The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

SURFACE VEHICLE STANDARD

SAE J2501

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Submitted for recognition as an American National Standard

Round, Unscreened, 60 V and 600 V Multicore Sheathed Cables

Foreword—The SAE Standard is technically equivalent to ISO 14572.

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SAE WEB ADDRESS http://www.sae.org

1. ***Scope—***This SAE Standard specifies basic and high performance test methods and requirements for round, unscreened, multicore sheathed cables intended for use in road vehicle applications.

The unscreened, single core cables shall be in accordance with ISO 6722, SAE J1127, SAE J1128, SAE J1654, SAE J1678, or SAE J2183. Other cores may be used, but in these cases, the construction and tests required to ensure functionality of these cores shall be agreed between the customer and supplier. See ISO 6722 for temperature classes. ISO 6722 will be needed to perform some of the tests in this standard.

2. ***References***

2.1 **Applicable Publications—**The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J1127—Battery Cable
SAE J1128—Low Tension Primary Cable
SAE J1654—High Voltage Primary Cable
SAE J1678—Ultra Thin Wall Primary Cable
SAE J2183—60 V and 600 V single core cables
SAE Dictionary of Materials and Testing

2.1.2 ASTM DOCUMENTS—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959

ASTM B 354—Definitions of Terms Relating to Uninsulated Metallic Electrical Conductors
ASTM D 471—Standard Test Method for Rubber Property—Effect of Liquids
ASTM F 1251—Standard Terminology Relating to Polymeric Biomaterials in Medical and Surgical Device

2.1.3 ISO DOCUMENTS—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002

ISO 6722—Road vehicles—60 V and 600 V single core cables—Test methods, dimensions and requirements
ISO 14572—Road vehicles—Round, unscreened, 60 V and 600 V multicore sheathed cables—Basic and high performance test methods and requirements

2.1.4 IEC DOCUMENTS—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002

IEC 216-4-1—Guide for the determination of thermal endurance properties of electrical insulating materials – Part 4: Ageing ovens – Section 1: Single-chamber ovens
IEC, Electricity, Electronics and Telecommunications, Multilingual Dictionary

2.2 **Related Publications—**The following publications are provided for information purposes only and are not a required part of this specification.

2.2.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE EA-1128—Wire Color Charts
SAE J156—Fusible Links
SAE J1067—Seven Conductor Jacketed Cable for Truck Trailer Connections

2.2.2 ASTM DOCUMENTS—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959

ASTM B 1—Standard Specification for Hard-Drawn Copper Wire
ASTM B 3—Standard Specification for Soft or Annealed Copper Wire
ASTM B 8—Concentric-Lay-Stranded Copper conductors, Hard, Medium-Hard, or Soft
ASTM B 33—Standard Specification for Tinned Soft or Annealed Copper Wire
ASTM B 174—Standard Specification for Bunch-Stranded Copper Conductors for Electrical Conductors
ASTM B 193—Standard Test Method for Resistivity of Electrical Conductor Materials
ASTM B 263—Method for Determination of Cross-Sectional Area of Standard Conductors
ASTM B 298—Standard Specification for Silver-Coated Soft or Annealed Copper Wire
ASTM B 355—Standard Specification for Nickel-Coated Soft or Annealed Copper Wire
ASTM B 452—Standard Specification for Copper-Clad Steel Wire for Electronic Application
ASTM B 787—19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation
ASTM E 145—Standard Specification for Gravity-Convection and Forced-Ventilation Ovens

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

IEC 811-1-1—Common test methods for insulating and sheathing materials of electric cables - Part 1: Methods for general application - Section 1: Measurement of thicknesses and overall dimensions - Tests for determining the mechanical properties
IEC 811-2-1—Common test methods for insulating and sheathing materials of electric cables - Part 2: Methods specific to elastomeric compounds - Section 1: Ozone resistance test - Hot set test - Mineral oil immersion test

3. Definitions

3.1 60 Volt (V) Cable—Cables intended for use in road vehicle applications where the nominal system voltage ≤60 V DC (25 V AC). AC tests are performed at 60 Hz. Applications at higher frequencies may require additional testing.

3.2 600 Volt (V) Cable—Cables intended for use in road vehicle applications where the nominal system voltage is >60 V DC (25 V AC) to ≤600 V DC (600 V AC). AC tests are performed at 60 Hz. Applications at higher frequencies may require additional testing.

3.3 3000 h Temperature Class Rating—A letter designation (class) based on the maximum test temperature (rating) at which a primary cable successfully passes the minimum requirements of 3000 h of heat aging.

3.4 Additional Mass (ref. "Resistance to Sandpaper Abrasion" test)—The mass which is applied to the support rod. The combination of the forces exerted by the additional mass and the 0.63 N exerted by the remaining apparatus (bracket, support rod, and pivoting arm) is applied to the cable.

3.5 Basic Performance (Cable)—Requirements for general automotive applications.

3.6 Cable—See primary cable.

3.7 Coated Wire—Wire comprised of a given metal covered with a relatively thin application of a different metal. (ASTM B 354)

3.8 Conductor—A wire or combination of wires not insulated from one another, suitable for carrying an electrical current. (ASTM B 354)

3.9 Conductor Size—See SAE conductor size.

3.10 Data Cable—Cables used to transmit electrical digital signals to allow electronic devices to communicate with each other.

3.11 Decimals—Decimal points are shown as "." instead of "," commonly used in ISO standards.

3.12 Fluid Compatibility—The ability of a cable to resist the effects of various fluids found in surface vehicles.

3.13 High Performance (Cable)—Meeting all basic requirements plus enhanced mechanical and/or environmental performance (as defined by the customer).

3.14 Hot Plate—An electrically heated device used to test thermoset cables.

3.15 Low Voltage—Usually considered to be 60 V DC (25 V AC).

3.16 Minimum Wall (Thickness)—The lowest allowable insulation thickness at any point.

3.17 Nominal—A suitable approximate value used to designate or identify a component.

3.18 Ozone Resistance—The ability of a material to withstand the deteriorating effect of ozone (surface cracking). SAE, Dictionary of Materials and Testing.

3.19 Plastic—Any of numerous polymeric materials that are usually thermoplastic or thermosetting, of high molecular weight and that can be molded, cast, extruded, drawn, laminated, or otherwise fabricated into objects, powders, beads, films, filaments, fibers, or other shapes. (ASTM F 1251)

3.20 Primary Cable—The single or multi-stranded, single conductor, insulated cable used to carry electric current, by attachment to the low voltage side of an ignition coil in surface vehicles.

3.21 SAE Conductor Size—A system that indicates the cross sectional area of the conductor. The Metric SAE Conductor Size is the approximate area of the conductor. The English SAE Conductor Size number indicates that the area of the conductor approximates the area of the American Wire Gauge for the equivalent size.

3.22 Separator—A thin layer used as a barrier to prevent mutually detrimental effects between different components of a cable such as between the conductor and insulation or between the insulation and the sheath. (IEC, Electricity, Electronics and Telecommunications, Multilingual Dictionary)

3.23 Screen (Screened, Electromagnetic Screen)—A screen of conductive material intended to reduce the penetration and/or radiation of a varying electromagnetic field into an assigned region.

3.24 Strip Force—The peak axial force required to overcome the adhesion between the conductor and the insulation.

3.25 Strand—See wire.

3.26 Thermoplastic—A plastic capable of being softened by heating and hardened by cooling through a temperature range characteristic of the plastic and, in the softened state, capable of being repeatedly shaped by flow into articles by molding, extrusion or forming. (IEC, Electricity, Electronics and Telecommunications, Multilingual Dictionary)

3.27 Thermoset—A plastic which, when cured by heat or other means, changes into a substantially infusible and insoluble product. Note—Thermosets are often called thermosetting before curing and thermoset after cure. (IEC, Electricity, Electronics and Telecommunications, Multilingual Dictionary)

3.28 Unscreened—The absence of a screen.

3.29 Wire (strand)—A rod or filament of drawn or rolled metal whose length is great in comparison with the major axis of its cross section. (ASTM B354)

3.30 Wire Size—See SAE conductor size

4. General Requirements

4.1 Cables

4.1.1 See the applicable standard, i.e., ISO 6722, ISO 14572, SAE J1127, SAE J1128, SAE J1654, SAE J1678, or SAE J2183.

4.1.2 The cables shall be submitted to the tests as specified in Figure 1.

Clause	Test Description	See ISO	Certification Initial	Certification Periodic[1)]	If Required[2)] Initial	If Required[2)] Periodic[1)]
5	**Dimensions**					
5.1	Outside Cable Diameter and Ovality	14572	X	X		
5.2	Thickness of the Sheath	14572	X	X		
5.3	Visual Appearance	14572				
6	**Electrical Characteristics**					
6.1	Continuity	14572	X	X		
6.2	Withstand Voltage	14572	3)	3)		
7	**Mechanical Characteristics**					
7.1	Adhesion of the Sheath	14572	X	X		
7.2	Cyclic Bending	14572			X	X
8	**Low temperature Characteristics**					
8.1	Winding	14572	X	X		
9	**Resistance to Abrasion**	14572	X	X		
10	**Heat Aging**					
10.1	Short Term Aging 240 h	14572	X	X		
10.2	Long Term Aging, 3000 h	14572	X			
11	**Resistance to Chemicals**					
11.1	Fluid Compatibility of the Sheath	14572	X	X		
11.2	Resistance to Ozone	14572			X	
12	**Resistance to Flame Propagation**	14572	X	X		

NOTE 1: The frequency of periodic testing will be established by agreement between the customer and the supplier.

NOTE 2: The usage of "if required" tests will be established by agreement between customer and supplier.

NOTE 3: Some cables are rated at 60 V and others at 600 V. See clause 3 for details.

FIGURE 1—TESTS
REF. 4.2

4.2 600 Volt Cables—See ISO 14572.

4.3 General Test Conditions—See ISO 14572.

4.4 Ovens—See ISO 6722. The ovens shall meet the requirements of IEC 216-4-1.

5. Dimensions

5.1 Outside Cable Diameter and Ovality—See ISO 14572.

5.2 Thickness of the Sheath—See ISO 14572.

5.3 Visual Appearance—See ISO 14572.

6. Electrical Characteristics

6.1 Continuity—See ISO 14572.

6.2 Withstand Voltage—See ISO 14572.

7. Mechanical Characteristics

7.1 Adhesion of the Sheath—See ISO 14572.

7.2 Cyclic Bending—See ISO 14572.

8. Low Temperature Characteristics

8.1 Winding —See ISO 14572.

9. Resistance to Abrasion—See ISO 14572.

10. Heat Aging

10.1 Short Term Aging, 240 h—See ISO 14572.

10.2 Long Term Aging, 3000 h—See ISO 14572.

11. Resistance to Chemicals

11.1 Fluid Compatibility of the Sheath—See ISO 14572 and Appendix A.

11.2 Resistance to Ozone—See ISO 14572.

12. Resistance to Flame Propagation—See ISO 14572.

PREPARED BY THE SAE CABLE TASK FORCE COMMITTEE

APPENDIX A

SOURCES FOR SAE REFERENCE MATERIALS

Fluid	Supplier	Packaging
Engine Oil ASTM D471 IRM 902 Oil	R. E. Carol, Inc. P. O. Box 5806 Trenton, NJ 08638-0806 Contact: Customer Service Phone: (800)-257-9365 Fax: (609)-695-0102	5 Gal Can
	Penreco 4426 East Washington Blvd. Los Angeles, CA 90023 Phone: (213)-268-4271 Fax: (213)-268-7972	5 Gal Can
Power Steering ASTM D471 IRM 903 Oil	R. E. Carol, Inc. P. O. Box 5806 Trenton, NJ 08638-0806 Contact: Customer Service Phone: (800)-257-9365 Fax: (609)-695-0102	5 Gal Can
	Penreco 4426 East Washington Blvd. Los Angeles, CA 90023 Phone: (213)-268-4271 Fax: (213)-268-7972	5 Gal Can
Automatic Trans Fluid Dexron III Citgo Part No. 33123	Citgo Petroleum 699 Heights Rd. Lake Orion, MI 48362 Contact: Dave LaRocca Phone: (800)-331-4068	55 Gal Drum or Quart
Kester #2164 Flux	Kester Solder 515 East Touhy Avenue Des Plaines, IL 60018-2675 Contact: Julie Courtney Phone: (847) 699-4628 Fax: (847) 699-5548	Pint Quart or Gallon
Sandpaper Abrasion Tape	Glowe-Smith Industrial, Inc. 812 Youngstown Kingsville Rd. Vienna, Ohio 44473 Contact: Terry Dillman Phone: (330) 539-5085 Fax: (330) 539-7750	Single Roll ≥ 2 Rolls ≥ 6 Rolls ≥ 11 Rolls ≥ 51 Rolls

FIGURE A1—SOURCES FOR SAE REFERENCE MATERIALS