SURFACE VEHICLE RECOMMENDED PRACTICE	J2840	FEB2014
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High Voltage Shielded and Jacketed Cable

RATIONALE

Due to the need for increased vehicle electrification and energy efficiency this document was created to provide High Voltage Shielded Cable performance requirements and dimensions for use in vehicle electrical system architecture up to 1000 V (AC rms or DC).

TABLE OF CONTENTS

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1. SCOPE

This SAE Standard covers cable, shielded and jacketed, intended for use at a nominal system voltage up to 1000 V (AC rms or DC). It is intended for use in surface vehicle electrical systems.

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 issue 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 J1127 Low Voltage Battery Cable

SAE J1128 Low Voltage Primary Cable

SAE J1654 Unshielded High Voltage Primary Cable

SAE J1678 Low Voltage Ultra Thin Wall Primary Cable

SAE Dictionary of Materials and Testing

2.1.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org

B354 Standard Terminology Relating to Un-insulated Metallic Electrical Conductors

ASTM D-833 Standard Terminology Relating to Plastics

2.1.3 IEC Publications

Available from American National Standards Institute, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

IEC, Electricity, Electronics and Telecommunications, Multilingual Dictionary

IEC62513-4 Surface transfer impedance and Shield effectiveness

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.2.1 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 J156 Fusible Links

SAE J1673 High Voltage Automotive Wiring Assembly Design

SAE J2501 Round, Screened and Unscreened, 60 V and 600 V Multi-Core Sheathed Cables

2.2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org

ASTM B1 Standard Specification for Hard-Drawn Copper Wire

ASTM B3 Standard Specification for Soft or Annealed Copper Wire

ASTM B8 Concentric-Lay-Stranded Copper conductors, Hard, Medium-Hard, or Soft

ASTM B174 Standard Specification for Bunch-Stranded Copper Conductors for Electrical Conductors

ASTM B787 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation

2.2.3 ISO Publications

Available from American National Standards Institute, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ISO 6722 Road vehicles - 60 V and 600 V single core cables - Test methods, dimensions and requirements

ISO 14572 Road vehicles - Round, screened and unscreened, 60 V and 600 V multicore sheathed cables - Basic and high performance test methods and requirements

3. DEFINITIONS

3.1 ADDITIONAL MASS (ref. “Resistance to Sandpaper Abrasion” test)

The mass 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

An assembly of one or more insulated primary cables within an enveloping protective jacket (sheath), with such an arrangement that will permit their use separately or in groups. (Data Communications Dictionary, 1976)

3.4 CABLE FAMILY

A group with multiple conductor sizes having the same conductor strand coating, insulation formulation, and wall thickness type.

3.5 CONDUCTOR

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

3.6 CONDUCTOR SIZE

See “SAE Conductor Size”.

3.7 CORE

One of the components in an assembly. A component may be an uninsulated conductor, an insulated conductor, a twisted pair, a shielded assembly, a coaxial cable, or any finished cable.

3.8 JACKET

A protective insulating sheath enveloping a cable assembly.

3.9 PLASTICS

A material that contains as an essential ingredient one or more organic polymeric substances of large molecular weight, is solid in its finished state, and, at some stage in its manufacture or processing into finished articles, can be shaped by flow. (ASTM D-833)

3.10 PRIMARY CABLE

The single or multi-stranded, single conductor, insulated cable used to carry electric current.

3.11 SAE CONDUCTOR SIZE

A system that indicates the cross sectional area of the conductor. The “SAE Conductor Size” is the approximate area of the conductor.

3.12 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)

3.13 SHIELD

Conductive material intended to reduce the penetration and/or radiation of a varying electromagnetic field into an assigned region. Not intended as a current carrying member.

3.14 STRAND

One of the wires of any stranded conductor.
(ASTM B354)

3.15 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)

3.16 THERMOSET

A polymeric material 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.

3.17 UNSHIELDED

Absence of a shield

3.18 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)

4. TECHNICAL REQUIREMENTS

4.1 General Test Conditions

Test samples shall be preconditioned for at least 16 h at a room temperature of (23 ± 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.

4.3 Representative Conductor Sizes for Testing

When a test is required, all combinations of conductor size, wall thickness, and insulation formulation shall meet the appropriate requirements. However, if testing representative conductor sizes is permitted, compliance for a cable family may be demonstrated by testing examples of large and small conductor sizes only. Permission to show compliance for a cable family by testing “Representative conductor sizes” will be established by agreement between customer and supplier.

4.4 Insulated Conductor Requirements

The cable shall meet all of the requirements of SAE J1654 for the applicable cable type.

4.5 Shield Requirements

The cable shall be tested per Method 1, Section 5, of IEC 62513-4 for surface transfer impedance and shield effectiveness. The requirements shall be established by agreement between the customer and supplier.

4.6 Jacket Requirements

4.6.1 Outside Cable Diameter

The “Outside Cable Diameter” shall be measured at five separate cross sections spaced 50 mm apart with an optical device accurate to at least .01 mm. Other devices may be used; however, in case of dispute, the referee shall be the optical device. A minimum of two readings shall be taken at each cross section. The sample should be rotated 90 degrees between readings. The mean of the diameter readings shall determine the ”Outside Cable Diameter” and shall be in accordance with Table 1 for Thin Wall cables or Table 2 for Thick Wall cables. Figure 1 provides the references for the various dimensions.

4.6.2 Jacket Wall Thickness

The minimum “Wall Thickness” shall be measured at five separate cross sections spaced 400 mm apart using the equipment described in 4.6.1. No single value shall be less than 0.4mm. The minimum wall thickness specified in Table 1 or Table 2, whichever is applicable.

4.7 Dielectric Test

The test shall be conducted according to section 6.4 of SAE J1128. The voltage is to be applied between the shield and the water.

4.8 Spark Test

100% of the in-process cable shall be subjected to a spark test. 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 jacket. The spark test voltage shall be 2 KV.

4.9 Abrasion Resistance

The test shall be conducted in accordance with section 6.10 of SAE J1128. The minimum abrasion resistance of the jacket shall be 300mm of tape (jacket to shield only).

4.10 Pinch Resistance

The test shall be conducted in accordance with section 6.9 of SAE J1128. The minimum pinch resistance of the jacket shall be 2.0 kg (jacket to shield only).

5. NOTES

5.1 Marginal Indicia

A change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

TABLE 1 – THIN WALL DIMENSIONS[1,2]

Nominal Conductor Size	Nominal Conductor Diameter d1	Minimum Insulation Thickness S1	Nominal Insulation Thickness S1	Maximum Insulation Diameter d2	Nominal Braided Shield Strand Diameter	Maximum Braided Core Diameter	Minimum Outer Jacket Thickness S2	Nominal Outer Jacket Thickness S2	Minimum Finished Cable Diameter d3	Maximum Finished Cable Diameter d3	Tolerance Range
18	1.17	0.28	0.40	2.2	0.13	2.72	0.28	0.40	3.1	3.5	0.40
16	1.45	0.28	0.40	2.4	0.13	2.92	0.28	0.40	3.3	3.7	0.40
14	1.81	0.28	0.40	2.7	0.13	3.22	0.28	0.40	3.6	4.0	0.40
12	2.29	0.32	0.46	3.3	0.16	3.94	0.32	0.46	4.3	4.9	0.60
10	2.87	0.35	0.50	4.0	0.16	4.64	0.35	0.50	5.0	5.6	0.60
8	3.63	0.39	0.55	4.9	0.19	5.66	0.39	0.55	6.1	6.8	0.60
6	4.57	0.76	1.09	7.8	0.19	8.56	0.76	1.09	10.1	10.7	0.60
4	5.64	0.78	1.12	9.5	0.19	10.26	0.78	1.12	11.9	12.5	0.60
2	7.30	0.78	1.12	11.0	0.21	11.84	0.78	1.12	13.4	14.1	0.60
1	8.79	0.78	1.12	12.0	0.21	12.84	0.78	1.12	14.4	15.1	0.60
1/0	9.91	0.78	1.12	13.0	0.21	13.84	0.78	1.12	15.3	16.1	0.80
2/0	11.13	0.78	1.12	14.5	0.21	15.34	0.78	1.12	16.8	17.6	0.80
3/0	13.77	0.78	1.12	17.0	0.26	18.04	0.78	1.12	19.4	20.3	0.80
4/0	15.18	0.78	1.12	18.5	0.26	19.54	0.78	1.12	21.0	21.8	0.80

1. Dimensions are in mm
2. Foil shield is optional