SAE International™

SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J2192

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Recommended Testing Methods for Physical Protection of Wiring Harnesses

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1. Scope

This SAE Recommended Practice describes the recommended methods for testing flexible harness coverings for use on ground vehicle electrical distribution systems. This Recommended Practice shall apply to all tapes, extruded tube and textile tube.

1.1 Rationale

Establishing a recommended methodology will allow the performance of tapes, extruded-tubing and textile-tubing harness coverings to be evaluated per a standard method, and this will further facilitate the future establishment of performance requirements for such coverings.

1.2 Application

This document shall be applied for coverings used on wiring assemblies. The Customer's Engineering Group must approve material based on the functional application performance requirements to assure proper validation of covering materials.

2. Applicable Publications

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

2.1 SAE Publications

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

SAE ARP1536A—Abrasion Test Procedure for Chafe Guard
SAE J311—Fluid for Passenger Car Type Automatic Transmission
SAE J369—Flammability of Polymeric Interior Materials – Horizontal Test Method
SAE J1128—Low Temperature Primary Cable
SAE J1756—Test Procedure to Determine the Fogging Characteristics of Interior Automotive Materials
SAE J2302—Thermal Effectiveness of Sleeve Insulation
SAE J2495—Thermal Containment Efficiency of Sleeve Materials

2.2 ASTM Publications

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM D 471—Standard Test Method for Rubber Property – Effect of Liquids
ASTM D 3032—Standard Test Methods for Hookup Wire Insulation, Section 22 – Dynamic Cut Through
ASTM D 4157—Test Method for Abrasion Resistance of Textile Fabrics
ASTM D 5423—Forced-Convection Laboratory Ovens for Evaluation of Electrical Insulation
ASTM F 1306—Test Method for Slow Rate Penetration Resistance of Flexible Barrier Films

2.3 ISO Publications

Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002.

ISO 3795—Road vehicles, and tractors and machinery for agriculture and forestry – Determination of burning behavior of interior materials
Applicable Quality Standards (e.g., QS 9000, ISO/TS16949, etc)

3. Glossary

3.1 Functionality

Performs to design intent.

3.2 Degradation

Loss of functionality due to physical changes such as cracks, tears, melting or other forms of reduction in material strength, composition or integrity.

3.3 Exterior Application

Applications outside the passenger compartment

3.4 Interior Application

Applications inside the passenger compartment.

3.5 Recommended Practices

Suggested test method that does not include specification limits.

3.6 Tape

Polymeric or cloth material with or without adhesive.

3.7 Extruded Tube

Homogenous polymeric components consisting of thermoplastic and thermo-set materials. (e.g. convolute, vinyl and heat shrink)

3.8 Textile Tube

Components consisting of braided, knitted or woven constructions.

4. Quality Requirements

4.1 Product Quality Assurance

Product Quality Assurance must follow the requirements and be in compliance with the applicable Quality Standard.

5. Classification (Temperature Identification)

Temperature requirement is by class as noted in Table 1. It is the responsibility of the customer to determine the "Class" to be used for any application. Temperature ratings are to be considered the minimum service temperature required.

It is the responsibility of the supplier to properly designate the service temperature of their product and provide the necessary data to the performance criteria in this specification when submitting to the customer for approval. Verification of any and all of the data submitted by the supplier is at the discretion of the customer.

TABLE 1

Class	Temperature (°C)
Class A	-40 to 85
Class B	-40 to 100
Class C	-40 to 125
Class D	-40 to 150
Class E	-40 to 175
Class F	-40 to 200
Class G	-40 to 225
Class H	-40 to 250

6. Testing Methods

The recommended test methods are found in Table 2.

TABLE 2

Test	Category			Applicable Class	Test Method
	Tape	Extruded Tube	Textile Tube		
Heat Aging	X	X	X	All Classes	7.3
Temperature/Humidity	X	X	X	All Classes	7.4
Flammability	X	X	X	All Classes	7.5
Low Temperature Flexibility	X	X	X	All Classes	7.6
Automotive Fluids Resistance	X	X	X	For Exterior Applications Only	7.7
Fogging	X	X	X	For Interior Applications Only	7.8
Component Compatibility	X	X	X	All Classes	7.9
Noise Suppression	X	X	X	Customer Designated	7.10
Abrasion Resistance	X	X	X	Customer Designated	7.11
Puncture/Pinch	X	X		Customer Designated	7.12
Cut Through	X	X	X	Customer Designated	7.13
Impact		X		Customer Designated	7.14
Thermal Insulation	X	X	X	Customer Designated	7.15

7. Tests Procedures

7.1 Sampling

If it is not specified, the sample size must be five (5). The suggested dimension of the sample is 10 mm minimum, however, if the manufacturer is supplying sizes other than 10 mm, the customer may request other sample sizes. Selection must be representative of the current production for each test and test results should be reported. Precondition/equilibrate dry samples to 23 °C ± 5 °C and 50% ± 5% relative humidity for a minimum of 24 hours prior to testing unless otherwise noted.

7.2 Sample Preparation

7.2.1 TAPE

Assemble a bundle of wire 450 mm in length of an appropriate number and size to approximate a diameter of 10 mm as designated by customer. If specified, cover the bundle with a 450 mm length of 10 mm diameter convoluted tubing. Note that the appropriate wire type and tubing with the same operation temperature, as the tape in question must be used. Wrap the tape to be tested around the bundle with a 50% overlap.

7.2.2 EXTRUDED TUBE

Assemble a bundle of wire 450 mm in length of wire of an appropriate number and size to approximate a diameter of 10 mm. Cover the bundle with a 450 mm length of test specimen. Note that the appropriate wire type with the same continuous operating temperature must be used with the extruded tube being tested as specified by the customer or test method.

7.2.3 TEXTILE TUBE

Assemble a bundle of wire 450 mm in length of an appropriate number and size to approximate a diameter of 10 mm. Cover the bundle with a 450 mm length of braid. Note that the appropriate wire type with the same continuous operating temperature must be used with the textile tube being tested as specified by the customer or test method.

7.3 Heat Aging

7.3.1 The material shall withstand temperature according to class noted in Table 3, and tested according to the procedure described in 7.3.2.

7.3.2 Place 30 pieces of 450 mm long test specimens of each sample in a forced air convection oven (Type II as specified in ASTM D 5423, with air exchange rate of 100 to 200 per hour) at the sample maximum class temperature (Refers to Table 3) for the duration of time interval.

TABLE 3—TEST TEMPERATURE FOR HEAT AGING AND TEMPERATURE/HUMIDITY CYCLING

Class	Temperature (°C)
Class A	85 ± 2
Class B	100 ± 2
Class C	125 ± 3
Class D	150 ± 3
Class E	175 ± 3
Class F	200 ± 3
Class G	225 ± 4
Class H	250 ± 4

7.3.3 At 500, 1000, 1500, 2000, 2500, and 3000 hour intervals, remove five pieces of test specimens of each sample from the oven and condition them at 23 °C ± 5 °C and 50% ± 5 % relative humidity for at least 4 hours.

7.3.4 Wrap each of the conditioned test specimens around a mandrel with a diameter equal to four times the nominal ID of the test specimen at a uniform rate of one turn per 10 seconds. Visually inspect each specimen for any sign of degradation. Record and report any change in appearance and signs of degradation.

7.4 Temperature/Humidity Cycling

7.4.1 Place test specimens in an environmental chamber and set the cycling sequence as following for three cycles. Refer to SAE J1128, Temperature and Humidity Cycling Section, for complete description.

TABLE 4

Step	Condition	Duration	Total Time
1	Increase Temperature From 23 °C ± 5 °C & 50% ± 5% RH to -40 °C	30 minutes	0:30
2	Hold Temperature at -40 °C ± 2 °C	1 hour	1:30
3	Increase Temperature From -40 °C ± 2 °C to 80 °C ± 2 °C & 95% ± 5% RH	30 minutes	2:00
4	Hold Temperature @ 80 °C ± 2 °C & 95% ± 5% RH	4 hours	6:00
5	Change Temperature From 80 °C ± 2 °C & 95% ± 5% RH to the Class Temperature[1]	30 minutes	6:30
6	Hold at Class Temperature[1]	1 hour	7:30
7	Change Temperature from the Class Temperature[1] to 23 ° ± 5 °C & 50% ± 5% RH	30 minutes	8:00

[1] Refers to Table 3.

7.4.2 Wrap each of the conditioned test specimens around a mandrel with a diameter equal to four times the nominal ID of the test specimen at a uniform rate of one turn per 10 seconds. Visually inspect each specimen for any sign of degradation. Record and report any change in appearance and signs of degradation.

7.5 Flammability

Conduct horizontal burn test, calculate and record burn rate of each test specimen following the guidelines as established in SAE J369 (ISO 3795). Record and report as required by the customer.

7.6 Low Temperature Flexibility

7.6.1 Assemble test specimens by inserting a taped wire bundle into a 450 mm length of harness covering sample. The wire bundle shall have a diameter equal to 80% of the ID of sample. Condition test specimens in a -40 °C ± 2 °C cold chamber for 4 hours.

7.6.2 Remove test specimens from cold chamber and condition them at 23 °C ± 5 °C and 50% ± 5% relative humidity for 4 hours.

7.6.3 Wrap the test specimens around a mandrel with a diameter equal to four times the nominal ID of the test specimen at a uniform rate of one turn per 10 seconds.

7.6.4 Visually inspect each specimen for any sign of degradation. Record and report any change in appearance and signs of degradation.

7.7 Fluids Resistance

7.7.1 Prepare 3 specimens for each test fluid.

7.7.2 Immerse each set of test specimens in each test fluid specified in Table 5 for 5 minutes. Take precautions to ensure that at least 10 mm from each end of the sample is not exposed to the fluid. For exposures to engine coolant, engine oil, power steering and transmission fluids, ensure that fluid and samples are aged at the specified temperature for 5 minutes. For exposures to diesel fuel, gasohol and gasoline, ensure that fluid is saturated by a non-immersion technique until dripping occurs.

7.7.2.1 Solutions are determined as % by volume.

7.7.2.2 See SAE J1128 (Table C) for reference standard sources as denoted in Table 5.

7.7.3 Remove each specimen from test fluid and allow it to drain for 20 minutes. Let samples condition 23 °C ± 5 °C for 72 hours.

7.7.4 Visually inspect each specimen for any sign of degradation after 1, 24, 48 and 72 hours. Wrap each bundle a complete 360 degrees around a mandrel with a diameter equal to four times the nominal ID of the test specimen at a uniform rate of one turn per 10 seconds. Record and report any change in appearance, signs of degradation or loss of flexibility.

TABLE 5

Fluid Name	Reference Standard	Test Temperature (°C)
Engine Oil	ASTM D 471,IRM-902	50 ± 3
Gasoline	ASTM D 471, Ref. Fuel C	23 ± 5
Gasohol	10% Ethanol + 90% ASTM D 471, Ref. Fuel C	23 ± 5
Diesel Fuel	90 % ASTM D 471, IRM-903 + 10% p-xylene	23 ± 5
Power Steering	ASTM D 471, IRM-903	50 ± 3
Auto Trans	Dexron III, SAE J311	50 ± 3
Engine Coolant	50% distilled Water + 50% Ethylene Glycol	50 ± 3
Battery Acid	H2SO4, Specific Gravity = 1.260 ± 0.005	23 ± 5

7.8 Fogging

7.8.1 Conduct the Fogging Test according to SAE J1756 using either the Photometric Method or the Gravimetric Method per agreement between customer and the supplier.

7.8.2 The test duration is to be specified by the customer.

7.8.3 Report Fog Number when using the Photometric Method; and Fog Mass when using the Gravimetric Method or as required by the customer.

7.9 Component Compatibility

7.9.1 Assemble components and test as specified by customer.

7.9.2 Test to be performed at rated temperature as required by Class specified (refer to Table 3) with no loss of functionality observed.

7.10 Noise Suppression

7.10.1 Noise Suppression is a comparative test and its requirements are to be established by the customer. It is recommended that testing be conducted with a reference standard of known or acceptable noise suppression performance level.

7.10.2 TEST APPARATUS

7.10.2.1 Insulating Cabinet

Provides a 30 dB attenuation of the laboratory ambient noise.

7.10.2.2 Excitation Equipment

The excitation of test equipment is created by a signal generator and amplified. The power amplifier runs a vibrator. The axle of the vibrator goes through a hole inside the cabinet and is fixed to the equipment.

7.10.2.3 Noise Measurement

The microphone is inside the cabinet and connected to an integrating sonometer outside the cabinet. The microphone is fixed at 150 mm from the noisy contact of the wirebundle and steel plate.

7.10.3 TEST SET-UP

7.10.3.1 Rattling Test Set-Up

See Figure 1.

7.10.3.2 Rubbing Test Set-Up

See Figure 2.

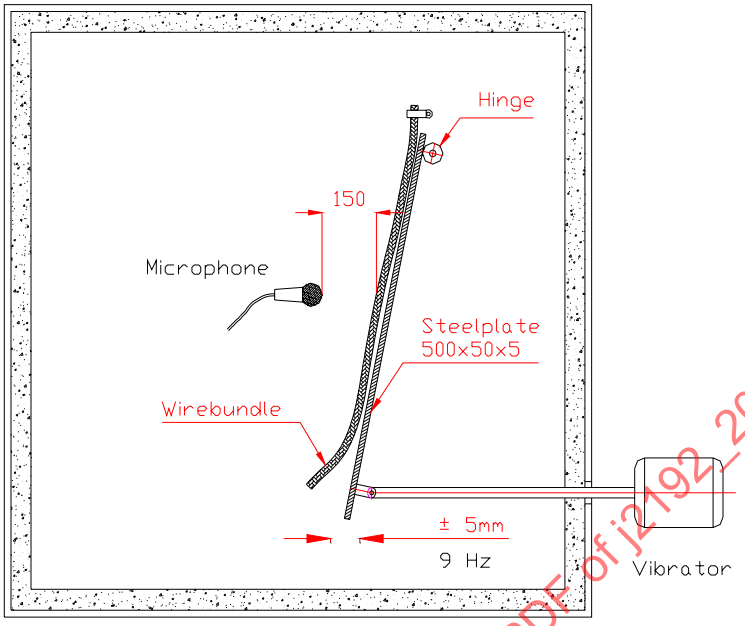

FIGURE 1—RATTLING TEST SET-UP

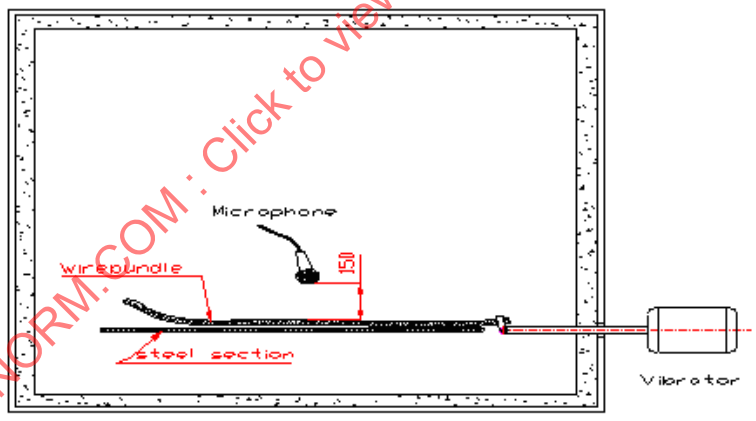

FIGURE 2—RUBBING TEST SET-UP

7.10.4 TEST PROCEDURE

7.10.4.1 Run the test on the steel panel without the wire bundle following the Rattling or Rubbing Test set-up illustration. This provides the background noise (A) inside the cabinet.

7.10.4.2 Affix wire bundle without harness covering along the steel plate and run the test again. The noise level (B) is measured.