

LOW TENSION THIN WALL PRIMARY CABLE

1. Scope—This SAE Standard covers thin wall, low tension primary cable intended for use at 50 V or less in surface vehicle electrical systems.

2. References

2.1 Applicable Documents—The following publications form a part of this specification to the extent specified herein.

2.1.1 ASTM PUBLICATIONS—Available from ASTM, 1916 Race Street, Philadelphia, PA 19103.

ASTM B 1—Specification for Hard-Drawn Copper Wire

ASTM B 33—Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes

ASTM B 174—Specification for Bunch-Stranded Copper Conductors for Electrical Conductors

ASTM B 189—Specification for Lead-Coated and Lead-Alloy-Coated Soft Copper Wire for Electrical Purposes

ASTM D 471—Test Method for Rubber Property—Effect of Liquids

ASTM D 573—Test Method for Rubber—Deterioration in an Air Oven

2.1.2 IEC PUBLICATIONS—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

IEC 216.1—Part 1: General Guidelines for Aging Procedure and Evaluation of Test Results

3. Specification Types

3.1 Type TWP—Thinwall, thermoplastic insulated

3.2 Type TXL—Thinwall, crosslinked polyethylene insulated

3.3 Type TWE—Thinwall, thermoplastic elastomer, insulated

4. General Specifications

4.1 Conductors—The finished, uninsulated conductor, shall meet the elongation requirements specified in ASTM B 174. When tin, lead, or lead alloy coated wires are used, they shall withstand the continuity of coating tests specified in 5.1. A separator shall be used between uncoated conductors and insulation to comply with 4.2, as required. The cross-sectional area of stranded conductors shall not be less than the values specified in Table 1.

NOTE—Hard copper wire per ASTM B 1 may be used for special applications when agreed between the supplier and purchaser.

4.2 Insulation—Insulation shall be homogeneous and shall be placed concentrically within commercial tolerances about the conductor. Insulation shall adhere closely to, but strip readily from, the conductors leaving them reasonably clean and in suitable condition for terminating.

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TABLE 1—CONDUCTORS

SAE Wire Size No.	SAE Wire Size mm ²	Minimum Conductor Area cmils	Minimum Conductor Area mm ²
24	0.22	405	0.205
22	0.35	681	0.324
20	0.50	1072	0.508
18	0.80	1537	0.760
16	1	2336	1.12
14	2	3702	1.85
12	3	5833	2.91
10	5	9343	4.65
8	8	14810	7.23

NOTES:

1. SAE wire size number indicates that the cross-sectional area of the conductors approximate the area of American Wire Gauge for equivalent sizes.
2. Metric wire size is the approximate nominal area of the stranded conductor. Metric dimensions and resistances are not direct conversions from circular mils.
3. See Appendix B for various individual conductor constructions and nominal strand diameters.

The nominal wall thickness, minimum wall thickness, and maximum overall diameter of the finished cable shall be in accordance with Table 2 for the various cable types. The minimum wall thickness shall be measured at five cross sections spaced approximately 50 mm (2 in) apart with an optical device accurate to at least 0.01 mm (0.001 in) or with a pin dial micrometer that exerts a force of 0.25 N $\pm$ 0.02 N (25 g $\pm$ 2 g) on the specimen through a flat rectangular pressure foot. The dimensions of the pressure foot shall be 1 $\times$ 8 mm (0.043 $\times$ 0.312 in) and the pin shall be 11 mm (0.437 in) long with a diameter of 0.5 mm (0.020 in). In case of dispute the referee method shall be the optical device.

TABLE 2—DIMENSIONS (TWP/TXL/TWE)

SAE Wire No.	SAE Wire mm ²	Minimum Wall Individual mm	Minimum Wall Individual in	Minimum Wall Average mm	Minimum Wall Average in	Nominal Wall mm	Nominal Wall in	Maximum O.D. mm	Maximum O.D. in
24	0.22	0.28	0.011	0.32	0.013	0.40	0.016	1.48	0.062
22	0.35	0.28	0.011	0.32	0.013	0.40	0.016	1.63	0.069
20	0.50	0.28	0.011	0.32	0.013	0.40	0.016	1.85	0.076
18	0.80	0.28	0.011	0.32	0.013	0.40	0.016	2.12	0.084
16	1	0.28	0.011	0.32	0.013	0.40	0.016	2.25	0.095
14	2	0.28	0.011	0.32	0.013	0.40	0.016	2.66	0.109
12	3	0.32	0.013	0.35	0.014	0.45	0.018	3.20	0.132
10	5	0.35	0.014	0.40	0.016	0.50	0.020	3.88	0.161
8	8	0.39	0.015	0.44	0.017	0.55	0.022	4.70	0.196

NOTE—Metric dimensions are not direct conversion from inches.

4.3 Finished Cable—The finished cable shall meet the requirements for all tests specified in Table 3 for each cable type.

5. Tests

5.1 Strand Coating—Continuity of coating test shall be conducted on strands prior to stranding and shall be conducted per ASTM B 33 or ASTM B 189.

TABLE 3—TEST REQUIREMENTS

Tests	Cable Types TWP	Cable Types TXL	Cable Types TWE
Conductor Area	X	X	X
Dimensions	X	X	X
Strand Coating	X	X	X
Physical Properties	X	X	X
Dielectric	X	X	X
Cold Bend	X	X	X
Flame	X	X	X
Oil Absorption	X	X	X
Pinch	X	X	X
Abrasion			
Crosslinking		X	

5.2 Insulation Physical Properties—An accelerated aging test shall be conducted in accordance with ASTM D 573 except using specimens of insulation removed from finished cable. The sample shall be stretched at a rate of 500 mm/min (20 in/min). The original properties shall conform to the values shown in Table 4. Samples of insulation shall be aged 168 h in a circulating air oven. The test temperature shall be as shown in Table 4. After aging, the tensile strength shall not be less than 80% of the original test value and the elongation shall not be less than 50% of the original test value.

5.2.1 NOTES

- TWE samples may be preconditioned at test temperature for 24 h prior to taking original measurements. The samples will then be aged for 168 h. The TWE samples shall be stretched at a rate of 50 mm/min (2 in/min).
- The previous accelerated aging test is appropriate for insulating materials currently specified in this document; different test conditions may be necessary for other materials.
- The temperature rating of the insulating material may be determined by conducting a long-term test in accordance with IEC Publication 216-1 or equivalent using 0.40 mm (0.016 in) test specimens.

TABLE 4—INSULATION PROPERTIES

Cable Type	Minimum Tensile Strength MPa	Minimum Tensile Strength psi	Minimum Elongation %	Heat Aging Test ¹ Temperature °C ± 2 °C
TWP	11	1600	125	110
TXL	10	1500	150	155
TWE	11	1600	200	150

¹ For higher temperature materials, higher test temperatures may be used.

5.3 Dielectric Test—Twenty-five mm (1 in) of insulation shall be removed from each end of a 600 mm (24 in) sample of finished cable and the two ends twisted together. The loop thus formed shall be immersed in water containing 5% salt by weight at room temperature so that not more than 150 mm (6 in) of each end of the sample protrudes above the solution. After being immersed for 5 h and while still immersed, the sample shall withstand the application of 1000 V at 60 Hz between the conductor and the solution for 1 min without puncture of the insulation.

5.4 Cold Bend Test—Twenty-five mm (1 in) of insulation shall be removed from each end of a 600 mm (24 in) sample of finished cable. The sample shall be placed in a cold chamber at the specified tem-