A-09-15

SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL

A Product of the
Cooperative Engineering Program

SAE J1494 JUN89

Battery Booster Cables

SAE Recommended Practice
Issued June 1989

Submitted for Recognition as an American National Standard

SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®
400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

HIGHWAY VEHICLE RECOMMENDED PRACTICE

Submitted for recognition as an American National Standard

SAE J1494

Issued June 1989

BATTERY BOOSTER CABLES

1. SCOPE:

The purpose of this SAE Recommended Practice is to establish minimum performance and user information requirements for battery booster cable sets. Such sets may be used to provide a temporary connection of a surface vehicle battery to another similar battery to provide emergency power when required. This recommended practice DOES NOT ENDORSE NOR RECOMMEND the potentially hazardous procedure of jump starting a vehicle.

2. SPECIFICATION TYPES:

The battery booster cable sets covered by this specification shall have a minimum rating as shown below when tested in accordance with 3.3.

2.1 Light duty - 125 A minimum

2.2 Medium duty - 225 A minimum

2.3 Heavy-duty - 350 A minimum

2.4 Extra heavy-duty - 500 A minimum

2.5 Super heavy-duty - 750 A minimum

3. GENERAL SPECIFICATIONS:

3.1 Conductors: The conductors shall be bunched, concentric or rope stranded as specified in Table 1 and shall be annealed copper wire in accordance with ASTM B 3.

3.1 (Continued):

When tin-alloy-coated wires are used, they shall withstand the continuity of coating test as specified in ASTM B 33 or B 189. If a synthetic rubber insulation is used, a separator shall be placed between the uncoated conductor and the insulation. When coated conductors or chemically nonreactive insulation materials are used, no separator is required. The cross sectional area of stranded conductors shall not be less than the values specified in Table 1.

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

The minimum wall thickness of the finished cable shall be in accordance with Table 1. 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 (the nominal wall thickness is one half the difference between the nominal overall diameter of the finished cable and the nominal conductor diameter). The minimum wall thickness shall be measured with an optical device accurate to at least 0.001 in (0.01 mm) or with a pin dial micrometer that exerts a force of 25 g ± 2 (0.25 N ± 0.02) on the specimen through a flat rectangular pressure foot. The dimensions of the pressure foot shall be 0.043 in x 0.312 (1 mm x 8) and the pin shall be 0.437 in (11 mm) long with a diameter of 0.020 in (0.5 mm). In the case of a dispute, the referee method shall be the optical device.

The temperature rating of the cable insulation shall be a minimum of 140°F (60°C) as determined by an accelerated aging test conducted in accordance with ASTM D 573, except samples of insulation are to be removed from the finished cable and aged 168 h. The test temperature shall be 54°F (30°C) above the intended rated temperature.

The tensile strength after aging shall not be less than 80% of the original tensile strength. The elongation after aging shall be at least 50% of the original elongation. Samples may be preconditioned at the test temperature for a period not to exceed 24 h before conducting the accelerated aging test.

3.3 The Procedure For Determining Battery Booster Cable Set Rating: The following procedure should be performed at an ambient temperature of 73°F ± 9 (23°C ± 5), in order to determine the battery booster cable set rating as shown in section 2.

3.3.1 Recommended Equipment:

a. Source of constant DC current with sufficient capacity to allow a 2.5 V minimum drop on each cable with a current measuring capability of ±1% accuracy.

b. Stainless steel electrodes per Fig. 1 attached to current source electrodes.

c. Voltmeter (accurate to 0.01 V).

3.3.1 (Continued):

d. Timing device.

e. Thermocouple (iron/constantan type).

f. Chart recorder with 250°F ± 5 (121°C ± 3) maximum reading. Accurate to 0.25% full scale.

3.3.2 Test Procedure:

a. Attach one of the cables of the battery booster cable set to the current source by clamping to the stainless steel electrode area A (see Fig. 1) in the manner the clamps would normally be used.

b. Attach the thermocouple to the battery booster cable clamp handle by taping tightly to the outer surface at a mid-point between the pivot and the rear of the current carrying clamp. If nonpermanently attached grips are used, slide the grip off the handle and apply thermocouple directly to the handle. (Thermocouple is attached in an area normally gripped by the user). Attach the other end of the thermocouple lead to the chart recorder.

c. Select a test current and apply to the cable.

d. After 10 s, measure and record the voltage drop from one stainless steel electrode to the other.

e. After 15 s, turn off the current.

f. Monitor the temperature of the handle for an additional 2 min and record the maximum temperature. The maximum temperature permitted is 150°F (66°C).

Note: Some clamps will be at a maximum temperature immediately after the current is turned off, others will continue to rise for various periods.

g. Repeat steps a through f with the other cable of the battery booster cable set.

h. Repeat steps a through g with successive greater test currents until the test current produces a combined total voltage drop of 5.0 V for both cables in the battery booster cable set. The cables should be allowed to cool for approximately 15 min before retesting.

3.3.2 (Continued):

i. Repeat steps a through h with the battery booster cable clamp attached to area B (see Fig. 1) of the stainless steel electrode.

j. Using the test data from area A and B, determine the largest of the test currents that does not cause a combined total voltage drop of more than 5.0 V or a temperature of more than 150°F (66°C) on the handle. The rating of the cable set shall be the lowest amperage rating of the results of tests performed using Clamping Area A and Clamping Area B.

4. CABLE REQUIREMENTS:

4.1 Cold Bend Test: Remove 1 in (25 mm) of insulation from each end of a 24 in (610 mm) sample of finished cable. Attach the sample to either a revolving or a stationary mandrel. If a revolving mandrel is used, the sample is to be secured to the mandrel and a weight attached to the free end as specified in Table 2. If a stationary mandrel is used, the sample is to be conditioned at the low temperature without weights, and manually bent around the specified mandrel. Lower the temperature to -40°F (-40°C) and maintain for 3 h. While the sample is still at -40°F (-40°C), it shall be wrapped around the mandrel for 180 deg at a uniform rate of one turn in 10 s.

The cable shall then be looped and immersed in water containing 5% salt by weight for a period of 5 h at room temperature with 5 in (127 mm) to 6 in (152 mm) of each end of the sample protruding above the solution. The sample shall withstand the application of 1000 V at 60 Hz between the conductor and solution for 1 min without puncturing the insulation.

4.2 Flame Test: A bunsen burner having a 1/2 in (13 mm) inlet, a nominal bore of 3/8 in (10 mm), a length of approximately 4 in (102 mm) above the primary inlets equipped with a wing top flame spreader, is positioned parallel to the cable, and has a 1/16 x 2 in (1.6 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 that 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 gages 10 (5 mm^2) through 4/0 (103 mm^2). After removal of the bunsen burner flame, the sample shall not continue to burn for more than 30 s.

4.3 Deformation Test: The insulation thickness T_1 is to be determined from measurements made on a 24 in (610 mm) length of insulated cable. The ends of parallel cables must be separated. The difference method consists of obtaining five readings to determine the average diameter over the insulation and subtracting from it the diameter of the conductor plus any separator with the difference divided by two. Measurements are made with a machinist's caliper micrometer having flat surfaces on both the anvil and the end of the spindle and calibrated to read directly to at least 0.001 in (0.01 mm).

The insulation thickness T_2 at an elevated temperature shall be determined from measurements made by a dead-weight dial micrometer with a presser foot 0.375 in ± 0.010 (9.5 mm ± 0.2) in diameter and with graduations of 0.001 in (0.01 mm). The micrometer shall be actuated by a weight of a magnitude that causes the foot of the micrometer to press on a specimen positioned between the foot and the anvil with 500 gf (4.9 N) load.

With the weight in place on its spindle, the micrometer shall be placed beside the test specimen in a full-draft circulating air oven, which has been preheated to a temperature of 250°F ± 2.0 (121°C ± 1.0). The specimen and the micrometer shall remain side by side in the oven for 1 h of preliminary heating at full draft. At the end of the hour, the specimen shall be placed on the anvil of the micrometer. The loaded presser foot shall be gently brought to bear on the specimen and shall continue to bear on it while the micrometer and the specimen remain in the oven for an additional hour at full draft at a temperature of 250°F ± 2.0 (121°C ± 1.0). The entire surface of the presser foot shall be in contact with the specimen.

At the end of the second hour, the thickness T_2 of the specimen shall read directly from the dial on the loaded micrometer and shall be recorded to the nearest 0.001 in (0.01 mm). From this reading, subtract the core diameter and divide by two. The specimens shall not decrease more than 50% in thickness.

5. CONNECTOR DEVICES:

All connector devices shall provide a sound mechanical and good electrical connection to the point of attachment such as a battery terminal, stud, or metallic ground. The connector devices shall be free from burrs and sharp corners. The temper of the connectors shall be sufficiently soft to permit the connectors being assembled to the cable from showing any fracture or cracks that would impair the strength of the assembly. All connector devices shall be insulated to protect the user against cuts, burns, and scratches.

5.1 Connector Attachment: The connectors may be attached to the cables by crimping, swaging or a combination of both. Each end of a cable connected to a connector device must be able to withstand a tensile force of 100 lb (445 N) applied in an axial direction without affecting the cable/connector device interface or the integrity of the current carrying connection.

5.2 Connector Identification: The color black and any contrasting color, except white, connectors must be used at the battery contact point. If "+", "POS", and/or "POSITIVE" is marked on a connector, it must appear on the contrasting color clamp. If "-", "NEG", and/or "NEGATIVE" is marked on a connector, it must appear on the black clamp.

6. LABELING INFORMATION:

6.1 Tags: The following information must be affixed to the battery booster cable set. It should be printed on a material that is capable of withstanding abuse during normal usage.

a. Instructions For Jump Starting An Engine:

WARNING - Batteries Contain Acid And Produce Explosive Gases

Note: Consult the owner's manual for complete instructions. SHIELD THE EYES AND FACE FROM THE BATTERIES AT ALL TIMES. Be sure the vent caps are tight and level. Place a damp cloth, if available, over any vent caps on both batteries. Be sure the vehicles do not touch and that both electrical systems are off and at the same voltage. These instructions are for negative ground systems only.

(1) Connect the positive (+) cable to the positive (+) terminal of the discharged battery that is wired to the starter or solenoid.

(2) Connect the other end of the positive cable to the positive terminal of the booster battery.

(3) Connect the black negative (-) cable to the other terminal (negative) of the booster battery.

(4) MAKE THE FINAL CONNECTION ON THE ENGINE BLOCK OF THE STALLED VEHICLE (NOT TO THE NEGATIVE POST) AWAY FROM THE BATTERY. STAND BACK.

(5) Start the vehicle and remove the cables in the reverse order of connection (the engine block (black) connection is the first to disconnect).

6.2 Packaging: The tag information, see 6.1, must appear on the package in addition to the following warnings and safety procedures:

a. Battery Booster Cable Instructions for Jump Starting an Engine:

Warning - Batteries Contain Acid And Produce Explosive Gases.

These instructions are designed to minimize the explosion hazard. Keep sparks, flames, and cigarettes away from the batteries at all times. Wear safaety glasses, and protect the eyes at all times. Do not lean over the batteries during this operation.

Both the battery to be jumped and the booster source must be of the same voltage (6 or 12 V, etc.). Power sources other than batteries should not exceed 16 V DC for use with 12 V systems, and 8 V DC for use with a 6 V DC system.

Position the vehicle with the booster battery, or other power source, adjacent to the vehicle with the discharged battery so that booster cables can be connected easily between both vehicles. Make certain that the vehicles do not touch each other.

(1) Turn off all electrical loads on all vehicles and set the parking brake. Place the automatic transmissions in "PARK" (manual transmission in "NEUTRAL").

(2) Determine whether the discharged battery has the negative (-) or the positive (+) terminal connected to the ground. The ground lead is connected to the engine block, the vehicle frame, or some other good metallic ground. The battery terminal connected to the starter is the one that is not grounded. All vehicles manufactured in the U.S.A. after 1955 have the negative battery terminal grounded. All European and Asian passenger vehicles manufactured after 1971 have the negative battery terminal grounded.

(3) On a negative ground system, connect the positive (+) cable to the positive (+) terminal of the discharged battery wired to the starter or solenoid. Do not allow the positive cable clamps to touch any metal other than the battery positive (+) terminals.

(4) Be sure that the vent caps are tight and level on both batteries. Place a damp cloth over any vent caps on each battery making certain it is clear of fan blades, belts, and other moving parts.

6.3 Supplemental Packaging Information: Additional supplemental information and instructions may also be included.

TABLE 1 – Recommended Conductor Constructions and Insulation Thickness

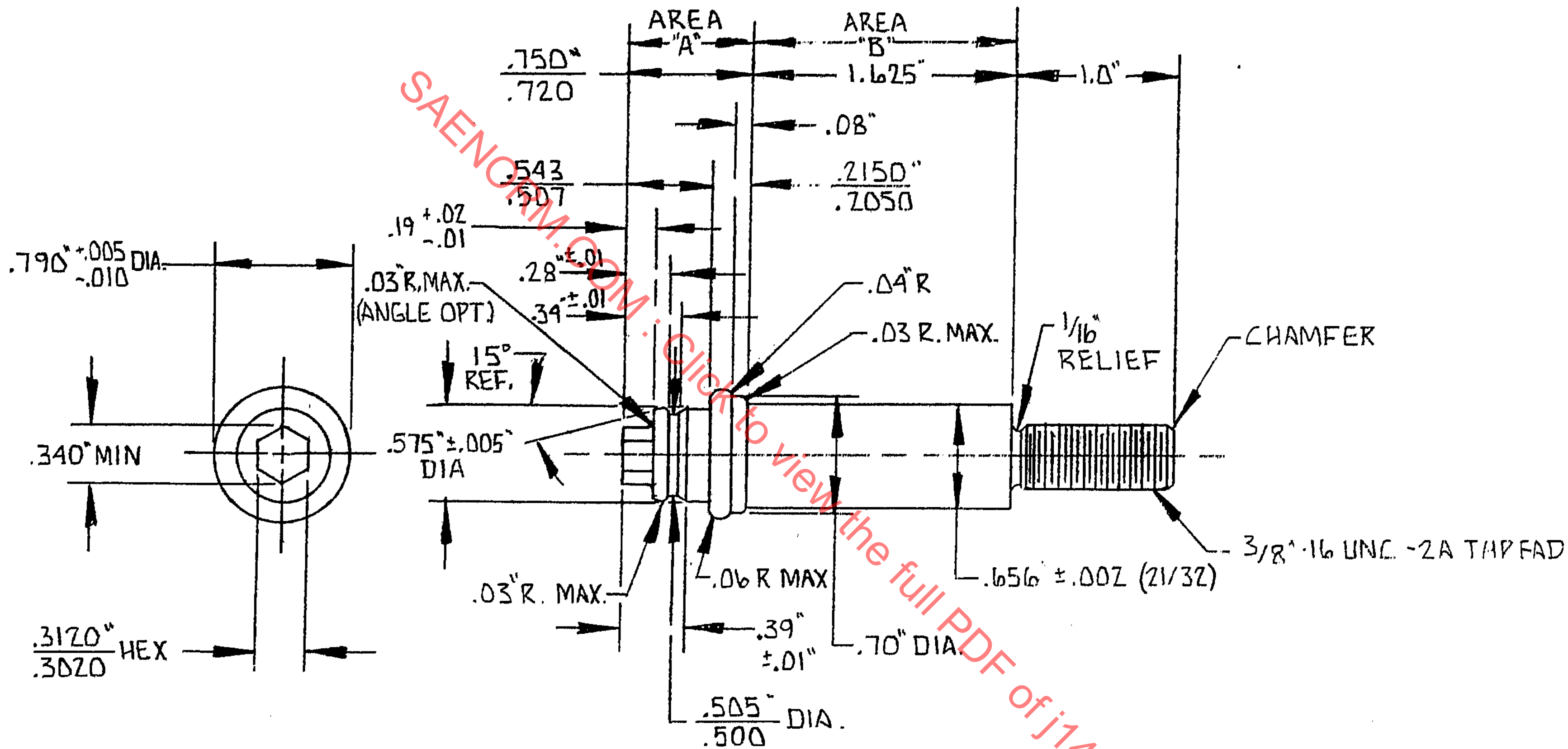
SAE Wire[a] Size	Metric Wire[b] Size mm^2	Minimum Conductor Area For Finished Cable Cir Mil	Minimum Conductor Area For Finished Cable mm^2	No. Strands	Gage in	Gage mm	Minimum Wall Thickness in	Minimum Wall Thickness mm
10	5	9343	4.65	19/23	0.0226	0.574	0.042	1.07
8	8	14810	7.23	19/21	0.0285	0.724	0.042	1.07
6	13	25910	12.1	37/21	0.0285	0.724	0.042	1.07
4	19	37360	18.3	61/22	0.0253	0.643	0.046	1.17
2	32	62450	31.1	127/23	0.0226	0.574	0.046	1.17
1	40	77790	38.1	127/22	0.0253	0.643	0.046	1.17
0	50	98980	48.3	127/21	0.0285	0.724	0.046	1.17
2/0	62	125100	59.8	127/20	0.0320	0.813	0.046	1.17
3/0	81	158600	77.6	259/22	0.0253	0.643	0.055	1.40
4/0	103	205500	98.5	427/23	0.0226	0.574	0.055	1.40

[a]The SAE wire size number indicates that the cross sectional area of the conductors approximate the area of the American Wire Gage for equivalent sizes.
[b]The metric wire size is the approximate nominal area of the stranded conductor. The metric dimensions are not the direct conversion from the circular mils.

NOTE: Stranding other than those shown for SAE and metric wire sizes are acceptable provided they meet the minimum conductor area specifications in Table 1.

TABLE 2 – Cold Bend Test
–40°F (–40°C)

Wire Size SAE	Wire Size mm^2	Mandrel in	Mandrel mm	Weight lb	Weight kg
10	5	6	152	6	2.72
8	8	6	152	6	2.72
6	13	6	152	6	2.72
4	19	6	152	6	2.72
2	32	8	203	6	2.72
1	40	8	203	6	2.72
0	50	10	254	10	4.54
2/0	62	10	254	10	4.54
3/0	81	10	254	10	4.54
4/0	103	10	254	10	4.54



MATERIAL: SAE 30302, 51410, 51416 OR 51430 STAINLESS STEEL

FIGURE 1 - Stainless Steel Electrode