SAE International™

SURFACE VEHICLE STANDARD

J1067	REV. JUN2007
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Superseding J1067 JUN1998	

Seven Conductor Cable—Truck and Bus

RATIONALE

The SAE J1067 document was reviewed as part of the SAE five-year review process. The document contains stronger references to superseding SAE J1067 for ABS applications, now includes converter dollies within its scope, substituted SAE J1128 test methods for previous UL references where practical to better reflect methods that are familiar to the SAE community, clarified the deformation or pinch test, eliminated the Taber abrasion resistance approach and specified a minimum performance value for the SAE J1128 abrasion method. A new cold impact test guideline was also included.

FOREWORD

This document has been re-published for tractors or trailers that are not equipped with ABS as the wire size of the ABS circuit in this standard is insufficient to effectively power ABS. The use of the superseding SAE J2394 standard that does support ABS power is strongly recommended.

1. SCOPE

This SAE standard establishes the minimum construction and performance requirements for seven conductor 1/8-1/10-5/12 cable for use on trucks, trailers and converter dollies. Where appropriate, the standard refers to two types of cables, (Type F and S, described later in the standard), due to the variation in the performance demands of cables used in flexing and stationary applications.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest version of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

SAE J844 Nonmetallic Airbrake System Tubing

SAE J1128 Low Tension Primary Cable

2.1.2 ASTM Publications

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM B 3 Specification for Soft or Annealed Copper Wire

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

ASTM B 117 Method of Salt Spray (Fog) Testing

ASTM B 172 Specification for Rope Lay Stranded Copper Conductors Having Bunch-Stranded Members for Electrical Conductors

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 B 263 Standard Test Method for Determination of Cross-Sectional Area of Stranded Conductors

ASTM D 412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers—Tension

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

ASTM D 4060 Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser

ASTM E 145 Standard Specification for Gravity—Convection and Forced-Ventilation Ovens

2.1.3 UL (Underwriters Laboratory) Publications

Available from Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096, Tel: 847-272-8800, www.ul.com.

UL 1581 Reference Standard for Electrical Wires, Cables, and Flexible Cords—Section 593

3. DEFINITIONS

3.1 Flexing

Describes a condition where the cable is installed in an unsupported way over a distance of greater than 0.5 m (18 in) and/or where there is a reasonable likelihood that the cable will be subjected to bending, longitudinal extension, or significant movement. As an example all cables connecting the tractor to trailer or dolly to trailer are to be considered flexing cables.

3.2 Stationary

Describes a condition where the cable is installed in a fashion where its weight is supported within a distance of 0.5 m (18 in) or less, and where there is little likelihood of flexing as described above. An example of a stationary application is cable that is connected with clamps to a vehicle chassis.

3.3 Conductor

The current carrying element(s) in a cable comprised of a series of copper strands twisted together.

3.4 Strand

The solid component members of a conductor.

3.5 Lay

The measure along a single plane, between an individual strand or series of copper strands or insulated conductor's starting and ending points in a complete spiral wrap around the grouping of which it is a part.

3.6 Insulation

The material applied to the conductor to provide electrical insulation and a level of mechanical protection.

3.7 Cable Core

The grouping of insulated conductors twisted together.

3.8 Jacket

The outer sheath applied to the cable core to maintain inner conductor positioning and to enhance the mechanical strength and durability of the cable.

4. TYPES

Due to the variation in the performance demands of cables used in different applications within the truck-trailer system, this document addresses two types of cables, determined by their mode of installation.

4.1 Type F—Flexing

Pertains to cables that are subjected to flexing as defined in 3.3.

4.2 Type S—Stationary

Pertains to cables that are stationary as defined in 3.3.

5. IDENTIFICATION CODE DESIGNATION

Cable conforming to this document shall be identified with the manufacturer's identification, and shall be identified with SAE J1067 and the revision (month and year) of this document along with the cable type as described in this document.

EXAMPLE: XYZ Corp SAE J1067(mo/yr) - Type S (or F)

6. TECHNICAL REQUIREMENTS

6.1 Conductors

6.1.1 Material

All conductors shall be of stranded, soft-annealed copper, complying with ASTM B 3, and ASTM B 174-Class K or ASTM B 172-Class K. Strands may be uncoated or may be coated in a tin complying with ASTM B 33 or a tin/lead coating complying with ASTM B 189.

6.1.2 Cross-Sectional Area

The cross-sectional area of stranded conductors shall not be less that the values specified in Table 1. The cross-sectional area may be verified by measuring actual strand sizes or by using the weight method in ASTM B 263 with a calculated factor to allow for the twist loss.

6.1.3 Stranding

The individual strands contained within a conductor shall be of the same nominal diameter. The minimum number of strands per wire size for the two types of cable covered by this document, are as shown in Table 1.

6.1.4 Strand Lay

The maximum acceptable lay of strands for each wire size, regardless of the number of strands in the conductor, is as shown in Table 1.

6.1.5 Conductor Splicing

When agreed between the supplier and purchaser, splices may be used for the individual strands or for the conductor as a whole, provided that they are made in a workmanlike manner as described in ASTM B 172-95/174, and that they fulfill the following criteria:

6.1.5.1 The break strength shall not be reduced by more than 20%.

6.1.5.2 The resistance shall not be increased.

6.1.5.3 The diameter of the splice must not exceed the diameter of the uninsulated strand or conductor being spliced by more than 20%.

6.1.5.4 Single strand splices are not to be closer together than two lay lengths in a bunched or concentric stranded conductor and twenty lay lengths in a rope-lay construction and there shall be no more than three single strand splices per 3 m of conductor.

6.1.5.5 Whole conductor splices are not to be closer together than twenty conductor lay lengths in the cable core and there shall be no more than three whole conductor splices per 100 m of cable.

TABLE 1 - CONDUCTORS

METRIC					ENGLISH		
SAE Wire Size mm^2	Min. Cond. Area mm^2	Max. Strand Lay Length mm	Type F (Flexing) Min. Strands	Type S (Stationary) Min. Strands	SAE Wire Size No.	Min. Cond. Area cir mils	Max. Strand Lay Length Inches
3	3.24	70	65	19	12	6334	2.75
5	5.16	64	104	19	10	10069	2.50
8	8.20	76	168	19	8	16104	3.00

NOTE 1: English units are not direct conversions from metric.
NOTE 2: The metric wire size is the approximate nominal area of the conductor.
NOTE 3: The SAE wire size number indicates that the cross-sectional area of the conductor approximates the area of the American Wire Gauge for the equivalent size.

6.2 Insulation

6.2.1 Material Physical Properties

The unaged physical properties of insulation material, tested in accordance with the method identified in ASTM D 412 at room temperature, (23 °C ± 5 °C) shall be a minimum of the following values:

6.2.1.1 Minimum tensile strength of 10 MPa (1500 psi).

6.2.1.2 Minimum elongation of 150%.

An accelerated aging test involving heat aging for 168 hours at 110 °C shall be conducted in accordance with SAE J1128.

6.2.2 Application

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 conductor leaving it reasonably clean and in suitable condition for termination.

6.2.3 Insulated Conductor Outside Diameter

The outside diameter of each insulated conductor shall be measured in accordance with SAE J1128. The mean of the diameter readings shall determine the finished insulated conductor diameter and shall be no greater than the maximum values shown in Table 2.

6.2.4 Wall Thickness

The minimum wall thickness shall be measured using the method outlined in SAE J1128. All individual wall thickness values must be in accordance with those listed in Table 2.

6.2.5 Dielectric Voltage Withstand Test

This test is only practical for use by manufacturers of the wire or cable. Refer to 6.2.6 for an alternate test for use by those wishing to test cable before installation or use in harness assemblies. Unless otherwise specified, all specimens shall be the entire length of wire conductors subjected to continuous spark testing with voltage set at 1500 volts, AC.

6.2.5.1 Apparatus

6.2.5.1.1 Spark Tester

A transformer of sufficient capacity to maintain the test voltage specified in the detailed specification under all normal conditions of leakage current shall be used. The core of the transformer and one end of the secondary winding shall be connected to ground. A voltmeter shall be so located in the circuit that it will indicate at all times the actual test voltage applied. The spark tester shall not be simultaneously connected to more than one electrode.

6.2.5.1.2 Electrode

An electrode which makes direct mechanical contact with the surface of the insulation of the wire or cable undergoing test shall be used. A pipe, coiled spring or the like shall not be acceptable. If the link bead-chain type of electrode is used, the bottom of the metal electrode enclosure shall be “V”-shaped. The chains shall have a length appreciably greater that the depth of the enclosure. The width of the trough shall be approximately 38 mm (1.5 in) greater than the diameter of the largest wire or cable to be tested. If a bead-chain type of electrode is used, the beads shall have a diameter of 5 mm (3/16 in). The longitudinal spacing of the chains shall not be more than 13 mm (1/2 in). The transverse spacing of the chains shall not be more than 9.5 mm (3/8 in), except that the spacing may be 13 mm (1/2 in) if the transverse rows of chain are staggered. The electrode shall be provided with a grounded metallic screen or the equivalent as a guard against contact by personnel. The length of the electrode shall be sufficient to meet the requirements in 6.2.5.2.

6.2.5.1.3 Fault Signaling Device

A fault signaling device or system shall include a visible signal, a defect recording device, and/or an automatic stop device. The arrangement shall operate in such a way that when the fault signal is given, it will be maintained until manually reset.

6.2.5.2 Procedure

The spark test shall be conducted as near to the end of the manufacturing process as is practicable. The test voltage shall be as specified in the detailed specification. The specimen shall be attached to the electrode and the electrode connected to one lead of the transformer secondary. Both ends of the conductor of the specimen, the other secondary lead and the transformer core shall be grounded. A direct connection shall be made between the ground of the conductor at the take-up end of the transformer secondary ground. The voltmeter located in the circuit shall indicate the test potential at all times during the test. The speed of the specimen through the electrode shall be adjusted so that contact between the electrode and any point on the insulation of the specimen will be maintained for at least 0.15 seconds. This rate limits the speed of the specimen travel to a maximum of 10 m (33 ft) per minute per 25 mm (1 in) of electrode length. Unless otherwise specified in the detailed specification, the entire delivery of the wire shall be tested.

6.2.6 Alternate Dielectric Test

This test is an alternative to the dielectric voltage withstand test of 6.2.5, for users of cable who wish to perform such a test prior to installation or use in harness assemblies. A 25 mm (1 in) length of insulation shall be removed from each end of a 600 mm (24 in) sample of each size of finished insulated conductor 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 hours and while still immersed, the sample shall withstand the application of 1000 V rms at 50 to 60 Hz between the conductor and the solution for 1 minute without failure of the insulation.

6.2.7 Cold Bend Test

Using a specimen of each of the insulated conductor sizes employed in the cable and a mandrel size as identified in Table 2, condition and test the specimen at –40 °C according to the method outlined in SAE J1128. A visual inspection shall reveal no cracks or splits. The sample is to be returned to room temperature and then subjected to the dielectric test specified in 6.2.5 or 6.2.6.

6.2.8 Deformation (Pinch) Test

Insulated conductors shall pass the pinch test outlined in SAE J1128. Note that while this test does not specify elevated temperature in the way that a UL deformation test would, the heat aging requirement contained in the above physical properties section is considered fully adequate for the application.

6.2.9 Abrasion Resistance

The cable jacket shall be subjected to the sandpaper abrasion resistance test outlined in SAE J1128. The resistance shall meet or exceed the minimum abrasion requirement of 0.7 N (3 lb).

6.2.10 Fluid Resistance

Insulated conductors shall pass the fluid compatability requirements as outlined in SAE J1128.

6.2.11 Color-Coding

The conductor color-coding by wire size for this construction is as follows:

3mm^2(12 AWG)—Black, Yellow, Green, Brown, Blue (5 conductors)
5mm^2(10 AWG)—Red (1 conductor)
8mm^2(8 AWG)—White (1 conductor)

The color of the insulated conductors shall match as closely as possible the central colors specified in SAE J1128.

TABLE 2 - INSULATION

METRIC				
SAE Wire Size mm^2	Max. OD mm	Minimum Wall Thickness mm	Mandrel Diameter mm	Abrasion Resistance Newtons
3	3.80	0.46	12.7	0.7
5	4.70	0.56	12.7	0.7
8	6.00	0.46	12.7	0.7
ENGLISH				
SAE Wire Size No.	Max. OD in	Minimum Wall Thickness in	Mandrel Diameter in	Abrasion Resistance Lbs
12	0.150	0.018	0.5	3.0
10	0.185	0.022	0.5	3.0
8	0.235	0.018	0.5	3.0

NOTE 1: English units are not direct conversions from metric.
NOTE 2: The metric wire size is the approximate nominal area of the conductor.
NOTE 3: The SAE wire size number indicates that the cross-sectional area of the conductor approximates the area of the American Wire Gauge.

6.3 Cable Core

6.3.1 Insulated Conductor Lay

The maximum lay of the individual insulated conductors in the cable core shall be 14 times the cable core diameter. Fillers may be used to improve the roundness of the cable core.

6.4 Cable Jacket

6.4.1 Material Physical Properties

The unaged physical properties of the jacket material, tested in accordance with the method identified in ASTM D 412 at room temperature, (23 °C ± 5 °C), shall be a minimum of the following values:

6.4.1.1 Minimum tensile strength of 10 MPa (1500 psi).

6.4.1.2 Minimum elongation of 150%.

An accelerated aging test involving heat aging for 168 hours at 110 °C shall be conducted in accordance with SAE J1128.

6.4.2 Application

The cable jacket shall be homogeneous and shall be placed concentrically within commercial tolerances about the cable core. The jacket shall be readily strippable from the core for purposes of termination.

6.4.3 Overall Cable Diameter

Due to the internal diameter restrictions of the SAE J560 connectors, the overall cable diameter must not exceed 18 mm (0.710 in).

6.4.4 Wall Thickness

The minimum jacket thickness at any point shall be measured in the method described in SAE J1128. The minimum wall thickness at any point of shall be 1.00 mm (0.040 in).