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SURFACE VEHICLE STANDARD

SAE J1654

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Submitted for recognition as an American National Standard

(R) High Voltage Primary Cable

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1. Scope—This SAE Standard covers cable intended for use at a nominal system voltage up to 600 V DC or 600 V AC. It is intended for use in surface vehicle electrical systems.

2. References

2.1 Applicable Publications—The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated, the latest revision 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 J1678—Ultra Thin Wall Primary Cable
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 F 1251—Standard Terminology Relating to Polymeric Biomaterials in Medical and Surgical Device

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

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 J156—Fusible Links
SAE J1292—Automobile, Truck, Truck-Tractor, Trailer, And Motor Coach Wiring
SAE J1673—High Voltage Automotive Wiring

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 174—Standard Specification for Bunch-Stranded Copper Conductors for Electrical Conductors
ASTM B 787—19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation

2.2.3 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

3. Definitions

3.1 Additional Mass (Reference "Sandpaper Abrasion Resistance" 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.

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

3.3 Cable—See primary cable.

3.4 Conductor—A wire or combination of wires not insulated from one another, suitable for carrying an electrical current. (ASTM B354)

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

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

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

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

3.9 Nominal—Name or identifying value of a measurable property by which a conductor or component or property identified, and to which tolerances may be applied.

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

3.11 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)

3.12 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.

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

3.14 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)

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

3.16 Strand—See wire.

3.17 Temperature Class Rating—A class designation based on the retention of “Mechanical Properties” (tensile and elongation) after 168 h of heat aging at 30 °C above the temperature class rating.

3.18 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)

3.19 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)

3.20 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 B 354)

3.21 Wire Size—See SAE wire size

4. General Requirements—The cable shall meet all of the requirements of SAE J1127, SAE J1128, or SAE J1678 for the applicable cable type.

4.1 General Test Conditions—Test samples shall be preconditioned for at least 16 h at a room temperature of 23 °C ± 5 °C. Unless otherwise specified, all tests shall be conducted at this same temperature.

4.2 Tolerances—Unless otherwise specified, all values are considered to be approximate.

5. *Additional Requirements*

5.1 Dielectric Test—The test shall be conducted according to the applicable section of SAE J1127, SAE J1128, or SAE J1678 except the voltage shall be as defined in Figure 1. This test shall be used for virgin cable and after all other tests which require a "Dielectric Test," such as cold bend, fluid exposure, etc.

SAE Wire Size Range (mm^2)	Test Voltage (Volts AC)	
	Dielectric Ref. 5.1	Spark Test Ref. 5.2
0.1 - 0.5	2,500	5,000
0.6 - 5	2,500	6,000
5.1 - 32	2,500	10,000
32.1 - 120	2,500	12,500
Note: Round the wire size to the nearest 0.1 mm^2		

FIGURE 1—DIELECTRIC TEST AND SPARK TEST, REFERENCE 5.1 AND 5.2

5.2 Spark Test—100% of the in process cable shall be subjected to a spark test at the voltage specified in Figure 1. Every point on the cable shall withstand a minimum of 18 positive and negative crests of the supply voltage (the equivalent of nine full cycles of the supply voltage) without failure of the insulation.

5.3 Insulation Resistance—25 mm of insulation shall be removed from each end of a 5 m sample of finished cable. Twist the ends together. Immerse the sample to within 1 m from the end of the insulation in tap water at 21 °C ± 6 °C for a minimum of 6 h. Measure the resistance between the core and water using a bridge that is accurate to within ±10% of the measured value and having an open circuit potential of 125 V or more. The sample shall have a minimum resistance of 30 MΩ.

SAE Wire Size Range (mm^2)	Minimum Resistance	
	Abrasion Ref. Section 5.4	Pinch Ref. Section 5.5
0.1 - 0.4	J1128 Type GPT 0.5 mm^2 (No.20)	
0.5 - 8	J1128 Type GPT	
8.1 - 120	J1127 Type STT	
Note: Round the wire size to the nearest 0.1 mm^2		

FIGURE 2—MINIMUM ABRASION AND PINCH RESISTANCE, REFERENCE 5.4 AND 5.5

5.4 Abrasion Resistance—The cable shall meet the "Abrasion Resistance" requirements of SAE J1127, J1128, or J1678 for the applicable cable type or the requirements of Figure 2, which ever is greater.