BATTERY CABLE—SAE J1127 JUN80 SAE Standard

Report of the Electrical Equipment Committee, approved November 1975, last revised June 1980.

1. Scope—This standard covers battery cables intended for use at 50 volts or less in surface vehicle wiring. Requirements for cable sizes 6 thru 4/0 previously contained in SAE Standard, Low Tension Cable SAE J558 are included. Cable sizes 20 through 4 previously specified in SAE J558 are now included in SAE J1128.

2. Specification Types

2.1 Type SGT—Starter or ground. Thermoplastic insulated.

2.2 Type SGR—Starter or ground. Synthetic rubber insulated.

2.3 Type SGX—Starter or ground. Cross linked polyethylene insulated.

3. General Specifications:

3.1 Conductors—Conductors shall be bunched, concentric or rope stranded as specified in the Appendix and shall be annealed copper wire in accordance with ASTM B-3. When tin or alloy coated wires are used they shall withstand the continuity test as specified under Strand coating test (paragraph 5.1). A separator shall be used between the uncoated conductor and the synthetic rubber insulation. When coated conductors are used no separator is required. The cross sectional area of stranded conductors shall not be less than the values specified in Table 1.

TABLE 1—CONDUCTORS

SAE Wire[a] Size	Metric Wire[b] Size, mm²	Minimum Conductor Area For Finished Cable	
		Cir Mil	mm²
6	13.0	25910	12.1
4	19.0	37360	18.3
2	32.0	62450	31.1
1	40.0	77790	38.1
0	50.0	98980	48.3
2/0	62.0	125100	59.8
3/0	81.0	158600	77.6
4/0	103.0	205500	98.5

[a] SAE wire size number indicates that the cross sectional area of the conductors approximate the area of American Wire Gauge for equivalent sizes.
[b] Metric wire size is the approximate nominal area of the stranded conductor.
Metric dimensions are not direct conversion from circular mils.
See Appendix for various individual conductor constructions and nominal strand diameters.

Minimum conductor area for circular mils is based on 98% of total minimum strand area as specified in ASTM B-3. Minimum conductor area for mm² is based on 98% of minimum strand area. Before processing into finish cable, the minimum strand area for metric strands shall not vary from the specified nominal by more than 1% expressed to the nearest .001 mm.

3.2 Insulation—Insulation shall be homogeneous in character 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.

Insulation thickness shall be in accordance with the appropriate table for the various cable types. Variations in insulation wall thickness are permissible due to eccentricity. However, the minimum wall thickness at any cross section of a test specimen shall not be less than 70% of the nominal wall thickness of insulation specified in the appropriate table for the various cable types. The minimum wall thickness shall be measured with a pin dial micrometer exerting a force of 0.245 N with a mass of 0.025 kg and using a 0.043 in (1 mm) maximum diameter pin.

4. Cable Type Requirements

4.1 Construction—The conductors and insulation shall be as specified in paragraph 3 for each type of cable.

4.2 Test Requirements—The test requirements for each type of cable shall be as indicated in Table 3.

4.3 Dimensions—The nominal wall thickness and maximum overall diameter of finished cable shall be as specified in Table 4.

5. Tests

5.1 Strand Coating—Tin test shall be conducted on strands prior to stranding and shall be conducted per ASTM B-33. Alloy coated wire shall conform to ASTM B-189.

5.2 Physical Properties (Insulation)—Test samples of insulation that have been removed from the conductors shall be used. The conductor may be stretched for greater ease in removing it from the insulation. The sample may be tested as tube, slit-tube forms, or as dumbbells. The sample shall have marks placed upon it 2 in (50 mm) apart. The sample shall then be stretched at the rate of 20 in (508 mm) per min. The tensile strength shall be calculated upon the original cross section of the test sample before stretching. Physical tests shall be made at room temperature of 75 ± 5°F (21.1°C). For the purpose of these tests care must be used in cutting and obtaining samples of uniform cross section.

5.3 High Temperature—One in (25 mm) of insulation shall be removed from each end of a 24 in (610 mm) sample of finished cable. The sample shall be suspended around a cylindrical mandrel with a weight attached to each end of the sample. This condition shall be maintained in a circulating air oven. The mandrel size, weight, temperature and time shall be as specified in Table 5.

At the end of the above conditioning period the sample shall be removed from the oven and allowed to cool to room temperature. When cool the weights shall be removed and the sample bent in the reverse direction around the mandrel at a rate not to exceed one complete turn per minute. The sample shall then be subjected to the Dielectric test as specified in paragraph 5.4.

5.4 Dielectric Test—One in (25 mm) of insulation shall be removed from each end of a 24 in (610 mm) sample of finished cable and the two ends connected together. The loop thus formed shall be immersed in water con-

TABLE 2—INSULATION PROPERTIES

Cable Types	Min. Tensile Strength		Min. Elongation Percent
	psi	kPa	
SGT	1600	11000	200
SGR	1000	6900	150
SGX	1500	10000	150

TABLE 3—TEST REQUIREMENTS

Tests	Cable Types		
	SGT	SGR	SGX
Strand Coating	x	x	x
Physical Properties	x	x	x
High Temperature	x	x	x
Dielectric	x		x
Cold Bend	x	x	x
Flame	x		x
Oil Absorption	x	x	x
Abrasion Resistance	x		x

TABLE 5—HIGH TEMPERATURE TEST

Cable Type Test Conditions	SGT SGR 120 h/250 ± 2°F (121°C)				SGX 168 h/302 ± 3°F (150°C)			
SAE Wire Size	Mandrel		Weight		Mandrel		Weight	
	in	mm	lb	kg	in	mm	lb	kg
6	10	254	6	2.72	10	254	6	2.72
4	10	254	6	2.72	10	254	6	2.72
2	10	254	6	2.72	10	254	6	2.72
1	10	254	6	2.72	10	254	6	2.72
0	10	254	10	4.54	10	254	10	4.54
2/0	10	254	10	4.54	10	254	10	4.54
3/0	10	254	10	4.54	—	—	—	—
4/0	10	254	10	4.54	—	—	—	—

Note: Metric dimensions and weights are direct conversion from inches and pounds.

TABLE 4—DIMENSIONS[b]

SAE Wire Size	Metric Wire Size, mm²	SGT				SGR				SGX			
		Nom. Wall		Max. Dia.		Nom. Wall		Max. Dia.		Nom. Wall		Max. Dia.	
		in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
6[a]	13.0	.060	1.52	.340	7.36	.047	1.19	.340	7.36	.043	1.09	.300	6.49
4[a]	19.0	.065	1.65	.420	8.86	.047	1.19	.420	8.86	.065	1.65	.420	8.86
2	32.0	.065	1.65	.505	12.74	.065	1.65	.505	12.74	.065	1.65	.505	12.74
1	40.0	.065	1.65	.557	13.86	.065	1.65	.557	13.86	.065	1.65	.557	13.86
0	50.0	.065	1.65	.600	14.95	.065	1.65	.600	14.95	.065	1.65	.600	14.95
2/0	62.0	.065	1.65	.655	16.15	.065	1.65	.655	16.15	.065	1.65	.655	16.15
3/0	81.0	.078	1.98	.750	18.67	.078	1.98	.750	18.67	—	—	—	—
4/0	103.0	.078	1.98	.810	19.73	.078	1.98	.810	19.73	—	—	—	—

[a] The 6 and 4 gage wall thickness can be the same as for GPT.
[b] Metric dimensions are not direct conversion from inches.

taining 5% salt by weight at room temperature so that not more than 6 in (152 mm) of each end of the sample protrudes above the solution. After being immersed for five hours and while still immersed the sample shall withstand the application of 1000 V (rms) at 60 Hz between the conductor and the solution for 1 min without puncture of the insulation.

5.5 Cold Bend Test—One in (25 mm) of insulation shall be removed from each end of a 24 in (610 mm) sample of finished cable. The temperature of the sample shall be lowered at a rate of 122°F (50°C) per minute until the specified temperature is reached. This temperature shall be maintained for three hours. While the sample is still at this low temperature it shall be wrapped around a mandrel for 180 deg at a uniform rate of one turn in 10 s. The temperature and mandrel size shall be as specified in Table 6. Either a revolving or stationary mandrel may be used. When a revolving mandrel is used fasten one end of the sample to the mandrel. The sample shall then be subjected to the dielectric test as specified in paragraph 5.4.

5.6 Flame Test—A bunsen burner having a $\frac{1}{2}$ in (13 mm) inlet, a nominal bore of $\frac{3}{8}$ in (10 mm), a length of approximately 4 in (102 mm) above the primary inlets, equipped with a wing top flame spreader having a $\frac{1}{16}$ x 2 in (1 x 51 mm) opening fitted to the top of the burner shall be used. A 24 in (610 mm) sample of finished cable shall be suspended taut in a horizontal position within a partial enclosure which allows a flow of sufficient air for complete combustion but is free from drafts. The top of a 2 in (51 mm) gas flame with an inner cone one-third its height shall then be applied to the center of the suspended cable. The time of application of the flame shall be 30 s for SAE wire 6 through 4/0. After removal of the bunsen burner flame the sample shall not continue to burn for more than 30 s.

5.7 Oil Absorption Test—One in (25 mm) of insulation shall be removed from each end of a 24 in (610 mm) sample of finished cable. The sample shall be immersed to within $1\frac{1}{2}$ in (38 mm) from the ends of the insulator in a liquid containing equal parts of kerosene and SAE 10W engine oil at a temperature of 118–122°F (48–50°C) for a period of at least 20 h. The outside diameter of the cable shall not increase more than 15%. The sample shall then be bent around a 10 in (254 mm) mandrel and then subjected to the Dielectric Test, paragraph 5.4.

5.8 Abrasion Resistance—One in (25 mm) of the insulation shall be removed from one end of a 36 in (914 mm) sample of finished cable. The sample shall then be placed taut, without stretching between the cable clamps as shown in military specification MIL-T-5438. Using the weight support bracket and weight specified in Table 8. The sample shall then be subjected to the abrasion test. After each reading the sample shall be moved 2 in (51 mm) and rotated clockwise 90 deg. Eight readings shall be obtained for each sample. Obtain an average by calculating the arithmetic mean of all readings. Discard all readings above the arithmetic mean and average the remaining readings. The average shall define the abrasion resistance of the cable under ϕ test.

TABLE 6—COLD BEND TEST

Cable Type Test Conditions	SGT SGR SGX 3 h/−40°F (−40°C)			
SAE Wire Size	Mandrel		Weight	
	in	mm	lb	kg
6	10	254	6	2.72
4	10	254	6	2.72
2	10	254	6	2.72
1	18	457	6	2.72
0	18	457	10	4.53
2/0	18	457	10	4.53
3/0	18	457	10	4.53
4/0	18	457	10	4.53

Note: Metric dimensions and weights are direct conversion from inches and pounds.

ϕ TABLE 7—ABRASION TEST (REQUIREMENTS)

SAE Wire Size	Minimum Resistance—in (mm) of Tape			
	SGT		SGX	
	in	mm	in	mm

Previous abrasion data invalid. Corrected values to be established at a later date.

TABLE 8—ABRASIONS TEST (CONDITIONS)

SAE Wire Size	SGT SGX		
	Br	lb	kg
6	C	4.25	1.93
4	C	4.25	1.93
2	C	4.25	1.93
1	C	4.25	1.93
0	C	4.25	1.93
2/0	C	4.25	1.93
3/0	C	4.25	1.93
4/0	C	4.25	1.93

APPENDIX—RECOMMENDED CONDUCTOR CONSTRUCTIONS (AWG STRANDS)

SAE Wire Size	Class I No. Strands/AWG Size (in)	Class II No. Strands/AWG Size (in)
6	37/21 (.0285)	7 x 19/27 (.0142)
4	61/22 (.0253)	7 x 19/25 (.0179)
2	127/23 (.0226)	7 x 19/23 (.0226)
1	127/22 (.0253)	7 x 37/25 (.0179)
0	127/21 (.0285)	7 x 37/24 (.0201)
2/0	127/20 (.0320)	7 x 37/23 (.0226)
3/0	—	7 x 37/22 (.0253)
4/0	—	19 x 22/23 (.0226)

RECOMMENDED CONDUCTOR CONSTRUCTIONS (METRIC STRANDS)

SAE Wire Size	Metric Size, mm^2	Class I No. Strands/mm Size	Class II No. Strands/mm Size
6	13.0	37/.66	
4	19.0	61/.63	—
2	32.0	127/.57	7 x 19/.57
1	40.0	127/.63	7 x 19/.63
0	50.0	127/.71	7 x 19/.71
2/0	62.0	127/.79	7 x 19/.79
3/0	81.0	—	7 x 37/.63
4/0	103.0	—	7 x 37/.71

Note: Stranding other than those shown above for both SAE and metric wire sizes are acceptable providing they meet the minimum conductor area specified in Table 1.