



UL 1309

STANDARD FOR SAFETY

Marine Shipboard Cable

UL 1309 2013

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UL Standard for Safety for Marine Shipboard Cable, UL 1309

Second Edition, Dated April 5, 2011

Summary of Topics

This Revision of ANSI/UL 1309 Contains the Following Changes in Requirements:

Revised Thermal Aging Requirements for Silicone S100

Text that has been changed in any manner or impacted by UL's electronic publishing system 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 Proposal(s) on this subject dated January 4, 2013.

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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that have been revised and that have a future effective date are located after the Standard, and are preceded by a "SUPERSEDED REQUIREMENTS" notice.

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

Future Effective Date	Reference
August 1, 2013	Entire Standard



APRIL 5, 2011
(Title Page Reprinted: March 18, 2013)



ANSI/UL 1309-2013

1

UL 1309

Standard for Marine Shipboard Cable

First Edition – July, 1995

Second Edition

April 5, 2011

This ANSI/UL Standard for Safety consists of the Second Edition including revisions through March 18, 2013.

The most recent designation of ANSI/UL 1309 as an American National Standard (ANSI) occurred on March 18, 2013. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, or effective date information.

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>.

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INTRODUCTION

1 Scope

Section 1 effective August 1, 2013

1.1 This Standard specifies the requirements for distribution (power) cables, and control and signal cables for installation aboard marine vessels, fixed and floating offshore petroleum facilities, and mobile offshore drilling units (MODUs), in accordance with industry installation standards and the regulations of the authorities having jurisdiction. The cables are single or multi-conductor, with or without metal armor and/or jacket, and are rated 300 V to 35 kV.

1.2 These cables are not intended for use in accordance with the National Electrical Code (NEC), ANSI/NFPA-70. Cables that also meet the requirements for use with the NEC may be additionally marked with the appropriate "Type" designation from the NEC.

2 Units of Measurement

Section 2 effective August 1, 2013

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

3 References

Section 3 effective August 1, 2013

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.

CONSTRUCTION

4 Copper Conductors

Section 4 effective August 1, 2013

4.1 General

4.1.1 All conductors shall be of soft annealed stranded copper wire. The conductors may be tinned or alloy coated where necessary to ensure compatibility with primary insulation. Conductor sizes and resistances shall comply, within allowable tolerances, with the Reference Standard for Electrical Wires, Cables, and Flexible Cords, UL 1581.

4.2 Composition

4.2.1 Stranded conductors shall comply with the requirements of the Standard Specification for Soft or Annealed Copper Wire, ASTM B 3; the Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft, B 8; the Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes, B 33; the Standard Specification for Rope-Lay-Stranded Copper Conductors Having Bunch-Stranded Members, for Electrical Conductors, B 172; the Standard Specification for Rope-Lay-Stranded Copper Conductors Having Concentric-Stranded Members, for Electrical Conductors, B 173; the Standard Specification for Bunch-Stranded Copper Conductors for Electrical Conductors, B 174; the Standard Specification for Lead-Coated and Lead-Alloy-Coated Soft Copper Wire for Electrical Purposes, B 189; the Standard Specification for Compact Round Concentric-Lay-Stranded Copper Conductors, B 496; or the Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation, B 787; as applicable. Metric sizes complying with Conductors of Insulated Cables, IEC 60228 are acceptable.

4.3 Stranding

4.3.1 Except as specified in 4.3.2 – 4.3.5, the conductors shall be stranded Class B concentric conductors, as specified in the Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft, ASTM B 8. See Table 4.1.

Table 4.1
Construction and resistance of standard Class B concentric conductors

Conductor size			Class B stranding		Maximum dc resistance (Ω /km at 20°C)	
Area in circular mils	AWG or kcmil	Number of wires	Diameter of strand wire mm (mils)	Conductor diameter mm (in)	Uncoated	Alloy coated or tinned
640	22	7	0.240 (9.6)	0.7 (0.0288)	55.4	59.4
1 020	20	7	0.310 (12.1)	0.9 (0.0363)	34.6	36.7
1 620	18	7	0.386 (15.2)	1.2 (0.0456)	21.8	23.2
2 580	16	7	0.488 (19.2)	1.5 (0.0576)	13.7	14.6
4 110	14	7	0.615 (24.2)	1.8 (0.0726)	8.62	8.96
6 530	12	7	0.755 (30.5)	2.3 (0.0915)	5.43	5.64
10 380	10	7	0.987 (38.5)	2.9 (0.116)	3.41	3.55
16 510	8	7	1.234 (48.6)	3.7 (0.146)	2.14	2.23
20 820	7	7	1.384 (54.5)	4.2 (0.164)	1.70	1.77
26 240	6	7	1.554 (61.2)	4.8 (0.184)	1.35	1.40
33 090	5	7	1.748 (68.8)	5.2 (0.206)	1.07	1.11
41 740	4	7	1.961 (77.2)	5.9 (0.232)	0.848	0.882
52 620	3	7	2.202 (86.7)	6.6 (0.260)	0.673	0.700
66 360	2	7	2.474 (97.4)	7.4 (0.292)	0.534	0.555
83 690	1	19	1.687 (66.4)	8.4 (0.332)	0.423	0.440
105 600	1/0	19	1.892 (74.5)	9.5 (0.373)	0.335	0.349
133 100	2/0	19	2.126 (83.7)	10.6 (0.419)	0.266	0.277
167 800	3/0	19	2.386 (94.0)	11.9 (0.470)	0.211	0.219
211 600	4/0	19	2.680 (105.5)	13.4 (0.528)	0.167	0.172
250 000	250	37	2.088 (82.2)	14.6 (0.575)	0.142	0.147
300 000	300	37	2.286 (90.0)	16.0 (0.630)	0.118	0.123
350 000	350	37	2.471 (97.3)	17.3 (0.681)	0.101	0.105

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Table 4.1 Continued

Conductor size			Class B stranding		Maximum dc resistance (Ω /km at 20°C)	
Area in circular mils	AWG or kcmil	Number of wires	Diameter of strand wire mm (mils)	Conductor diameter mm (in)	Uncoated	Alloy coated or tinned
400 000	400	37	2.642 (104.0)	18.5 (0.728)	0.0885	0.0911
500 000	500	37	2.951 (116.2)	20.7 (0.813)	0.0708	0.0729
600 000	600	61	2.520 (99.2)	22.7 (0.893)	0.0590	0.0614
750 000	750	61	2.817 (110.9)	25.3 (0.998)	0.0472	0.0486
1 000 000	1000	61	3.251 (128.0)	29.2 (1.152)	0.0354	0.0364
1 250 000	1250	91	2.977 (117.2)	32.7 (1.289)	0.0283	0.0292
1 500 000	1500	91	3.261 (128.4)	37.0 (1.459)	0.0236	0.0243
2 000 000	2000	127	3.187 (125.5)	41.5 (1.632)	0.0177	0.0182

4.3.2 Class B stranded conductors, compressed to a reduction in diameter of 3 percent maximum of concentric stranded conductors, shall also be permitted.

4.3.3 Unilay stranded conductors complying with the Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation, ASTM B 787 shall also be permitted.

4.3.4 Flexible rope lay stranded conductors may be substituted for concentric conductors. Bunch-stranded conductors in sizes 6 AWG and smaller may be substituted for concentric stranded conductor. See Table 4.2.

Table 4.2
Construction and resistance of flexible stranded conductors

		Nominal stranding				Maximum dc resistance					
Conductor area in circular mils	AWG or kcmil	Number of wires	Individual strand dia. (in)	mm ²	Max conductor dia. (in)	Ohms per 1000 ft at 25°C		Ohms per 1000 ft at 20°C		Ohms per km at 20°C	
						Bare	Coated	Bare	Coated	Bare	Coated
1900	18	19	0.0100	0.96	0.049	6.95	7.21	6.82	7.06	22.4	23.2
2601	16	19	0.0117	1.32	0.059	4.27	4.52	4.19	4.43	13.7	14.5
4106	14	19	0.0147	2.08	0.074	2.68	2.85	2.63	2.79	8.63	9.15
6503	12	19	0.0185	3.29	0.093	1.69	1.79	1.66	1.75	5.45	5.74
10 319	10	37	0.0167	5.23	0.113	1.09	1.13	1.07	1.11	3.51	3.63
14 948	8	37	0.0201	7.57	0.136	0.669	0.694	0.656	0.679	2.15	2.23
24 645	6	61	0.0201	12.49	0.175	0.421	0.436	0.413	0.427	1.36	1.40
41 668	4	133	0.0177	21.11	0.258	0.276	0.286	0.271	0.280	0.889	0.918
66 140	or 4	105	0.0201	33.51	0.324	0.169	0.175	0.166	0.171	0.545	0.561
	or 2	150	0.0201								
84 438	1	209	0.0201	42.79	0.361	0.135	0.140	0.132	0.137	0.433	0.449
107 467	1/0	266	0.0201	54.45	0.407	0.107	0.111	0.105	0.109	0.344	0.358
138 172	2/0	342	0.0201	70.01	0.461	0.0853	0.0885	0.0837	0.0866	0.275	0.284
168 876	3/0	418	0.0201	85.57	0.510	0.0682	0.0702	0.0669	0.0687	0.219	0.225
214 933	4/0	532	0.0201	108.91	0.575	0.0538	0.0557	0.0528	0.0545	0.173	0.179
260 991	262	646	0.0201	132.25	0.654	0.0444	0.0460	0.0436	0.0450	0.143	0.148
313 916	313	777	0.0201	159.06	0.720	0.0371	0.0384	0.0364	0.0376	0.119	0.123

Table 4.2 Continued

		Nominal stranding				Maximum dc resistance					
Conductor area in circular mils	AWG or kcmil	Number of wires	Individual strand dia. (in)	mm ²	Max conductor dia. (in)	Ohms per 1000 ft at 25°C		Ohms per 1000 ft at 20°C		Ohms per km at 20°C	
						Bare	Coated	Bare	Coated	Bare	Coated
373 709	373	925	0.0201	189.36	0.785	0.0308	0.0320	0.0302	0.0313	0.0991	0.103
448 451	444	1110	0.0201	227.23	0.860	0.0260	0.0270	0.0255	0.0264	0.0836	0.0866
538 141	535	1332	0.0201	272.68	0.941	0.0216	0.0224	0.0212	0.0219	0.0695	0.0718
642 780	646	1591	0.0201	325.70	1.029	0.0179	0.0186	0.0176	0.0182	0.0577	0.0597
777 315	777	1924	0.0201	393.87	1.132	0.0149	0.0154	0.0146	0.0151	0.0479	0.0495
1 109 008	1111	2745	0.0201	561.94	1.354	0.0102	0.0106	0.0100	0.0104	0.0328	0.0341
NOTE – The total number of wires should be as specified ±1% providing that the maximum conductor diameter and conductor resistance does not exceed the values indicated.											
Tolerance for maximum resistance ^a											
Single conductor						$R_{\max}$ = value from Table 4.2					
Multiple conductor cable											
One layer of conductors						$R_{\max}$ = value from Table 4.2 × 1.02					
More than one layer of conductors						$R_{\max}$ = value from Table 4.2 × 1.03					
Pairs or other precabled units						$R_{\max}$ = value from Table 4.2 × 1.04					
More than one layer of pairs or other precabled units						$R_{\max}$ = value from Table 4.2 × 1.05					
^a From NEMA WC-55											
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4.3.5 Compact round concentric lay stranded copper conductors complying with the Standard Specification for Compact Round Concentric-Lay-Stranded Copper Conductors, ASTM B 496 shall also be permitted. See Table 4.3.

Table 4.3
Construction and resistance of stranded compact concentric conductors

Conductor size		Compact stranding		Maximum dc resistance Ω/km at 20°C	
Area in circular mils	AWG or kcmil	Number of wires	Conductor diameter mm (in)	Uncoated	Alloy coated or tinned
16 510	8	7	3.4 (0.134)	2.14	2.23
26 240	6	7	4.3 (0.169)	1.35	1.40
41 740	4	7	5.4 (0.213)	0.848	0.881
66 360	2	7	6.8 (0.268)	0.533	0.554
83 690	1	19 ^a	7.6 (0.299)	0.423	0.440
105 600	1/0	19 ^a	8.5 (0.336)	0.335	0.348
133 100	2/0	19 ^a	9.6 (0.376)	0.266	0.276
167 800	3/0	19 ^a	10.7 (0.423)	0.211	0.219
211 600	4/0	19 ^a	12.1 (0.475)	0.167	0.172
250 000	250	37 ^b	13.2 (0.520)	0.142	0.147
300 000	300	37 ^b	14.5 (0.570)	0.118	0.123
350 000	350	37 ^b	15.7 (0.616)	0.101	0.105
400 000	400	37 ^b	16.7 (0.659)	0.0884	0.0910
500 000	500	37 ^b	18.7 (0.736)	0.0708	0.0728
600 000	600	61 ^c	20.7 (0.813)	0.0590	0.0613
750 000	750	61 ^c	23.1 (0.908)	0.0472	0.0486

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Table 4.3 Continued

Conductor size		Compact stranding		Maximum dc resistance Ω/km at 20°C	
Area in circular mils	AWG or kcmil	Number of wires	Conductor diameter mm (in)	Uncoated	Alloy coated or tinned
1 000 000	1000	61 ^c	26.9 (1.060)	0.0354	0.0364
^a 18 wires minimum. ^b 35 wires minimum. ^c 58 wires minimum. To convert from kg/km to lb/1000 ft multiply number $\times 0.672$. To convert from Ω/km to $\Omega/1000$ ft multiply number $\times 0.3048$.					

4.4 Joints

4.4.1 Joints in the individual wires of a stranded conductor shall neither increase the diameter nor substantially decrease the strength of the conductor or the individual wire. Joints in stranded conductors larger than 16 AWG shall only be permitted in the individual wires of the strand. The distance between brazes or welds in individual strand wires shall be not less than 0.3 m (1 ft) of conductor.

4.4.2 For rope-lay stranded conductors, a stranded member (primary group) may be jointed as a unit; these joints shall not be closer than two lay lengths.

4.4.3 Joints in stranded conductors 16 AWG and smaller may be made in the whole conductor, provided that the solid section of the braze or weld does not exceed 13 mm (0.5 in) in length and the distance between brazes or welds is greater than 1000 m (3280 ft).

4.5 Conductor stress control layer (for cables rated above 2 kV)

4.5.1 The conductor stress control layer shall be an extruded semiconducting material of a thickness as shown in the Standard for Medium-Voltage Power Cables, UL 1072. This layer shall be applied over the surface of the conductor and bonded to the inner surface of the insulation. The conductor stress control layer material shall be compatible with all materials into which it comes in contact.

4.5.2 The contact surface between the conductor stress control layer and the insulation shall be cylindrical and free from protrusions and irregularities that extend more than 0.13 mm (0.005 in) into the insulation or more than 0.25 mm (0.01 in) into the conductor stress control layer.

4.5.3 The conductor stress control layer shall have a maximum volume resistivity of 1000 $\Omega \cdot \text{m}$ at 90 ± 1 °C (194 ± 1.8 °F), and other physical properties in accordance with the Standard for Medium-Voltage Power Cables, UL 1072.

4.5.4 The extruded conductor stress control layer may be supplemented by a semiconducting tape applied directly over the conductor. The maximum dc resistance of the semiconducting tape at room temperature shall be 10 000 Ω per unit square, when determined in accordance with the Standard Test Method for D-C Rated Resistance or Conductance of Moderately Conductive Materials, ASTM D 4496.

4.5.5 The extruded conductor stress control layer material shall have a brittleness temperature not warmer than -25°C (-13°F) when tested in accordance with the Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact, ASTM D 746.

4.5.6 The conductor stress control layer shall be easily removable from the conductor when terminating or splicing.

5 Insulation

Section 5 effective August 1, 2013

5.1 General

5.1.1 The insulation shall be one of the following types:

Marking code symbol	Material	Maximum conductor operating temperature $^{\circ}\text{C}$
T75	Polyvinyl chloride	75
TPE90	Thermoplastic elastomer	90
T/N90	Polyvinyl chloride/nylon	90
E90	Ethylene propylene rubber	90
X90	Cross-linked/polyolefin	90
X100	Cross-linked/polyolefin	100
X110	Cross-linked/polyolefin	110
X100P	Cross-linked/polyolefin for special applications	100
X110P	Cross-linked/polyolefin for special applications	110
S100	Silicone rubber	100
Note – The maximum short circuit temperature of all thermoplastic materials is 150°C , and of the thermoset materials is 250°C .		

5.2 Separator

5.2.1 Where required to ensure free stripping, a suitable opaque separator tape may be applied to the conductor of a cable rated 2 kV or less.

5.3 Thickness of extruded insulation

5.3.1 The average thickness of the insulation shall not be less than the values given in Table 5.1.

5.3.2 The minimum thickness of the insulation at any point shall not be less than 90 percent of the average value shown in Table 5.1.

5.3.3 For silicone insulated conductor sizes larger than 8 AWG, refer to the General Specification for Cable and Cord, Electrical, Low Smoke, for Shipboard Use, MIL-C-24643 for construction details using silicone impregnated tape insulation.

Table 5.1
Thickness of extruded insulations for distribution, control, and signal cables

Rated voltage phase to phase (V)	Conductor size (AWG or kcmil)	Average insulation thickness, mm (mils)			
		Types X90, X100, X100P, X110, X110P, E90	Type S100 Silicone rubber	Types T75 PVC, TPE90 Thermoplastic Elastomer	Types T/N90 PVC/ Nylon
0 – 300	22 – 19	0.28 (15)	0.87 (35)	0.50 (20)	0.37/0.10 (15/4)
	18 – 16	0.50 (20)	0.87 (35)	0.50 (20)	0.37/0.10 (15/4)
0 – 600/1000	18 – 11	0.76 (30)	1.14 (45)	1.14 (45)	0.37/0.10 (15/4)
	10 – 9	0.76 (30)	1.14 (45)	1.14 (45)	0.50/0.10 (20/4)
	8 – 5	1.14 (45)	1.50 (60)	1.50 (60)	0.76/0.13 (30/5)
	4 – 2	1.14 (45)	1.50 (60)	1.50 (60)	1.00/0.15 (40/6)
	1 – 4/0	1.37 (55)	2.00 (80)	2.00 (80)	1.25/0.18 (50/7)
	225 – 500	1.62 (65)	2.37 (95)	2.37 (95)	1.50/0.20 (60/8)
	525 – 1000	2.00 (80)	2.75 (110)	2.75 (110)	1.75/0.23 (70/9)
	1100 – 2000	2.37 (95)	–	–	–
1001 – 2000	14 – 9	1.14 (45)			
	8 – 2	1.37 (55)			
	1 – 4/0	1.62 (65)			
	225 – 500	1.87 (75)			
	525 – 1000	2.25 (90)			
2400 (unshielded)	1100 – 2000	2.75 (110)			
	8 – 1000	2.25 (90)			
5 kV – 35 kV shielded	See the Standard for Medium-Voltage Power Cables, UL 1072 for dimensions.				