

**Underwriters Laboratories Inc.®**A not-for-profit organization dedicated to public safety
and committed to quality service**December 5, 1995****Revision pages for****Standard for****Electrical Cables for Boats****UL 1426, Second Edition**

Attached to this transmittal notice is a reprinted title page for the Second edition of UL 1426.

THIS REVISION IS BEING ISSUED TO CORRECT PARAGRAPHS 21.4 AND 23.1, TABLES 5.1, 12.1, 20.1, 20.2, AND 21.1. THE REQUIREMENTS ARE NOW IN EFFECT.

Attention is directed to the note on the title page of this standard outlining the procedure to be followed to retain the approved text of ANSI/UL 1426-1995.

Revised and/or additional pages may be issued from time to time.

With the inclusion of the accompanying material, the standard consists of pages dated as shown in the following checklist:

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1	April 28, 1994 (Reprinted December 5, 1995)
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3, 4	April 28, 1994
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UL 1426**Standard for****Electrical Cables for Boats**

First Edition – December, 1986

Second Edition**April 28, 1994**

Approval as an American National Standard (ANSI) covers the numbered paragraphs on pages dated April 28, 1994 and December 5, 1995. These pages should not be discarded when revised or additional pages are issued if it is desired to retain the ANSI approved text.

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

Approved as ANSI/UL 1426-1987, October 19, 1987

Approved as ANSI/UL 1426-1995, August 24, 1995

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 published set of revision pages.

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INTRODUCTION

1 Scope

1.1 These requirements cover electrical cables for boats. The cables are intended for use in marine pleasure craft and consist of a single insulated conductor without a jacket or of two or more insulated conductors with or without an overall nonmetallic jacket. Each boat cable is rated as follows: 50 or 600 V; 60°C (140°F) or 75°C (167°F) wet; and 60°C (140°F), 75°C (167°F), 90°C (194°F), or 105°C (221°F) dry. Boat cable dry-rated 125°C (257°F) or 200°C (392°F) may be investigated. A boat cable so marked has insulation (and jacket if a jacket is used) that are for use where exposed to oil at 60°C (140°F) and lower temperatures. Boat cables employ stranded copper conductors that are Nos. 18 – 4/0 AWG for multiple conductors and Nos. 16 – 4/0 AWG for single conductors.

1.2 The construction and performance details of single-conductor 50-volt cables are outlined in the Society of Automotive Engineers, Inc. Standard for Battery Cable (SAE J1127), Low-Tension Primary Cable (SAE J1128), and Recommended Practice for Marine-Engine Wiring (SAE J378b). The cables covered in the Standard are in compliance with the American Boat and Yacht Council (ABYC) Standard E-9. The marking and optional jacket requirements for 50-volt cables, and the complete construction, performance, and marking requirements for single- and multiple-conductor boat cables rated 600 volts are stated in these requirements.

1.2 revised December 5, 1995

1.3 The ampacity of a boat cable shall be as stated in the US Coast Guard regulations Title 33, Chapter I, Parts 183.430 and 183.435 of the CFR.

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 acceptable 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 may be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this Standard.

2 Units of Measurement

2.1 If a value for measurement is followed by a value in other units in parentheses, the second value may be only approximate. The first stated value is the requirement. 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 The reference to SAE standards is to the latest editions.

CONSTRUCTION

4 Conductors

4.1 The conductors shall be stranded annealed copper, Nos. 18 – 4/0 AWG. The No. 18 AWG size is limited to a jacketed multiple-conductor cable and shall employ 16 or more strands. All other conductor sizes shall employ 19 or more strands. Conductors may be coated with tin or a tin/lead alloy.

5 Insulation

5.1 The insulation shall be any of the PVC insulation materials having a wet rating in the Standard for Thermoplastic-Insulated Wires and Cables (UL 83). In addition, the insulation in a cable that is marked as being oil-resistant shall comply with the requirements for 60°C (140°F) oil resistance in UL 83. The average and minimum-at-any-point thicknesses shall comply with one of the constructions in Table 5.1 or 5.2. Insulated conductors employing other insulation, wall thicknesses, or temperature ratings may be investigated.

Table 5.1
Insulation thickness

Conductor size	Construction A 75°C (167°F) dry 60°C (141°F) wet				Construction B 90°C (194°F) dry 75°C (167°F) wet				Construction C 90°C (194°F) dry 75°C (167°F) wet			
	Minimum acceptable average thickness		Minimum acceptable thickness at any point		Minimum acceptable average thickness		Minimum acceptable thickness at any point		Minimum acceptable average thickness		Minimum acceptable thickness at any point	
	Mils	mm	Mils	mm	Mils	mm	Mils	mm	Mils	mm	Mils	mm
18 – 10 AWG	30	0.76	27	0.69	30	0.76	27	0.69	45	1.14	40	1.02
8	45	1.14	40	1.02	45	1.14	40	1.02	60	1.52	54	1.37
6 – 2	60	1.52	54	1.37	60	1.52	54	1.37	60	1.52	54	1.37
1 – 4/0	80	2.03	72	1.83	80	2.03	72	1.83	80	2.03	72	1.83

Table 5.1 revised December 5, 1995

12 Heat-Shock Test

12.1 Neither the insulation nor the jacket shall crack or check as a result of being wound onto a mandrel and then heated in air as indicated in 12.2.

12.2 Specimens of finished cable and of the insulated conductors taken from finished cable are to be wound tightly, with adjacent turns touching, onto metal mandrels. The size of the mandrels and number of turns wound are to be as indicated in Table 12.1 for the test of the individual conductors. For the test of the complete cable, a mandrel five times the measured overall diameter of the complete cable or the length of the minor axis of a flat cable shall be used. The cable is to be wrapped for not less than 180° around the mandrel. The ends of each specimen are to be secured to the mandrels and the assemblies placed in a full-draft circulating-air oven operating at a temperature of $121.0 \pm 1.0^{\circ}\text{C}$ ($249.8 \pm 1.8^{\circ}\text{F}$) for one hour.

Table 12.1
Mandrel diameters and number of turns

Size of conductor	Mandrel diameter		Number of turns
	Inches	Millimeters	
18, 16 AWG	0.094	2	4
14	0.131	3	4
12	0.148	4	4
10	0.168	4	4
8	0.228	6	
6	0.646	16	4
4	0.744	19	4
3	0.802	20	4
2	0.866	22	4
1	1.016	26	4
1/0	1.098	28	180-degree U bend
2/0	1.190	30	180-degree U bend
3/0	1.294	33	180-degree U bend
4/0	1.410	36	180-degree U bend

Table 12.1 revised December 5, 1995

13 Flexibility Test

13.1 Within 16 – 96 hours after oven treatment under the conditions described in 10.1, the insulation shall not show any cracks on its inside or outside surfaces when a specimen of finished cable at room temperature is wound onto a mandrel using the method described in 15.2 and 15.3. The mandrel diameter shall be as specified in Table 15.1.

14 Deformation Test

14.1 Neither the insulation nor the jacket from finished cable shall decrease more than 50 percent in thickness while at a temperature of $121.0 \pm 1.0^{\circ}\text{C}$ ($249.8 \pm 1.8^{\circ}\text{F}$) under the pressure indicated in Table 14.1.

14.2 One-inch or 25-mm specimens of the finished insulated conductor on which the thickness of insulation (T_1) has been determined by the difference method are to be used for tests of the insulation.

14.3 For tests of the jacket, specimens that are 1 inch by 9/16 inch wide or 25 by 14 mm are to be cut from an 8-inch or 200-mm sample of jacket taken from a length of finished cable, but, before the specimens are cut, the sample is to be buffed:

- a) To remove all traces of the impressions left by the assembly underlying the jacket, and
- b) To make sure that the specimens cut from the sample have a uniform thickness. The thickness (T_1) of the buffed specimen is to be determined (with no weight added) by means of a dead-weight dial micrometer having a flat-faced presser foot 0.250 ± 0.010 inch or 6.4 ± 0.2 mm or 0.375 ± 0.010 inch or 9.5 ± 0.2 mm in diameter. The anvil of the instrument is to be at least 1.5 inches or 38 mm in diameter and is to be parallel to the face of the presser foot.

14.4 Weight is to be added to the spindle of the dial micrometer to make the presser foot exert the force indicated in Table 14.1 on a specimen if a specimen were in place between the foot and anvil. The micrometer, with the presser foot so loaded, is to be placed beside a test specimen in a full-draft circulating-air oven that has been preheated at full draft to a temperature of $121.0 \pm 1.0^\circ\text{C}$ ($249.8 \pm 1.8^\circ\text{F}$). The specimen and the micrometer are to remain in the oven for one hour of preheating at full draft.

14.5 At the end of one hour, the specimen is to be placed on the anvil directly under the weighted presser foot. The specimen and micrometer are to remain in the heated oven at full draft for an additional hour. At the end of the second hour, the thickness (T_2) is to be read from the dial micrometer. If T_2 is less than half of T_1 , the insulation or the jacket is not acceptable.

Table 14.1
Specimen loading

Size of specimen	Load exerted on specimen by presser foot ^a	
	Grams force	Newtons
18, 16 AWG	400	3.92
14 – 8	500	4.90
6 – 1	750	7.36
1/0 – 4/0	1000	9.81
Cable jackets	2000	19.61

^a The specified load is not the weight to be added to the spindle of the dead-weight dial micrometer but rather the total of the weight added and the weight of the spindle. Since the weight of the spindle varies from one dial micrometer to another, specifying the exact weight to be added to the spindle to achieve the specified load on the specimen is impractical in all cases except for an individual instrument.

15 Cold-Bend Test

15.1 Neither the insulation nor the jacket shall crack or check as a result of being cooled in air and then wound onto a mandrel as indicated in 15.2 and 15.3.

19 Dielectric Voltage-Withstand Test and Alternatives

19.1 The insulation on the conductors in full-length coils or reels of finished cable shall withstand a 60-second application of the 48 – 62 Hertz essentially sinusoidal potential indicated in Table 19.1. The potential shall be applied successively between each conductor and all of the other conductors connected together. The equipment and the method of test are to be as indicated in Section 820 of UL 1581 but the cable is not to be immersed in water.

19.2 For routine production testing at the factory, 15-second rather than 60-second applications may be used, or a spark test may be substituted for the dielectric voltage-withstand test between conductors. If the spark test is used, the insulated conductors are to be spark tested at the voltage specified in Table 20.1, as single conductors before being assembled into the cable, or as twisted groups immediately after being cabled and before being assembled into the cable. The equipment and the method of spark testing are to be as indicated in Section 900 of UL 1581.

Table 19.1
Dielectric voltage-withstand and
spark-test potentials

Size of conductor	Dielectric voltage-withstand test potential	Spark-test potential
18 – 10	1500 volts	7,500 volts
8 – 2	2000	10,000
1 – 4/0	2500	10,000

20 Insulation Resistance Test at 60.0°F (15.6°C)

20.1 The insulation shall result in the finished cable having an insulation resistance of not less than the number of megohms, based on 1000 conductor feet, or not less than the number of megohms, based on a conductor kilometer, indicated in Table 20.1 when the cable is tested under the following conditions. The cable shall be immersed in tap water at 60.0°F (15.6°C) for not less than 6 hours, following which it shall be tested for insulation resistance while still immersed. This test is to be conducted immediately following the dielectric voltage-withstand test. The coil or coils shall be earth-grounded and completely discharged previous to the measurement of insulation resistance.

20.2 The insulation-resistance test equipment and procedures shall be acceptable and applicable but otherwise are not specified. A megohm bridge used for this purpose shall be of applicable range and calibration, shall present readings that are accurate to 3 percent or less of full scale, and shall have a 125-volt or higher open-circuit potential.

20.3 The sample for the room-temperature test is to be brought out well above the water level in the tank. It is acceptable to dip the bared insulation at the ends in melted paraffin to keep moisture from forming a conductive path from the conductor metal across the surfaces of the insulation and to the water. The coil or reel is then to remain immersed in water for not less than 6 hours before the test is conducted. The water temperature is to be maintained within $\pm 1.0^{\circ}\text{C}$ ($\pm 1.8^{\circ}\text{F}$) of being constant at any temperature in the range of $10.0 - 26.7^{\circ}\text{C}$ ($50.0 - 80.0^{\circ}\text{F}$) for the entire 6 hours or longer immersion previous to the measurement of the insulation resistance (see 21.1 and note ^a to Table 20.2).

20.4 The temperature of the water in which the coil is immersed has a marked effect upon the insulation resistance and, if the temperature at which the readings are taken (see 20.3) is other than 60.0°F (15.6°C), the readings are to be multiplied by the applicable correction factor from Table 20.2. One of the four columns in the table is assigned to all PVC insulation compounds. If a compound cannot be made to fit into any of the four patterns (columns), applicable temperature-correction factors are to be determined.

Table 20.1
Minimum acceptable insulation resistance
in megohms at 60.0°F (15.6°C)

Conductor	Based on 1000 conductor feet					Conductor	Based on a conductor kilometer				
	Construction						Construction				
	A	B	C	D	E		A	B	C	D	E
18 AWG	195	785	1025	1590	970	18 AWG	65	240	315	485	300
16	170	680	890	1360	815	16	55	210	275	415	250
14	140	575	765	1150	665	14	45	180	235	355	205
12	120	485	650	970	560	12	40	150	200	300	175
10	100	400	550	805	580	10	35	125	170	250	180
8	105	415	520	835	595	8	35	130	160	255	185
6	105	435	435	870	495	6	35	135	135	265	155
4	90	360	360	725	505	4	30	115	115	225	155
3	80	325	325	655	465	3	25	110	110	205	145
2	75	295	295	595	415	2	25	95	95	175	130
1	85	340	340	680	455	1	30	105	105	155	140
1/0	75	310	310	620	415	1/0	25	95	95	190	130
2/0	70	280	280	560	370	2/0	25	85	85	175	115
3/0	60	250	250	505	330	3/0	20	80	80	155	105
4/0	55	225	225	455	300	4/0	20	70	70	140	95

Table 20.1 revised December 5, 1995

Table 20.2
Factors for correcting insulation resistance to 60.0°F (15.6°C)

Temperature ^a		Correction factor			
°F	°C	I	II	III	IV
50	10.0	0.35	0.4	0.46	0.56
51	10.6	0.39	0.46	0.50	0.59
52	11.1	0.43	0.50	0.54	0.63
53	11.7	0.48	0.55	0.58	0.67
54	12.2	0.54	0.60	0.63	0.70
55	12.8	0.60	0.65	0.68	0.75
56	13.3	0.66	0.71	0.74	0.79
57	13.9	0.73	0.78	0.80	0.84
58	14.4	0.82	0.85	0.86	0.90
59	15.0	0.90	0.92	0.93	0.95
60	15.6	1.00	1.00	1.00	1.00
61	16.1	1.11	1.09	1.08	1.06
62	16.7	1.24	1.19	1.17	1.13
63	17.2	1.38	1.30	1.26	1.19
64	17.8	1.53	1.41	1.36	1.26
65	18.3	1.70	1.54	1.47	1.34
66	18.9	1.88	1.69	1.59	1.42
67	19.4	2.09	1.84	1.72	1.51
68	20.0	2.31	1.99	1.85	1.60
69	20.6	2.57	2.18	2.00	1.69
70	21.1	2.85	2.38	2.17	1.79
71	21.7	3.17	2.59	2.34	1.90
72	22.2	3.52	2.82	2.53	2.02
73	22.8	3.90	3.08	2.72	2.14
74	23.3	4.31	3.35	2.94	2.27
75	23.9	4.78	3.65	3.18	2.40
76	24.4	5.30	3.98	3.43	2.54
77	25.0	5.88	4.34	3.70	2.70
78	25.6	6.51	4.73	4.00	2.86
79	26.1	7.27	5.16	4.33	3.03
80	26.7	8.07	5.61	4.67	3.21
81	27.2	8.98	6.12	5.04	3.40
82	27.8	9.92	6.69	5.45	3.60
83	28.3	11.0	7.28	5.89	3.82
84	28.9	12.2	7.92	6.35	4.05
85	29.4	13.5	8.67	6.84	4.30

^a The temperature of the water in which the coils are immersed at the time that the insulation-resistance readings are taken is the basis for the selection of the temperature-correction factor. If, because of hot or cold weather or local conditions, the temperature of the insulation to be tested differs by more than 5.0°F (2.8°C) from the temperature of the water in which the insulation is to be immersed, the test results after a 6-hour immersion are not accurate unless one of the following is accomplished before insulation-resistance readings are taken:

A. The cable is to be left in the water long enough to attain the same temperature as the water. The water and the cable immersed in it are to be considered to be at the same temperature when three successive measurements of the d-c resistance of the conductor made at 30-minute intervals show no change.

B. The water is to be heated or cooled, as necessary, to within 5.0°F (2.8°C) of the temperature of the cable before the cable is immersed for at least 6 hours.

Table 20.2 revised December 5, 1995

21 Insulation Resistance Test at Elevated Temperature

21.1 The insulation on the individual conductors of boat cable shall result in the finished cable having an insulation resistance in tap water at 50°C (122°F), for insulation rated 60°C wet, and at 75°C (167°F), for insulation rated 75°C wet, that is not less than the number of megohms based on 1000 conductor feet, or the number of megohms based on a conductor kilometer, specified in Table 21.1, at any time during immersion under the following conditions. The period of immersion shall be 12 weeks or more if the insulation resistance throughout the last 6 weeks of the period is higher than 10 megohms based on 1000 conductor feet or is higher than 3 megohms based on a conductor kilometer. The period of immersion shall be 24 – 36 weeks if the insulation resistance is less than 10 megohms based on 1000 conductor feet or 3 megohms based on a conductor kilometer but more than the value indicated in Table 21.1. An essentially sinusoidal rms potential of 600 volts at 48 – 62 Hertz shall be applied to the insulation at all times other than while readings of insulation resistance are being taken. See also 21.3 covering the maximum acceptable rate of decrease of the insulation resistance.

21.2 The values in Table 21.3 apply only to the construction with insulations of the materials and in the thickness indicated in Tables 5.1 and 5.2. For other thicknesses of the same materials, and for other materials in any thickness, the insulation-resistance values are to be calculated by means of whichever of the following formulas is applicable.

Construction A:

$$IR_{50^{\circ}\text{C}} = K_{15.6^{\circ}\text{C}} \times 6.63 \times 10^{-4} \times \log_{10} \frac{\text{DIA}}{\text{dia}}$$

Constructions B and C:

$$IR_{75^{\circ}\text{C}} = K_{15.6^{\circ}\text{C}} \times 6.63 \times 10^{-4} \times \log_{10} \frac{\text{DIA}}{\text{dia}}$$

Constructions D and E:

$$IR_{75^{\circ}\text{C}} = K_{15.6^{\circ}\text{C}} \times 1.74 \times 10^{-4} \times \log_{10} \frac{\text{DIA}}{\text{dia}}$$

in which IR at 50°C (122°F) or 75°C (167°F) is the insulation resistance in megohms based on 1000 conductor feet at 50°C (122°F) or 75°C (167°F), K is the constant for the insulation material at 15.6°C (60.0°F) in megohms based on 1000 conductor feet, 6.63×10^{-4} is the multiplier necessary for reducing K at 15.6°C (60.0°F) to the value it would have at 50°C (122°F) or 75°C (167°F) for constructions A and B and C, 1.74×10^{-4} is the multiplier necessary for reducing K at 15.6°C to the value it would have at 75°C (167°F) for constructions D and E, DIA is the diameter over the insulation in inches, and dia is the diameter of the metal conductor in inches; or

Construction A:

$$IR_{50^{\circ}\text{C}} = K_{15.6^{\circ}\text{C}} \times 2.02 \times 10^{-4} \times \log_{10} \frac{\text{DIA}}{\text{dia}}$$

Constructions B and C:

$$IR_{75^{\circ}\text{C}} = K_{15.6^{\circ}\text{C}} \times 2.02 \times 10^{-4} \times \log_{10} \frac{\text{DIA}}{\text{dia}}$$

Constructions D and E:

$$IR_{75^{\circ}\text{C}} = K_{15.6^{\circ}\text{C}} \times 5.30 \times 10^{-5} \times \log_{10} \frac{\text{DIA}}{\text{dia}}$$

in which IR at 50°C (122°F) or 75°C (167°F) is the insulation resistance in megohms based on a conductor kilometer at 50°C (122°F) or 75°C (167°F), K is the constant for the insulation material at 15.6°C (60.0°F) in megohms based on 1000 conductor feet, 2.02×10^{-4} is the multiplier necessary for reducing K at 15.6°C (60.0°F) in megohms based on 1000 conductor feet to the value it would have at 50°C (122°F) or 75°C (167°F) for constructions A and B and C, 5.30×10^{-5} is the multiplier necessary for reducing K at 15.6°C (60.0°F) in megohms based on 1000 conductor feet to the value it would have at 75°C (167°F) based on a conductor kilometer for constructions D and E, DIA is the diameter over the insulation in millimeters, and dia is the diameter of the metal conductor in millimeters. For example, the insulation resistance of a No. 8 AWG wire of construction A with an average thickness of insulation of 0.060 inch would be calculated as follows:

dia of No. 8 AWG conductor = 0.146 inch

DIA = dia + 2 x (insulation thickness)

= 0.146 + 2 x (.060) = 0.266 inch

Construction A:

$$IR_{50^{\circ}\text{C}} = K_{15.6^{\circ}\text{C}} \times 6.63 \times 10^{-4} \times \log_{10} \frac{\text{DIA}}{\text{dia}}$$

$$= 500 \times 6.63 \times 10^{-4} \times \log_{10} \frac{0.266}{0.146}$$

= 0.086 megohm based on 1000 conductor feet

This value rounded down to 0.085 megohms based on 1000 conductor feet would be the requirement for insulation resistance at 50°C (122°F).

21.3 The insulation mentioned in 21.1 shall also have the effect that, during the extended immersion at 50°C (122°F) or 75°C (167°F), the maximum decrease in insulation resistance per week, as determined from a curve (drawn to represent the average of actual values), for every continuous period of 3 weeks during the latter half of the specified immersion time is not more than 4 percent if and while the insulation resistance on the basis of 1000 conductor feet is 10 megohms or more (3 megohms or more based on a conductor kilometer); and is not more than 2 percent if and while the insulation resistance is less than 10 megohms based on 1000 conductor feet (less than 3 megohms based on a conductor kilometer) but more than the value indicated in Table 21.1.

21.4 To determine whether or not the insulation complies with the requirements in 21.1 and 21.3, the insulation is to be tested with the apparatus and according to the methods described in 20.2 – 20.4. The ends of a specimen are to be brought well away from the tank, and the temperature of the water is to be maintained at 50.0 ± 1.0°C (122.0 ± 1.8°F) or 75.0 ± 1.0°C (167.0 ± 1.8°F). A coil that shows a greater percent decrease in insulation resistance during the extended immersion than specified in 21.3 may be tested for additional 1-week immersion periods and judged on the basis of the results for every continuous period of 3 weeks, during the last 12 weeks of immersion, provided that the final insulation resistance is not less than specified in Table 21.1.

21.4 revised December 5, 1995

Table 21.1
Minimum acceptable insulation resistance in megohms

AWG conductor size	Based on 1000 conductor feet					AWG conductor size	Based on a conductor kilometer				
	Construction						Construction				
	A	B	C	D	E		A	B	C	D	E
18	0.130	0.520	0.680	0.275	0.165	18	0.015	0.050	0.065	0.030	0.020
16	0.110	0.450	0.590	0.235	0.140	16	0.015	0.045	0.055	0.025	0.015
14	0.095	0.380	0.505	0.200	0.115	14	0.010	0.040	0.050	0.020	0.015
12	0.080	0.320	0.430	0.165	0.095	12	0.010	0.030	0.040	0.020	0.010
10	0.065	0.265	0.365	0.140	0.100	10	0.010	0.025	0.035	0.015	0.010
8	0.070	0.275	0.345	0.145	0.100	8	0.010	0.030	0.035	0.015	0.010
6	0.070	0.285	0.285	0.150	0.085	6	0.010	0.030	0.030	0.015	0.010
4	0.060	0.240	0.240	0.125	0.085	4	0.010	0.025	0.025	0.015	0.010
3	0.050	0.215	0.215	0.110	0.080	3	0.010	0.020	0.020	0.015	0.010
2	0.050	0.195	0.195	0.100	0.070	2	0.010	0.020	0.020	0.010	0.010
1	0.055	0.225	0.225	0.115	0.075	1	0.010	0.025	0.025	0.015	0.010
1/0	0.050	0.205	0.205	0.105	0.070	1/0	0.010	0.020	0.020	0.010	0.010
2/0	0.045	0.185	0.185	0.095	0.065	2/0	0.010	0.020	0.020	0.010	0.010
3/0	0.040	0.165	0.165	0.085	0.055	3/0	0.010	0.020	0.020	0.010	0.010
4/0	0.035	0.150	0.150	0.075	0.050	4/0	0.010	0.015	0.015	0.010	0.010

Table 21.1 revised December 5, 1995

MARKINGS

22 Tag Marking

22.1 A tag on which the following information is indicated plainly shall be tied to every shipping length of finished cable. However, if the cable is coiled on a reel or is in a carton, the tag may be glued, tied, stapled, or otherwise attached to the reel or carton instead of to the cable, or the tag may be eliminated and the information printed or stenciled directly onto the reel or carton. Other information may be added if it does not confuse or mislead.

- a) The name of the cable manufacturer, that manufacturer's trade name for the cable, or both, or any other distinctive marking by means of which the organization responsible for the cable can readily be identified. If the organization that is responsible for the cable is different from the actual manufacturer, both the responsible organization and the actual manufacturer shall be identified by name or by coding such as by trade name, trademark, the assigned electrical reference number, or the assigned combination of colored marker threads. The meaning of any coded identification shall be made available. A private labeler may also be identified.
- b) The date of manufacture by month and year.
- c) The voltage rating of the cable: "50 volts" or "600 volts". "V" is acceptable in place of "volts".
- d) A description of the colored marker threads assigned to identify the organization responsible for the cable if the threads are used in the cable.
- e) The temperature rating in degrees C and, if used on the cable, the temperature rating code (see item f of 23.1).
- f) "Boat Cable", "oil resistant", "oil res", or "Oil Resistant I", may be added in the case of cable that complies with the requirements for 60°C (140°F) oil resistance. The temperature rating for the oil resistance shall not be included. Cable that complies with the requirements for oil resistance but is not marked to so indicate is not acceptable for oil-resistant use.
- g) The SAE type-letter designation of the cable if the cable is rated for 50 volts (such as Type SGT, SGR, or SGX).
- h) The number and size of conductors if the cable is a multiple-conductor cable.
- i) Size of conductor if a single-conductor cable.

23 Cable Marking

23.1 The following information shall be surface-marked (ink, embossing, or indent printing is acceptable) on the surface of a single-conductor cable, individual conductors of a multiple-conductor cable and, where noted, on the overall jacket of a multiple-conductor cable, repeated at least every 24 inches or 610 mm. The embossing or indent printing shall not reduce the wall at any point below the minimum acceptable thickness. Cables that cannot be surface-marked because of the configuration of conductors or the nature of the jacket material employed shall have a marker tape under the jacket indicating the required information. Marker threads are also required for surface-marked cable unless the surface marking is durable when evaluated as described in Section 1690 of UL 1581.

- a) The name of the cable manufacturer, that manufacturer's trade name for the cable, or both, or any other distinctive marking by means of which the organization responsible for the cable can readily be identified. Also required on the cable jacket of a multiple-conductor cable.
- b) AWG size of conductors.
- c) The voltage rating of the cable: "50 volts" or "600 volts". "V" is acceptable in place of "volts". Also required on the cable jacket of a multiple-conductor cable.
- d) "Boat Cable" or the boat-cable temperature-rating code (see item f). "Oil resistant", "oil res", "Oil Resistant I", or "oil res I" may be added in the case of cable that complies with the requirements for 60°C (140°F) oil resistance. The temperature rating for the oil resistance shall not be included. Cable that complies with the requirements for oil resistance but is not marked to so indicate is not acceptable for oil-resistant use. Also required on the cable jacket of a multiple-conductor cable.
- e) The SAE type-letter designation of the cable, if rated for 50 volts (Type SGT, SGR, SGX, etc.).
- f) The temperature rating of the cable in accordance with one of the following (boat cable that is additionally acceptable for a use covered by the National Electrical Code must use the temperature-rating code form of temperature marking):

Boat-Cable temperature rating	OR	Boat-cable temperature rating code
60°C dry 60°C wet		BC-1W1
75°C dry 60°C wet		BC-2W1
75°C dry 75°C wet		BC-2W2
80°C dry 60°C wet		BC-3W1
80°C dry 75°C wet		BC-3W2
90°C dry 60°C wet		BC-4W1
90°C dry 75°C wet		BC-4W2
105°C dry 60°C wet		BC-5W1
105°C dry 75°C wet		BC-5W2

23.1 revised December 5, 1995

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Subjects 1581 (44, 62, 83, 758, 854, 1063,
 1072, 1277, 1426, 1569)
 (In reply, refer to Subject 1581)

1285 Walt Whitman Road
 Melville, NY 11747
 June 20, 1995

TO: Electrical Council of Underwriters Laboratories Inc.,
 Subscribers to UL's Standards Services for
 Rubber-Insulated Wires and Cables, UL 44;
 Flexible Cord and Fixture Wire, UL 62;
 Thermoplastic-Insulated Wires and Cables, UL 83;
 Appliance Wiring Material, Subj 758;
 Service-Entrance Cables UL 854;
 Machine-Tool Wires and Cables, UL 1063;
 Medium-Voltage Power Cables, UL 1072;
 Electrical Power and Control Tray Cables with
 Optional Optical-Fiber Members, UL 1277;
 Electrical Cables for Boats, UL 1426;
 Metal-Clad Cables, UL 1569;
 Reference Standard for Electrical Wires, Cables, and
 Flexible Cords, UL 1581

SUBJECT: Request for Comments on Proposed Requirements for the Eighth Edition of the
 Standard for Service-Entrance Cables UL 854; the Fifth Edition of the Standard
 for Machine-Tool Wires and Cables, UL 1063; the First Edition of the Standard
 for Medium-Voltage Power Cables, UL 1072; the Second Edition of the Standard
 for Electrical Power and Control Tray Cables with Optional Optical-Fiber
 Members, UL 1277; the First Edition of the Standard for Metal-Clad Cables, UL
 1569; the Second Edition of the Reference Standard for Electrical Wires, Cables,
 and Flexible Cords, UL 1581; PROPOSED EFFECTIVE DATES

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Subjects 1581 (44, 62, 83, 758,
854, 1063, 1072,
1277, 1426, 1569)

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June 20, 1995

SUMMARY OF TOPICS

This bulletin proposes the following changes in requirements:

The replacement of ASTM Oil No. 2 with IRM902 oil for all oil-immersion tests in the wire and cable standards.

COMMENTS DUE: AUGUST 1, 1995

Attached as Appendix A for your review and comment are proposed requirements for UL 854, 1063, 1072, 1277, 1569, and 1581. Questions regarding interpretation of requirements should be directed to the responsible UL Staff. Please see Appendix B of this bulletin regarding designated responsibility for the subject product categories.

Please note that proposed requirements are of a tentative and early nature and are for review and comment only. Current requirements are to be used to judge a product until these requirements are published in final form.

PROPOSED EFFECTIVE DATES

The proposed requirements, accepting the use of either ASTM oil No. 2 or IRM902, will not necessitate a review or additional testing of currently Listed products. Therefore, UL proposes that the new requirements become effective upon publication.

The exclusive use of IRM902 oil as an immersion medium is proposed to become effective 2 years after publication. At that time, no review or retest will be necessary.

REQUEST FOR COMMENTS ON PROPOSALS

Please provide the following:

1. Your comments concerning the proposed requirements; and
2. Your comments concerning the proposed effective dates should the proposals be adopted.

Subjects 1581 (44, 62, 83, 758,
854, 1063, 1072,
1277, 1426, 1569)

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June 20, 1995

Comments should be made in writing and may be sent by fax (516-271-6221) or by mail to the attention of Mr. James McArdle at UL's Melville office, 1285 Walt Whitman Road, Melville, NY 11747-3081. Please reference all correspondence to Subject 1581.

All comments should be sent by August 1, 1995.

Unless specifically requested to do so, UL will not acknowledge comments indicating concurrence with these proposals.

UNDERWRITERS LABORATORIES INC.

REVIEWED BY:

James McArdle
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1581CON.M01;JMcA;cit

Subjects 1581 (44, 62, 83, 758,
854, 1063, 1072,
1277, 1426, 1569)

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June 1995

PROPOSED REQUIREMENTS ARE OF
A TENTATIVE AND EARLY NATURE
AND ARE FOR REVIEW AND
COMMENT ONLY. CURRENT
REQUIREMENTS ARE TO BE USED
TO JUDGE A PRODUCT UNTIL
THESE REQUIREMENTS ARE
PUBLISHED IN FINAL FORM.

A P P E N D I X A

PROPOSED REQUIREMENTS AND PROPOSED EFFECTIVE DATES FOR THE EIGHTH EDITION OF THE STANDARD FOR SERVICE-ENTRANCE CABLES UL 854; THE FIFTH EDITION OF THE STANDARD FOR MACHINE-TOOL WIRES AND CABLES, UL 1063; THE FIRST EDITION OF THE STANDARD FOR MEDIUM-VOLTAGE POWER CABLES, UL 1072; THE SECOND EDITION OF THE STANDARD FOR ELECTRICAL POWER AND CONTROL TRAY CABLES WITH OPTIONAL OPTICAL-FIBER MEMBERS, UL 1277; THE FIRST EDITION OF THE STANDARD FOR METAL-CLAD CABLES, UL 1569; THE SECOND EDITION OF THE REFERENCE STANDARD FOR ELECTRICAL WIRES, CABLES, AND FLEXIBLE CORDS, UL 1581

For your convenience in review, proposed additions to existing requirements are shown underlined and proposed deletions are shown ~~lined-out~~. Proposed new requirements are identified by (NEW). In the case of extensively revised paragraphs, the original text is identified by (CURRENT) and is ~~lined-out~~, followed by the proposed text identified by (PROPOSED). A paragraph that is proposed to be deleted is identified by (DELETED) and is shown ~~lined-out~~.

Subjects 1581 (44, 62, 83, 758,
854, 1063, 1072,
1277, 1426, 1569)

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June 1995

RATIONALE

In a bulletin dated February 1, 1994, UL announced its intention to eventually replace ASTM oil No. 2, currently used for all oil immersion tests, with IRM902 oil. This would only be done if and when sufficient tests were performed and a similarity in results was shown to exist. Over the past year, UL has conducted more than 50 side-by-side tests with the two oils. These tests compared the severity of an immersion, of both thermoplastic and thermoset materials, in ASTM oil No. 2 to that of IRM902 oil. The results in both oils were virtually identical.

UL proposes to add the use of IRM902 oil to its wire and cable standards as the medium for all oil immersion tests. Because manufacturers may have a substantial inventory of ASTM oil No. 2, the following proposal accepts the use of ASTM oil No. 2 for two years after the adoption of the proposal.

No changes are proposed for UL 44, UL 62, UL 83, and UL 1426 as they make reference to UL 1581 for tests involving oil immersion.

IMPACT

Adoption of this proposal will not require a review of currently Listed wire and cable products. Also for new product submittals there will be no change in the required testing.

Subjects 1581 (44, 62, 83, 758,
854, 1063, 1072,
1277, 1426, 1569)

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June 1995

PROPOSAL

(UL 854)

17.4 ~~ASTM Oil No. 2~~ is specified in several of the physical properties tables in ~~section 50 of~~ UL 1581 as an immersion medium for conditioning some specimens. In UL 854, the oil ~~aging~~ immersion is for the purpose of generic material identification, not to establish a particular compound as being oil-resistant. ~~ASTM oil No. 2 is medium swelling and of a petroleum base. Measured at 210.0°F (98.9°C), its Saybolt Universal viscosity is 100 + 5 s (443 — 490 m²/s at 310 K). Its aniline point is 93.0 ± 3.0°C (199.4 ± 5.4°F). Its open cup flash point is 475.0 ± 10.0°F (246.1 ± 5.6°C).~~

Paragraph 17.4 revised (date of publication)

(UL 1063)

Table 8.1
Minimum acceptable average physical properties
of pvc insulation and pvc jacket

Condition of specimens at time of measurement	Minimum acceptable ultimate elongation (1-in or 25-mm bench marks) — See 8.4.2	Minimum acceptable tensile strength — See 8.4.2
Unaged	100 percent (1-in or 25 mm)	1500 lbf/in ² or 10.3 MN/m ² or 1035 N/cm ² or 1.05 kgf/mm ²
Aged in a full-draft circulating-air oven for 168 h at 121.0 ± 1.0°C (249.8 ± 1.8°F) with nylon jacket of construction B removed	Die-cut specimens: 45 percent of the result with unaged specimens Other specimens: 65 percent of the result with unaged specimens	70 percent of the result with unaged specimens
Specimens (with nylon jacket of construction B in place) from wires or cables NOT marked "oil-resistant II" aged in ASTM oil No. 2 (see 8.4.3) for 96 h at 100.0 ± 1.0°C (212.0 ± 1.8°F)	50 percent of the result with unaged specimens	50 percent of the result with unaged specimens

Table 8.1 revised (date of publication)

Subjects 1581 (44, 62, 83, 758,
854, 1063, 1072,
1277, 1426, 1569)

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June 1995

(UL 1063)

(DELETED)

8.4.3 ~~The ASTM oil No. 2 mentioned in Table 8.1 is medium swelling and of a petroleum base. Measured at 210.0°F (98.9°C), its Saybolt Universal viscosity is 100 ± 5 s (433—490 $\text{m}^2 \text{ s}$ at 310 K). Its aniline point is $93.0 \pm 3.0^\circ\text{C}$ ($199.4 \pm 5.4^\circ\text{F}$). Its open cup flash point is $475.0 \pm 10.0^\circ\text{F}$ ($246.1 \pm 5.6^\circ\text{C}$).~~

8.4.3 deleted (date of publication)

(UL 1277)

(DELETED)

10.5 ~~ASTM oil No. 2 is specified in physical properties Tables 10.2—10.8 and 10.11—10.23 as an immersion medium for conditioning of some specimens of oil resistant jackets. ASTM oil No. 2 is medium swelling and of a petroleum base. Measured at 210.0°F (98.9°C), its Saybolt Universal viscosity is 100 ± 5 s (443—490 ms^2 at 310 K). Its aniline point is $93.0 \pm 3.0^\circ\text{C}$ ($199.4 \pm 5.4^\circ\text{F}$). Its open cup flash point is $475.0 \pm 10.0^\circ\text{F}$ ($246.1 \pm 5.6^\circ\text{C}$).~~

Paragraph 10.5 deleted (date of publication)

(UL 1277)

TABLE 10.2
PHYSICAL PROPERTIES OF 90°C (194°F) CP^a JACKET

Condition of Specimens at Time of Measurement	Minimum Acceptable Ultimate Elongation (1-in or 25-mm Bench Marks)	Minimum Acceptable Tensile Strength
Unaged	200 percent (2 in or 50 mm)	1500 lbf/in ² or 10.3 MN/m ² or 1034 N/cm ² or 1.05 kgf/mm ²
Aged in a full-draft circulating-air oven for 168 h at $121.0 \pm 1.0^\circ\text{C}$ ($249.8 \pm 1.8^\circ\text{F}$)	50 percent of the result with unaged specimens	85 percent of the result with unaged specimens
Aged in ASTM oil No. 2 (see paragraph 10.5) for 18 h at $121.0 \pm 1.0^\circ\text{C}$ ($249.8 \pm 1.8^\circ\text{F}$)	60 percent of the result with unaged specimens	60 percent of the result with unaged specimens
Specimens of 75°C (167°F) oil-resistant jacket from cable marked "oil resistant II" (see item I of paragraph 23.1): Aged in ASTM oil No. 2 (see paragraph 10.5) for 60 d at $75.0 \pm 1.0^\circ\text{C}$ ($167.0 \pm 1.8^\circ\text{F}$)	65 percent of the result with unaged specimens	65 percent of the result with unaged specimens
Specimens of 60°C (140°F) oil-resistant jacket from cable marked "oil resistant I" (see item J of paragraph 23.1): Aged in ASTM oil No. 2 (see paragraph 10.5) for 96 h at $100.0 \pm 1.0^\circ\text{C}$ ($212.0 \pm 1.8^\circ\text{F}$)	50 percent of the result with unaged specimens	50 percent of the result with unaged specimens

^a CP designates a cross-linked compound whose characteristic constituent is chlorosulfonated polyethylene.

Table 10.2 revised (date of publication)

Subjects 1581 (44, 62, 83, 758,
854, 1063, 1072,
1277, 1426, 1569)

-A5-

June 1995

(UL 1277)

TABLE 10.3
PHYSICAL PROPERTIES OF 75°C (167°F) CP^a JACKET

Condition of Specimens at Time of Measurement	Minimum Acceptable Ultimate Elongation (1-in or 25-mm Bench Marks)	Minimum Acceptable Tensile Strength
Unaged	200 percent (2 in or 50 mm)	1500 lbf/in ² or 10.3 MN/m ² or 1034 N/cm ² or 1.05 kgf/mm ²
Aged in a full-draft circulating-air oven for 168 h at 113.0 ± 1.0°C (235.4 ± 1.8°F)	50 percent of the result with unaged specimens	85 percent of the result with unaged specimens
Aged in ~~ASTM oil No. 2 (see paragraph 10.5)~~ for 18 h at 121.0 ± 1.0°C (249.8 ± 1.8°F)	60 percent of the result with unaged specimens	60 percent of the result with unaged specimens
Specimens of 75°C (167°F) oil-resistant jacket from cable marked "oil resistant II" (see item I of paragraph 23.1): Aged in ~~ASTM oil No. 2 (see paragraph 10.5)~~ for 60 d at 75.0 ± 1.0°C (167.0 ± 1.8°F)	65 percent of the result with unaged specimens	65 percent of the result with unaged specimens
Specimens of 60°C (140°F) oil-resistant jacket from cable marked "oil resistant I" (see item J of paragraph 23.1): Aged in ~~ASTM oil No. 2 (see paragraph 10.5)~~ for 96 h at 100.0 ± 1.0°C (212.0 ± 1.8°F)	50 percent of the result with unaged specimens	50 percent of the result with unaged specimens

^a CP designates a cross-linked compound whose characteristic constituent is chlorosulfonated polyethylene.

Table 10.3 revised (date of publication)

Subjects 1581 (44, 62, 83, 758,
854, 1063, 1072,
1277, 1426, 1569)

-A6-

June 1995

(UL 1277)

TABLE 10.4
PHYSICAL PROPERTIES OF 60 °C (140 °F) CP^a JACKET

Condition of Specimens at Time of Measurement	Maximum Acceptable Set in Recovery Test (1-in or 25-mm Bench Marks Stretched to 3 in or 75 mm)	Minimum Acceptable Ultimate Elongation (1-in or 25-mm Bench Marks)	Minimum Acceptable Tensile Strength
Unaged	25 percent (1/4 in or 6.2 mm)	300 percent (3 in or 75 mm)	1500 lbf/in ² or 10.3 MN/m ² or 1034 N/cm ² or 1.05 kgf/mm ²
Aged in full-draft circulating-air oven for 168 h at 70.0 ± 1.0 °C (158.0 ± 1.8 °F)	Not measured	70 percent of the result with unaged specimens	
Aged in ASTM oil No. 2 (see paragraph 10.5) for 18 h at 121.0 ± 1.0 °C (249.8 ± 1.8 °F)	Not measured	60 percent of the result with unaged specimens	
Specimens of 60 °C (140 °F) oil-resistant jacket from cable marked "oil resistant I" (see item J of paragraph 23.1): Aged in ASTM oil No. 2 (see paragraph 10.5) for 96 h at 100.0 ± 1.0 °C (212.0 ± 1.8 °F)	Not measured	50 percent of the result with unaged specimens	

^a CP designates a cross-linked compound whose characteristic constituent is chlorosulfonated polyethylene.

Table 10.4 revised (date of publication)

Subjects 1581 (44, 62, 83, 758,
854, 1063, 1072,
1277, 1426, 1569)

-A7-

June 1995

(UL 1277)

TABLE 10.5
PHYSICAL PROPERTIES OF THERMOPLASTIC CPE^a JACKET ON ANY CABLE

Condition of Specimens at Time of Measurement	Minimum Acceptable Ultimate Elongation (1-in or 25-mm Bench Marks)	Minimum Acceptable Tensile Strength
Unaged	150 percent (1-1/2 in or 38 mm)	1400 lbf/in ² or 9.65 MN/m ² or 965 N/cm ² or 0.984 kgf/mm ²
Aged in a full-draft circulating-air oven for 168 h at 121.0 ± 1.0 °C (249.8 ± 1.8 °F)	50 percent of the result with unaged specimens	85 percent of the result with unaged specimens
Specimens of 75 °C (167 °F) oil-resistant jacket from cable marked "oil resistant II" (see item I of paragraph 23.1): Aged in ASTM oil No. 2 (see paragraph 10.5) for 60 d at 75.0 ± 1.0 °C (167.0 ± 1.8 °F)	65 percent of the result with unaged specimens	65 percent of the result with unaged specimens
Specimens of 60 °C (140 °F) oil-resistant jacket from cable marked "oil resistant I" (see item J of paragraph 23.1): Aged in ASTM oil No. 2 (see paragraph 10.5) for 96 h at 100.0 ± 1.0 °C (212.0 ± 1.8 °F)	50 percent of the result with unaged specimens	50 percent of the result with unaged specimens

^a CP designates a cross-linked compound whose characteristic constituent is chlorinated polyethylene.

Table 10.5 revised (date of publication)

Subjects 1581 (44, 62, 83, 758,
854, 1063, 1072,
1277, 1426, 1569)

-A8-

June 1995

(UL 1277)

TABLE 10.6
PHYSICAL PROPERTIES OF 90 °C (194F) THERMOSET CPE^a JACKET

Condition of Specimens at Time of Measurement	Minimum Acceptable Ultimate Elongation (1-in or 25-mm Bench Marks)	Minimum Acceptable Tensile Strength
Unaged	200 percent (2-1/2 in or 62.5 mm)	1500 lbf/in ² or 10.3 MN/m ² or 1034 N/cm ² or 1.05 kgf/mm ²
Aged in a full-draft circulating-air oven for 168 h at 121.0 ± 1.0 °C (249.8 ± 1.8 °F)	60 percent of the result with unaged specimens	85 percent of the result with unaged specimens
Aged in ASTM oil No. 2 (see paragraph 10.5) for 18 h 121.0 ± 1.0 °C (249.8 ± 1.8 °F)	60 percent of the result with unaged specimens	60 percent of the result with unaged specimens
Specimens of 75 °C (167 °F) oil-resistant jacket from cable marked "oil resistant II" (see item I of paragraph 23.1): Aged in ASTM oil No. 2 (see paragraph 10.5) for 60 d at 75.0 ± 1.0 °C (167.0 ± 1.8 °F)	65 percent of the result with unaged specimens	65 percent of the result with unaged specimens
Specimens of 60 °C (140 °F) oil-resistant jacket from cable marked "oil resistant I" (see item J of paragraph 23.1): Aged in ASTM oil No. 2 (see paragraph 10.5) for 96 h at 100.0 ± 1.0 °C (212.0 ± 1.8 °F)	50 percent of the result with unaged specimens	50 percent of the result with unaged specimens

^a CP designates a cross-linked compound whose characteristic constituent is chlorinated polyethylene.

Table 10.6 revised (date of publication)

Subjects 1581 (44, 62, 83, 758,
854, 1063, 1072,
1277, 1426, 1569)

-A9-

June 1995

(UL 1277)

TABLE 10.7
PHYSICAL PROPERTIES OF 75 °C (167 °F) THERMOSET CPE^a JACKET

Condition of Specimens at Time of Measurement	Minimum Acceptable Ultimate Elongation (1-in or 25-mm Bench Marks)	Minimum Acceptable Tensile Strength
Unaged	250 percent (2-1/2 in or 62.5 mm)	1500 lbf/in ² or 10.3 MN/m ² or 1034 N/cm ² or 1.05 kgf/mm ²
Aged in a full-draft circulating-air oven for 168 h at 113.0 ± 1.0 °C (235.4 ± 1.8 °F)	60 percent of the result with unaged specimens	85 percent of the result with unaged specimens
Aged in ASTM oil No. 2 (see paragraph 10.5) for 18 h at 121.0 ± 1.0 °C (249.8 ± 1.8 °F)	60 percent of the result with unaged specimens	60 percent of the result with unaged specimens
Specimens of 75 °C (167 °F) oil-resistant jacket from cable marked "oil resistant II" (see item I of paragraph 23.1):		
Aged in ASTM oil No. 2 (see paragraph 10.5) for 60 d at 75.0 ± 1.0 °C (167.0 ± 1.8 °F)	65 percent of the result with unaged specimens	65 percent of the result with unaged specimens
Specimens of 60 °C (140 °F) oil-resistant jacket from cable marked "oil resistant I" (see item J of paragraph 23.1):		
Aged in ASTM oil No. 2 (see paragraph 10.5) for 96 h at 100.0 ± 1.0 °C (212.0 ± 1.8 °F)	50 percent of the result with unaged specimens	50 percent of the result with unaged specimens

^a CP designates a cross-linked compound whose characteristic constituent is chlorinated polyethylene.

Table 10.7 revised (date of publication)

Subjects 1581 (44, 62, 83, 758,
854, 1063, 1072,
1277, 1426, 1569)

-A10-

June 1995

(UL 1277)

TABLE 10.8
PHYSICAL PROPERTIES OF 60°C (140°F) THERMOSET CPE^a JACKET

Condition of Specimens at Time of Measurement	Minimum Acceptable Ultimate Elongation (1-in or 25-mm Bench Marks)	Minimum Acceptable Tensile Strength
Unaged	250 percent (2-1/2 in or 62.5 mm)	1500 lbf/in ² or 10.3 MN/m ² or 1034 N/cm ² or 1.05 kgf/mm ²
Aged in a full-draft circulating-air oven for 168 h at 100.0 ± 1.0°C (212.0 ± 1.8°F)	60 percent of the result with unaged specimens	85 percent of the result with unaged specimens
Aged in ~~ASTM oil No. 2 (see paragraph 10.5)~~ for 18 h at 121.0 ± 1.0°C (249.8 ± 1.8°F)	60 percent of the result with unaged specimens	60 percent of the result with unaged specimens
Specimens of 60°C (140°F) oil-resistant jacket from cable marked "oil resistant I" (see item J of paragraph 23.1): Aged in ~~ASTM oil No. 2 (see paragraph 10.5)~~ for 96 h at 100.0 ± 1.0°C (212.0 ± 1.8°F)	50 percent of the result with unaged specimens	50 percent of the result with unaged specimens

^a CPE designates a cross-linked compound whose characteristic constituent is chlorinated polyethylene.

Table 10.8 revised (date of publication)

Subjects 1581 (44, 62, 83, 758,
854, 1063, 1072,
1277, 1426, 1569)

-A11-

June 1995

(UL 1277)

TABLE 10.11
PHYSICAL PROPERTIES OF 90°C (194°F) NBR/PVC^a JACKET

Condition of Specimens at Time of Measurement	Maximum Acceptable Set in Recovery Test (1-in or 25-mm Bench Marks Stretched to 3 in or 75 mm)	Minimum Acceptable Ultimate Elongation (1-in or 25-mm Bench Marks)	Minimum Acceptable Tensile Strength
Unaged	31.25 percent (5/16 in or 7.8 mm)	250 percent (2-1/2 in or 62.5 mm)	1200 lbf/in ² or 8.27 MN/m ² or 827 N/cm ² or 0.844 kgf/mm ²
Aged in a full-draft circulating-air oven for 240 h at 121.0 ± 1.0°C (249.8 ± 1.8°F)	Not measured	50 percent	900 lbf/in ² or 6.21 MN/m ² or 621 N/cm ² or 0.633 kgf/mm ²
Aged in ASTM oil No. 2 (see paragraph 10.5) for 18 h at 121.0 ± 1.0°C (249.8 ± 1.8°F)	Not measured	60 percent of the result with unaged specimens	
Specimens of 75°C (167°F) oil-resistant jacket from cable marked "oil resistant II" (see item I of paragraph 23.1): Aged in ASTM oil No. 2 (see paragraph 10.5) for 60 d at 75.0 ± 1.0°C (167.0 ± 1.8°F)	Not measured	65 percent of the result with unaged specimens	
Specimens of 60°C (140°F) oil-resistant jacket from cable marked "oil resistant I" (see item J of paragraph 23.1): Aged in ASTM oil No. 2 (see paragraph 10.5) for 96 h at 100.0 ± 1.0°C (212.0 ± 1.8°F)	Not measured	50 percent of the result with unaged specimens	

^a NBR/PVC designates a cross-linked compound whose characteristic constituents are acrylonitrile butadiene rubber and polyvinyl chloride.

Table 10.11 revised (date of publication)

Subjects 1581 (44, 62, 83, 758,
854, 1063, 1072,
1277, 1426, 1569)

-A12-

June 1995

(UL 1277)

TABLE 10.12
PHYSICAL PROPERTIES OF 75 °C (167 °F) NBR/PVC^a JACKET

Condition of Specimens at Time of Measurement	Minimum Acceptable Ultimate Elongation (1-in or 25-mm Bench Marks)	Minimum Acceptable Tensile Strength
Unaged	200 percent (2 in or 50 mm)	1500 lbf/in ² or 10.3 MN/m ² or 1034 N/cm ² or 1.05 kgf/mm ²
Aged in an oxygen bomb for 168 h at 80.0 ± 1.0 °C (176 ± 1.8 °F) and a gauge pressure of 300 ± 10 lbf/in ² or 207 ± 7 N/cm ² 2.07 ± 0.07 MN/m ² or 0.211 ± 0.007 kgf/mm ²	50 percent of the result with unaged specimens	50 percent of the result with unaged specimens
Aged in an air bomb for 20 h at 127.0 ± 1.0 °C (260.6 ± 1.8 °F) and a gauge pressure of 80 ± 3 lbf/in ² or 55.2 ± 2.1 N/cm ² or 0.55 ± 0.02 MN/m ² or 0.056 ± 0.002 kgf/mm ²	50 percent of the result with unaged specimens	50 percent of the result with unaged specimens
Aged in ASTM oil No. 2 (see paragraph 10.5) for 18 h at 121.0 ± 1.0 °C (249.8 ± 1.8 °F)	60 percent of the result with unaged specimens	60 percent of the result with unaged specimens
Specimens of 75 °C (167 °F) oil-resistant jacket from cable marked "oil resistant II" (see item I of paragraph 23.1): Aged in ASTM oil No. 2 (see paragraph 10.5) for 60 d at 75.0 ± 1.0 °C (167.0 ± 1.8 °F)	65 percent of the result with unaged specimens	60 percent of the result with unaged specimens
Specimens of 60 °C (140 °F) oil-resistant jacket for cable marked "oil resistant I" (see items J of paragraph 23.1): Aged in ASTM oil No. 2 (see paragraph 10.5) for 96 h at 100.0 ± 1.0 °C (212.0 ± 1.8 °F)	50 percent of the result with unaged specimens	50 percent of the result with unaged specimens

^a NBR/PVC designates a cross-linked compound whose characteristic constituents are acrylonitrile butadiene rubber and polyvinyl chloride.

Table 10.12 revised (date of publication)

Subjects 1581 (44, 62, 83, 758,
854, 1063, 1072,
1277, 1426, 1569)

-A13-

June 1995

(UL 1277)

TABLE 10.13
PHYSICAL PROPERTIES OF 60 °C (140 °F) NBR/PVC^a JACKET

Condition of Specimens at Time of Measurement	Maximum Acceptable Set in Recovery Test (1-in or 25-mm Bench Marks Stretched to 3 in or 75 mm)	Minimum Acceptable Ultimate Elongation (1-in or 25-mm Bench Marks)	Minimum Acceptable Tensile Strength
Unaged	31 percent (5/16 in or 7.8 mm)	300 percent (3 in or 75 mm)	1500 lbf/in ² or 10.3 MN/m ² or 1034 N/cm ² or 1.05 kgf/mm ²
Aged in an oxygen bomb for 96 h at 70.0 ± 1.0 °C (158.0 ± 1.8 °F) and a gauge pressure of 300 ± 10 lbf/in ² or 2.07 ± 0.07 MN/m ² or 0.211 ± 0.007 kgf/mm ²	Not measured	65 percent of the result with unaged specimens if the sum of tensile and elongation percentage is at least 140. Otherwise, 70 percent of the result with unaged specimens	
Aged in full-draft circulating-air oven for 168 h at 70.0 ± 1.0 °C (158.0 ± 1.8 °F)	Not measured	70 percent of the result with unaged specimens	
Aged in ASTM oil No. 2 (see paragraph 10.5) for 18 h at 121.0 ± 1.0 °C (249.8 ± 1.8 °F)	Not measured	60 percent of the result with unaged specimens	
Specimens of 60 °C (140 °F) oil-resistant jacket from cable marked "oil resistant I" (see item J of paragraph 23.1): Aged in ASTM oil No. 2 (see paragraph 10.5) for 96 h at 100.0 ± 1.0 °C (212.0 ± 1.8 °F)	Not measured	50 percent of the result with unaged specimens	

^a NBR/PVC designates a cross-linked compound whose characteristic constituents are acrylonitrile butadiene rubber and polyvinyl chloride.

Table 10.13 revised (date of publication)

Subjects 1581 (44, 62, 83, 758,
854, 1063, 1072,
1277, 1426, 1569)

-A14-

June 1995

(UL 1277)

TABLE 10.14
PHYSICAL PROPERTIES OF 90 °C (194 °F) NEOPRENE^a JACKET

Condition of Specimens at Time of Measurement	Maximum Acceptable Set in Recovery Test (1-in or 25-mm Bench Marks Stretched to 3 in or 75 mm)	Minimum Acceptable Ultimate Elongation (1-in or 25-mm Bench Marks)	Minimum Acceptable Tensile Strength
Unaged	25 percent (1/4 in or 6.2 mm)	250 percent (2-1/2 in or 62.5 mm)	1200 lbf/in ² or 8.27 MN/m ² or 827 N/cm ² or 0.844 kgf/mm ²
Aged in full-draft circulating-air oven for 240 h at 121.0 ± 1.0 °C (249.8 ± 1.8 °F)	Not measured	50 percent (1/2 in or 12.5 mm)	900 lbf/in ² or 6.21 MN/m ² or 6.21 N/cm ² or 0.633 kgf/mm ²
Aged in ASTM oil No. 2 (see para- graph 10.5) for 18 h at 121.0 ± 1.0 °C (249.8 ± 1.8 °F)	Not measured	60 percent of the result with unaged specimens	
Specimens of 75 °C (167 °F) oil-resistant jacket from cable marked "oil resistant II" (see item I of paragraph 23.1): Aged in ASTM oil No. 2 (see paragraph 10.5) for 60 d at 75.0 ± 1.0 °C (167.0 ± 1.8 °F)	Not measured	65 percent of the result with unaged specimens	
Specimens of 60 °C (140 °F) oil-resistant jacket from cable marked "oil resistant I" (see item J of paragraph 23.1): Aged in ASTM oil No. 2 (see paragraph 10.5) for 96 h at 100.0 ± 1.0 °C (212.0 ± 1.8 °F)	Not measured	50 percent of the result with unaged specimens	

^a Neoprene designated a cross-linked compound whose characteristic constituent is polychloroprene.

Table 10.14 revised (date of publication)

Subjects 1581 (44, 62, 83, 758,
854, 1063, 1072,
1277, 1426, 1569)

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June 1995

(UL 1277)

TABLE 10.15
PHYSICAL PROPERTIES OF 75 °C (167 °F) NEOPRENE^a JACKET

Condition of Specimens at Time of Measurement	Maximum Acceptable Set in Recovery Test (1-in or 25-mm Bench Marks Stretched to 3 in or 75 mm)	Minimum Acceptable Ultimate Elongation (1-in or 25-mm Bench Marks)	Minimum Acceptable Tensile Strength
Unaged	19 percent (3/16 in or 4.7 mm)	300 percent (3 in or 75 mm)	1500 lbf/in ² or 10.3 MN/m ² or 1034 N/cm ² or 1.05 kgf/mm ²
Aged in an oxygen bomb for 168 h at 80.0 ± 1.0 °C (176.0 ± 1.8 °F) and a gauge pressure of 300 ± 10 lbf/in ² or 207 ± 7 N/cm ² or 2.07 ± 0.07 MN/m ² or 0.211 ± 0.007 kgf/mm ²	Not measured	50 percent of the result with unaged specimens	
Aged in an air bomb for 20 h at 127.0 ± 1.0 °C (260.6 ± 1.8 °F) and a gauge pressure of 80 ± 3 lbf/in ² or 55.2 ± 2.1 N/cm ² or 0.55 ± 0.02 MN/m ² or 0.056 ± 0.002 kgf/mm ²	Not measured	50 percent of the result with unaged specimens	
Aged in ASTM oil No. 2 (see paragraph 10.5) for 18 h at 121.0 ± 1.0 °C (249.8 ± 1.8 °F) Specimens of 75 °C (167 °F) oil-resistant jacket from cable marked "oil resistant II" (see item J of paragraph 23.1):	Not measured	60 percent of the result with unaged specimens	
Aged in ASTM oil No. 2 (see paragraph 10.5) for 60 d at 75.0 ± 1.0 °C (167.0 ± 1.8 °F) Specimens of 60 °C (140 °F) oil-resistant jacket from cable marked "oil resistant I" (see item J of paragraph 23.1):	Not measured	65 percent of the result with unaged specimens	
Aged in ASTM oil No. 2 (see paragraph 10.5) for 96 h at 100.0 ± 1.0 °C (212.0 ± 1.8 °F)	Not measured	50 percent of the result with unaged specimens	

^a Neoprene designates a cross-linked compound whose characteristic constituents is polychloroprene.

Table 10.15 revised (date of publication)

Subjects 1581 (44, 62, 83, 758,
854, 1063, 1072,
1277, 1426, 1569)

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June 1995

(UL 1277)

TABLE 10.16
PHYSICAL PROPERTIES OF 60°C (140°F) NEOPRENE^a JACKET

Condition of Specimens at Time of Measurement	Maximum Acceptable Set in Recovery Test (1-in or 25-mm Bench Marks Stretched to 3 in or 75 mm)	Minimum Acceptable Ultimate Elongation (1-in or 25-mm Bench Marks)	Minimum Acceptable Tensile Strength
Unaged	19 percent (3/16 in or 4.7 mm)	300 percent (3 in or 75 mm)	1500 lbf/in ² or 10.3 MN/m ² or 1034 N/cm ² or 1.05 kgf/mm ²
Aged in an oxygen bomb for 98 h at 70.0 ± 1.0°C (158.0 ± 1.8°F) and a gauge pressure of 300 ± 10 lbf/in ² or 207 ± 7 Ncm ² or 2.07 ± 0.07 MN/m ² or 0.211 ± 0.007 kgf/mm ²	Not measured	65 percent of the result with unaged specimens if the sum of tensile and elongation percentages is at least 140. Otherwise, 70 percent of the result with unaged specimens	
Aged in a full-draft circulating-air oven for 168 h at 70.0 ± 1.0°C (158.0 ± 1.8°F)	Not measured	70 percent of the result with unaged specimens	
Aged in ASTM oil No. 2 (see para- graph 10.5) for 18 h at 121.0 ± 1.0°C (249.8 ± 1.8°F)	Not measured	60 percent of the result with unaged specimens	
Specimens of 60°C (140°F) oil-resistant jacket from cable marked "oil resistant I" (see item J of paragraph 23.1): Aged in ASTM oil No. 2 (see paragraph 10.5) for 96 h at 100.0 ± 1.0°C (212.0 ± 1.8°F)	Not measured	50 percent of the result with unaged specimens	

^a Neoprene designates a cross-linked compound whose characteristic constituent is polychloroprene.

Table 10.16 revised (date of publication)

Subjects 1581 (44, 62, 83, 758,
854, 1063, 1072,
1277, 1426, 1569)

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June 1995

(UL 1277)

TABLE 10.17
PHYSICAL PROPERTIES OF 90°C (194°F) PVC^a JACKET

Condition of Specimens at Time of Measurement	Minimum Acceptable Ultimate Elongation (1-in or 25-mm Bench Marks)	Minimum Acceptable Tensile Strength
Unaged	100 percent (1 in or 25 mm)	1500 lbf/in ² or 10.3 MN/m ² or 1034 N/cm ² or 1.05 kgf/mm ²
Aged in a full-draft circulating-air oven for 168 h at 121.0 ± 1.0°C (249.8 ± 1.8°F)	45 percent of the result with unaged specimens	70 percent of the result with unaged specimens
Specimens of 75°C (167°F) oil-resistant jacket from cable marked "oil resistant II" (see item I of paragraph 23.1): Aged in ~~ASTM oil No. 2 (see paragraph 10.5)~~ for 60 d at 75.0 ± 1.0°C (167.0 ± 1.8°F)	65 percent of the result with unaged specimens	65 percent of the result with unaged specimens
Specimens of 60°C (140°F) oil-resistant jacket from cable marked "oil resistant I" (see item J of Paragraph 23.1): Aged in ~~ASTM oil No. 2 (see paragraph 10.5)~~ for 96 h at 100.0 ± 1.0°C (212.0 ± 1.8°F)	50 percent of the result with unaged specimens	50 percent of the result with unaged specimens
^a PVC designates a thermoplastic compound whose characteristic constituent is polyvinyl chloride or a copolymer of vinyl chloride and vinyl acetate.		

Table 10.17 revised (date of publication)

Subjects 1581 (44, 62, 83, 758,
854, 1063, 1072,
1277, 1426, 1569)

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June 1995

(UL 1277)

TABLE 10.18
PHYSICAL PROPERTIES OF 75°C (167°F) PVC^a JACKET

Condition of Specimens at Time of Measurement	Minimum Acceptable Ultimate Elongation (1-in or 25-mm Bench Marks)	Minimum Acceptable Tensile Strength
Unaged	100 percent (1 in or 25 mm)	1500 lbf/in ² or 10.3 MN/m ² or 1034 N/cm ² or 1.05 kgf/mm ²
Aged in a full-draft circulating-air oven for 240 h at 100.0 ± 1.0°C (212.0 ± 1.8°F)	45 percent of the result with unaged specimens	70 percent of the result with unaged specimens
Specimens of 75°C (167°F) oil-resistant jacket from cable marked "oil resistant II" (see item I of paragraph 23.1): Aged in ~~ASTM oil No. 2 (see paragraph 10.5)~~ for 60 d at 75.0 ± 1.0°C (167.0 ± 1.8°F)	65 percent of the result with unaged specimens	65 percent of the result with unaged specimens
Specimens of 60°C (140°F) oil-resistant jacket from cable marked "oil resistant I" (see item J of Paragraph 23.1): Aged in ~~ASTM oil No. 2 (see paragraph 10.5)~~ for 96 h at 100.0 ± 1.0°C (212.0 ± 1.8°F)	50 percent of the result with unaged specimens	50 percent of the result with unaged specimens

^a PVC designates a thermoplastic compound whose characteristic constituent is polyvinyl chloride or a copolymer of vinyl chloride and vinyl acetate.

Table 10.18 revised (date of publication)

Subjects 1581 (44, 62, 83, 758,
854, 1063, 1072,
1277, 1426, 1569)

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June 1995

(UL 1277)

TABLE 10.19
PHYSICAL PROPERTIES OF 60°C (140°F) PVC^a JACKET

Condition of Specimens at Time of Measurement	Minimum Acceptable Ultimate Elongation (1-in or 25-mm Bench Marks)	Minimum Acceptable Tensile Strength
Unaged	100 percent (1 in or 25 mm)	1500 lbf/in ² or 10.3 MN/m ² or 1034 N/cm ² or 1.05 kgf/mm ²
Aged in a full-draft circulating-air oven for 240 h at 100.0 ± 1.0°C (212.0 ± 1.8°F)	45 percent of the result with unaged specimens	70 percent of the result with unaged specimens
Specimens of 60°C (140°F) oil-resistant jacket from cable marked "oil resistant I" (see item J of Paragraph 23.1): Aged in ~~ASTM oil No. 2 (see paragraph 10.5)~~ for 96 h at 100.0 ± 1.0°C (212.0 ± 1.8°F)	50 percent of the result with unaged specimens	50 percent of the result with unaged specimens

^a PVC designates a thermoplastic compound whose characteristic constituent is polyvinyl chloride or a copolymer of vinyl chloride and vinyl acetate.

Table 10.19 revised (date of publication)

Subjects 1581 (44, 62, 83, 758,
854, 1063, 1072,
1277, 1426, 1569)

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June 1995

(UL 1277)

TABLE 10.20
PHYSICAL PROPERTIES OF 90°C (194°) TPE^a JACKET ON ANY CABLE

Condition of Specimens at Time of Measurement	Minimum Acceptable Ultimate Elongation (1-in or 25-mm Bench Marks)	Minimum Acceptable Tensile Strength
Unaged	300 percent (1 in or 25 mm)	1200 lbf/in ² or 8.27 MN/m ² or 827 N/cm ² or 0.844 kgf/mm ²
Aged in a full-draft circulating-air oven for 168 h at 121.0 ± 1.0° (249.8 ± 1.8°F)	80 percent of the result with unaged specimens	80 percent of the result with unaged specimens
Specimens of 75°C (167°F) oil-resistant jacket from cable marked "oil resistant II" (see item I of paragraph 23.1): Aged in ~~ASTM oil No. 2 (see paragraph 10.5)~~ for 60 d at 75.0 ± 1.0°C (167.0 ± 1.8°F)	65 percent of the result with unaged specimens	65 percent of the result with unaged specimens
Specimens of 60°C (140°F) oil-resistant jacket from cable marked "oil resistant I" (see item J of paragraph 23.1): Aged in ~~ASTM oil No. 2 (see paragraph 10.5)~~ for 96 h at 100.0 ± 1.0°C (212.0 ± 1.8°F)	50 percent of the result with unaged specimens	50 percent of the result with unaged specimens

^a TPE designates an extensible compound whose characteristic constituent is a thermoplastic elastomer.

Table 10.20 revised (date of publication)

Subjects 1581 (44, 62, 83, 758,
854, 1063, 1072,
1277, 1426, 1569)

-A21-

June 1995

(UL 1277)

TABLE 10.21
PHYSICAL PROPERTIES OF 90°C (194°) XL^a JACKET

Condition of Specimens at Time of Measurement	Minimum Acceptable Ultimate Elongation (1-in or 25-mm Bench Marks)	Minimum Acceptable Tensile Strength
Unaged	150 percent (1 in or 25 mm)	1500 lbf/in ² or 10.3 MN/m ² or 1034 N/cm ² or 1.05 kgf/mm ²
Aged in a full-draft circulating-air oven for 168 h at 121.0 ± 1.0° (249.8 ± 1.8°F)	70 percent of the result with unaged specimens	70 percent of the result with unaged specimens
Specimens of 75°C (167°F) oil-resistant jacket from cable marked "oil resistant II" (see item I of paragraph 23.1): Aged in ~~ASTM oil No. 2 (see paragraph 10.5)~~ for 60 d at 75.0 ± 1.0°C (167.0 ± 1.8°F)	65 percent of the result with unaged specimens	65 percent of the result with unaged specimens
Specimens of 60°C (140°F) oil-resistant jacket from cable marked "oil resistant I" (see item J of paragraph 23.1): Aged in ~~ASTM oil No. 2 (see paragraph 10.5)~~ for 96 h at 100.0 ± 1.0°C (212.0 ± 1.8°F)	50 percent of the result with unaged specimens	50 percent of the result with unaged specimens
^a XL designates a cross-linked compound whose characteristic constituent is XLPE (cross-linked polyethylene), XLPVC (cross-linked polyvinyl chloride), XLEVA (cross-linked ethylene vinyl acetate), or blends thereof. The cross linking may be accomplished either chemically (typically by the use of a peroxide accelerator and vulcanization) or irradiation.		

Table 10.21 revised (date of publication)