printed markings	No sequence is specified (23.1)		
	Responsible organization and factory IDs	(24.1 – 24.3 and 24.5)		
	Temperature ID	(25.1 and 25.2)		
	ID of VW-1 wire	(27.1)		
	Tag, reel, and carton markings	(28.1)		
	Current designation	Prohibited (29.1)		
Date of manufacture	(30.1)			
^a Index tables are explained in 4.1.				

Table 4.6
XLPO insulated Types XF and XFF^a

Table 4.6 revised July 16, 2003

Type-letter designation		XF	XFF
Maximum temperature		150°C (302°F)	
Maximum voltage		300	
CONDUCTOR	Sizes	18, 16, 14, 12, and 10 AWG	
	Metal	Nickel-base alloy or nickel- or silver-coated copper (6.1.2)	Nickel-base alloy or uncoated or coated copper (6.1.1 and 6.1.2)
	Stranding	Solid or 7-strand (6.1.1, 6.2.2, and 6.3.1)	Flexible-stranded (6.1.1, 6.2.2, and 6.3.1)
	Size verification	(6.4.1, 6.4.2, and 6.4.3)	(6.4.1, and 6.4.3)
	Maximum length of lay of strands	48 x individual strand diameter (6.3.2)	(Table 6.2)
	General	Continuity, joints, metal coating, and separator (6.5.1 – 7.3)	
	Material	XLPO [Table 50.232 of UL 1581] (8.1.1 – 8.1.4, 8.2.2.1, and 8.2.2.4)	
INSULATION	Minimum average thickness	18, 16, and 14 AWG: 30.0 mils or 0.76 mm 12 and 10 AWG: 45.0 mils or 1.14 mm (8.3.1)	
	Minimum thickness at any point	18, 16, and 14 AWG: 27.0 mils or 0.69 mm 12 and 10 AWG: 40.0 or 1.02 mm (Table 8.1)	
Covering over the insulation		No covering	
TESTS ON FINISHED WIRE	Physical properties tests of insulation	XLPO [Table 50.232 of UL 1581] (8.2.2.1 and 8.2.2.4)	
	Conductor corrosion test (uncoated copper only)	No test	[500.1 of UL 1581] (6.7.1)
	Continuity test of conductor	(6.5.1, 11.1, and 11.2)	
	D-C resistance test of conductor	(12.1 – 12.3)	
	Spark test	(13.1 and 13.2)	
	Deformation test	(14.1 – 14.3)	
	Cold bend test	(15.1 – 15.7)	
	Test for insulation resistance at 60°F	(16.1 and 16.2)	
	Flame tests for VW-1 wire (elective)	(17.1)	
	Vertical flame test (required)	(18.1)	
	Durability test of ink printing	(20.1)	
	Tag, reel, and carton markings	(28.1)	
MARKINGS	Polarity ID	(21.1)	
	Legibility of printing	(22.1)	
	Sequence of printed markings	No sequence is specified (23.1)	
	Responsible organization and factory IDs	(24.1 – 24.3 and 24.5)	
	Temperature ID	(25.1 and 25.2)	
	ID of VW-1 wire	(27.1)	
	Tag, reel, and carton markings	(28.1)	

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Table 4.6 Continued on Next Page



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