



SURFACE VEHICLE STANDARD

J2863™**FEB2023**Issued 2010-04
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Superseding J2863 JUL2016

Automotive Trailer Tow Connector

RATIONALE

Updated an incorrect section reference and an incorrect datum callout in Figure B1. Other editorial changes have also been made.

1. SCOPE

This SAE Standard provides the minimum requirements for automotive or RV, seven position, self-draining trailer tow connector interface. The procedures included within this specification are intended to cover the test methods, design, and performance requirements of the electrical interface of the seven-position trailer tow connector in low voltage (0 to 20) road vehicle applications.

1.1 Connector Labeling Identification

A connector and/or vehicle inlet manufactured to this Recommended Practice may optionally visibly display the following identification on its outer surface in Arial font: "SAE J2863™." Any party providing such identification warrants that the connector and/or vehicle inlet complies with all mandatory requirements of this SAE Standard and agrees to indemnify and hold SAE harmless from any and all liability arising out of any failure to comply and any resulting injury or damage arising from such failure.

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 +1 724-776-4970 (outside USA), www.sae.org.

SAE J1128 Low Voltage Primary Cable

SAE/USCAR-2 Performance Specification for Automotive Electrical Connector Systems

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For more information on this standard, visit
https://www.sae.org/standards/content/J2863_202302/

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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.

ASTM B117-94 Standard Method of Salt Spray (Fog) Testing

ASTM G153 Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials

ASTM G154 Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

2.1.3 AIAG Publications

Available from Automotive Industry Action Group, Box 77000, Detroit, MI 48277-0839, Tel: 248-358-3570, www.aiag.org.

Measurement Systems Analysis Reference Manual

3. DEFINITIONS

3.1 ACCEPTANCE CRITERIA

Generally, the final section in each test description. It specifies the requirements that all test samples must meet during or at the conclusion of that test.

3.2 AIAG

Abbreviation for Automotive Industry Action Group.

3.3 AUTHORIZED PERSON

One person will be responsible as the final authority for releasing a given part for production and/or for testing that part. Such person may delegate authority for testing that part or may retain the authority. The authorized person, as used in the specification, is the person with authority for making the final decision as to any question arising during testing to this specification or for any deviations from any requirement of this specification. Such authorized person is responsible for documenting any deviation they authorize from this specification. This documentation must be included in the final test report.

3.4 BENCHMARK

Performance measurements of a specific design which serve as a standard by which the performance of other connector systems and terminals can be compared.

3.5 BULK RESISTANCE

That part of total connection resistance attributed to the terminal body. Bulk resistance does not include crimp resistance or interface resistance.

3.6 CT

Abbreviation for continuity tester. A made-up test device composed of a data analyzer and a continuity monitor.

3.7 CUT

Abbreviation for component under test.

3.8 CRITICAL DIMENSION

Any dimension noted on the part drawing or otherwise specified that can adversely affect the performance or function of the part or assembly if it exceeds the applicable tolerance.

3.9 CROSS AXIS RESONANCE

Resonance measured on a vibration set up at right angles to the intentionally induced axis of motion. Example: X or Y measured resonance when shaker is operating in the Z axis.

3.10 DEVICE CONNECTOR

An electrical connector that mates with the electrical interface of a device (e.g., headlamp, switch, horn, etc.).

3.11 DIRECT CONNECT TYPE CONNECTION

A connector that is fixed to a module or panel that a cable plug or wired connector is mated with to provide an electrical interface. Typically, direct connect type connectors will contain the male terminals.

3.12 DMM

Abbreviation for digital multimeter.

3.13 DUE CARE

The proper use of sound engineering judgment to assure a part is fit for its intended use and meets all applicable FMVSS requirements. The assurance that design specifications and test plans satisfy all applicable FMVSS requirements. Use of sound, accepted engineering and laboratory practice to safeguard the integrity of all data and to ensure that no degradation of any sample occurs in any fashion except as specified in actual testing.

3.14 ENGAGING FORCE

The force required to mate a separate pair of contacts (terminals) or a contact and mating test gage. Note that engaging force is not used in this document.

3.15 EXTRACTION FORCE

The force required to completely remove an individual contact (terminal) from its cavity in a connector. Note that extraction force is not used in this document.

3.16 FEMALE CONNECTOR

The connector that houses the female terminal(s). Also referred to in this document as a cable plug connector.

3.17 FEMALE TERMINAL

The electrical receptacle that receives the male blade or pin.

3.18 FMVSS

Abbreviation for Federal Motor Vehicle Safety Standard.

3.19 FS

Abbreviation for full scale.

3.20 GD&T

Abbreviation for geometric dimensioning and tolerancing. A method required by the USCAR companies for representing dimensions and their tolerances on all part drawings

3.21 IACS

Abbreviation for International Annealed Copper Standard.

3.22 ISOLATION RESISTANCE

Isolation resistance, expressed in ohms (Ω), measures the electrical resistance between circuits in a connection system. This test is conducted to verify that there is sufficient spacing to prevent detrimental electrical conductivity between any circuits, terminals, shield, or housing in that connector for its intended application.

3.23 MALE CONNECTOR

The connector that houses the male terminal(s). Also referred to in this document as a receptacle connector.

3.24 MALE TERMINAL

The metal blade or pin that inserts into the female terminal.

3.25 MATING FORCE

The force required to mate male and female connector halves or to completely seat a connector in a receptacle when fully populated with applicable terminals.

3.26 MAXIMUM CURRENT CAPABILITY

The maximum current carrying capability at room temperature of the specific combination of terminal size, conductor gage, insulation type, etc., as determined in 5.2.2. This value must be de-rated for actual conditions in the expected application.

3.27 NOMINAL CURRENT

The current causing a 30 °C temperature rise over ambient based on given wire size.

3.28 PANEL MOUNT CONNECTOR

This type of connection system serves to pass a circuit or group of circuits through a panel, bracket, or other obstruction. It can be configured with connectors plugged into both ends or can be attached directly to a harness or circuit board on one end with a separable connector on the other end.

3.29 POWER CIRCUIT

Any electrical circuit expected to carry in excess of 5 A continuously for more than 1 minute.

3.30 RETENTION FORCE

The maximum force that can be exerted on an individual contact (terminal) without dislodging it from its proper position in its connector cavity. This force may have two different values; one with the associated wedge (TPA, PLK, etc.) installed and a second value without such assistance.

3.31 RH

Abbreviation for relative humidity.

3.32 ROA

Abbreviation for rise over ambient (temperature).

3.33 ROOM TEMPERATURE

23 °C ± 5 °C.

3.34 SEPARATING FORCE

The force required to disengage a mated pair of contacts (terminals) or a contact and a mating test gage.

3.35 SIGNAL CIRCUIT

Any electrical circuit expected to carry 5 A or less at all times.

3.36 SOAK

Refers to a time period during which the device under test is exposed to stated environmental conditions, such as temperature, humidity, current flow, etc. This exposure may be for the purpose of conditioning the sample prior to another test or may itself form part of a given test.

3.37 SPRUNG

Describes any portion or component of a motor vehicle that is supported by the suspension system. Sprung components do not include tires, wheels, hubs, or outboard disc or drum brake assemblies.

3.38 STEADY STATE

A condition of environment or current flow that remains stable for 1 minute or more.

3.39 TOTAL CONNECTION RESISTANCE

Electrical resistance of one terminal to terminal interface plus the resistance of the conductor to terminal grip for each terminal. For direct connect type connections, only the resistance of the one conductor to terminal grip is included. Included is the "bulk resistance" of the terminal material itself.

3.40 TUT

Abbreviation for terminal under test.

3.41 UNMATING FORCE

The force required to un-mate male and female connector halves (including terminals), or a connector from a direct connect or panel mount connector or receptacle.

3.42 UN-SPRUNG

Describes any component of a motor vehicle that is not supported by the suspension system.

3.43 USCAR

Abbreviation for United States Council for Automotive Research. A consortium of representatives from Ford, General Motors, and Stellantis to promote joint research in noncompetitive areas that can strengthen the U.S. automotive industry.

3.44 VOLTAGE DROP (VD)

The difference in potential between two points in an electrical circuit caused by resistance at nominal current. Voltage drop may be used to calculate resistance when the current value is known.

4. GENERAL REQUIREMENT

4.1 Sample Size

Minimum sample sizes are given for each test in this specification. A greater number of samples may be required by the test request/order. However, no part or device may be represented as having met this specification unless the minimum sample size has been tested and all samples of the group tested have met the applicable acceptance criteria for that test. It is never permissible to test a larger group then select the minimum sample size from among those that passed and represent that this specification has been met.

4.2 Default Test Tolerances

Default tolerances, expressed as a percentage of the nominal value, unless otherwise indicated:

Temperature = ± 3 °C

Voltage = $\pm 5\%$

Current = $\pm 5\%$

Resistance = $\pm 5\%$

Length = $\pm 5\%$

Time = $\pm 5\%$

Force = $\pm 5\%$

Frequency = $\pm 5\%$

Flow Rate = $\pm 5\%$

Relative humidity = $\pm 5\%$ (when controlled)

Speed = $\pm 5\%$

Sound = $\pm 5\%$

Pressure = $\pm 5\%$

Vacuum = $\pm 5\%$

4.2.1 Test Default Conditions

When specific test conditions are not given either in the product design specification, the test request/order or elsewhere in this specification, the following basic conditions shall apply:

Room temperature = 23 °C ± 5 °C

Relative humidity = Ambient (uncontrolled as in lab ambient conditions)

4.3 Equipment

Neither this list nor the list in each test section is all-inclusive. It is meant to highlight specialized equipment or devices with particular accuracy requirements. Many other items of customary laboratory equipment and supplies will also be required.

NOTE: On requirements: Use of equipment with a lesser range is acceptable for specific tests where the required range for that test can be met. The equipment range specified does not preclude use of equipment with a larger range, but the accuracy must remain within the specified tolerance. For example, a DMM with a range of 0 to 100 V could be substituted for one specified as 0 to 50 V, with the provision that the accuracy could be maintained as $\pm 0.5\%$ of the 50 V full scale, or 0.25 V, not 0.5% of the 100 V full scale of the substituted equipment.

Table 1 - Equipment

Item	Description	Requirements
1	DC power supply (regulated)	⇒0-20 V Current as necessary
3	Digital multimeter (DMM)	Capable of measuring the following at an accuracy of ≤0.5% of full scale: ⇒0-50 VDC ⇒0-10 MΩ
4	Current shunts	As required with accuracy of ±1% of nominal
5	Millivolt meter	Capable of measuring 0-100 m VDC at 0.5% full scale
6	Item removed	
7	Insertion/extraction force tester	Capable of 1.0% accuracy, full scale
8	Data logger	As required
9	Temperature chamber	⇒-40 to +85 °C ⇒0 to 95% RH
10	Vibration controller	As Required
11	Vibration table	⇒2640 N (600 pounds) sine force ⇒2200 N (500 pounds) RMS force
13	Megohmmeter	Accuracy <5% of full scale

4.4 Measurement Resolution

Unless otherwise specified, meters and gages used in measurements of the test sample(s) shall be capable of measuring with a resolution one decimal place better than the specified value. For example, even though a wire diameter specified as 0.1 mm might actually be the same as one specified as 0.10 mm, calipers capable of 0.01 mm resolution may be used to measure the first wire but a micrometer with 0.001 mm resolution is required to measure the second wire.

4.5 Test Repeatability and Calibration

All equipment used for test sample evaluation shall be calibrated and maintained according to the applicable standards and requirements set forth by ISO TS16949 and the AIAG publication Measurement Systems Analysis Reference Manual. Copies of this manual can be obtained from the AIAG. Refer to www.aiag.org for further information.

4.6 Conformance Determination

Conformance shall be determined by the specified requirements of the test being conducted. All samples must satisfy the requirements regardless of sample age, test cycles, or test temperature, except where a test to failure is specified.

4.7 Part Endurance

Successful completion of all requirements of this specification is intended to demonstrate that the design and construction of the components and connector systems tested are capable of operating in their intended vehicle environment and application.

5. TEST AND ACCEPTANCE REQUIREMENTS

5.1 General

The tests detailed in this specification are qualitative in nature and are not expected to stress any part beyond its anticipated application limit, except where tests to failure are specified. The test procedures that follow were written as stand-alone tests and may be used as such.

5.1.1 Performance Requirements

Trailer tow connection systems must meet all performance test requirements.

5.1.2 Dimensional Characteristics

Part construction shall conform to the dimensions, shape, and detail attributes specified on the latest revision of the applicable part drawing(s).

5.1.3 Material Characteristics

Parts are intended to be in their “as furnished for vehicle assembly” condition when testing begins, unless specific instructions as to any pre-test “conditioning” are contained in the test request/order. For example, electrical terminals typically have residual die lubricant on them when finally assembled into a vehicle. This same condition must prevail for test samples unless part cleaning is specified in the test request/order. All material used in each test sample shall conform to the material specifications shown on the latest revision of the applicable part drawing(s). The material hardness specified for electrical terminals refers to the blank strip material and not the finished product because the terminal manufacturing process can modify the hardness values.

5.1.4 Temperature, Sealing, and Vibration

5.1.4.1 Temperature Performance Requirements

The trailer tow interface is intended to operate in -40 to +85 °C environmental conditions. This includes ambient plus temperature rise due to electrical loading. Care must be taken to ensure that the conductor and insulation materials selected for the application, or any test will withstand the stated temperature range.

5.1.4.2 Sealing Performance Requirements

The sealing performance of the A~B interface (see Appendix A) is determined separately from this specification. SAE/USCAR-2 Sealing level 2, 2.5 are commonly used. The C~D interface defined in this specification is unsealed.

NOTE: The B and C connector interfaces must be environmentally sealed from each other to prevent contaminants from passing from the unsealed (C~D) section into the sealed (A~B) section of the interface. The sealing ability of the interface is determined in testing of the A~B interface, that is separate from tests described in this specification.

5.1.4.3 Vibration Requirements

These trailer tow connection components are intended for use on sprung portions of the vehicle (not coupled to the engine). They shall be tested to and meet the acceptance requirements of 5.4.3 (USCAR-2 Vibration Level 1).

5.1.5 Testing Panel Mount or Direct Connect Type Components

The trailer tow interface described in this specification is a direct connect type component. In order to completely test the electrical connection, access must be gained to both the terminals in the plug as well as those in the receptacle. This is accomplished by measuring the total resistance between T_1 and T_2 . The bulk resistance of the wire is measured and subtracted from the $T_1 \sim T_2$ value to obtain the total connection resistance value.



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5.1.8.2 Equipment

- Camera
- Video recorder
- Magnification apparatus (as required)

5.1.8.3 Procedure

Visually examine each test specimen prior to testing and/or conditioning, noting in detail any obvious manufacturing or material defects such as cracks, tarnishing, flash, etc. When specified in the test request/order, take photographs and/or video recordings of representative samples to be tested and keep a properly labeled control sample.

After testing and/or conditioning, re-examine each test sample and note in detail any observable changes, such as swelling, corrosion, discoloration, contact plating wear, physical distortions, cracks, etc. Compare the tested and/or conditioned samples to the control samples, the videos, and/or the photographs, recording any differences in the test report. The authorized person will need to provide an additional sample for this purpose.

Return test samples to requestor after all tests are completed and all necessary data have been obtained.

5.1.8.4 Acceptance Criteria

The device under test must not show, any evidence of deterioration, cracks, deformities, etc., that could affect their functionality. Additional criteria (if any are) listed under each test.

5.1.9 Circuit Continuity Monitoring

5.1.9.1 Purpose

Some procedures require continuous circuit monitoring of connectors during conditioning. The purpose of circuit monitoring is to detect intermittencies caused by micro-motion and resultant wear or build-up of non-conductive debris at the contact interface. Use this procedure when specified in the individual test.

5.1.9.2 Equipment

- Continuity tester (CT)

5.1.9.3 Procedure

Prepare six (at least six male and six female) connector samples per 5.1.6 using 3 mm² (12 gauge) wire. Three sets-center pin position #7 and three sets-blade positions #1, #3, and #5 will be monitored during this test. Solder the conductors from each terminal in the CUT in series to form one continuous current path with only two free ends. Solder one of the free conductor ends to a 2 W, 120 $\Omega \pm 1.2 \Omega$ resistor. Solder the negative “-” lead to the free end of the resistor and the positive “+” lead to the remaining free conductor end of the CUT. Connect the continuity tester (CT) across the resistor, making sure that the negative lead of the CT is connected to the negative side of the resistor. Adjust the power supply to provide 100 m ADC to the circuit. Set the CT to monitor the current through the resistor and record any instance where that current falls below 95 mA. As an option, the CT may be used to monitor one or more terminal pairs instead of the resistor. A reference illustration of the test set-up is shown in Figure 2. Other suitable continuity monitoring equipment may be used.

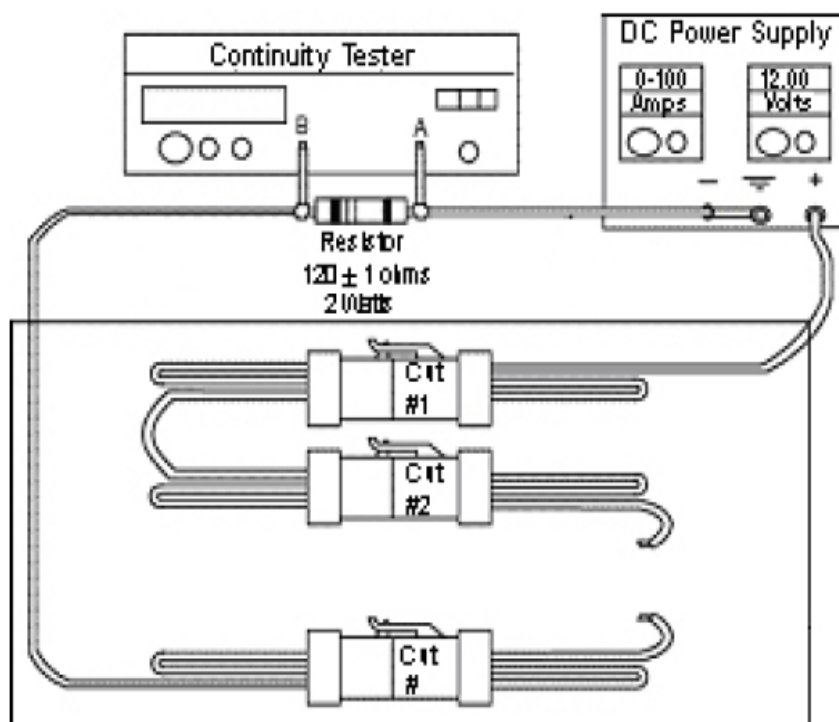


Figure 2 - Circuit continuity monitoring test set-up

5.1.9.4 Acceptance Criteria

Where continuity monitoring is required during any conditioning procedure, there must be no loss of electrical continuity (any instance of the resistor current dropping below 95 mA), for more than 1 μ s. If one or more terminal pairs are monitored, rather than the series resistor, there must be no instance in which the resistance of any terminal pair exceeds 7.0 Ω for more than 1 μ s. Figure 3 illustrates the acceptance criteria graphically.

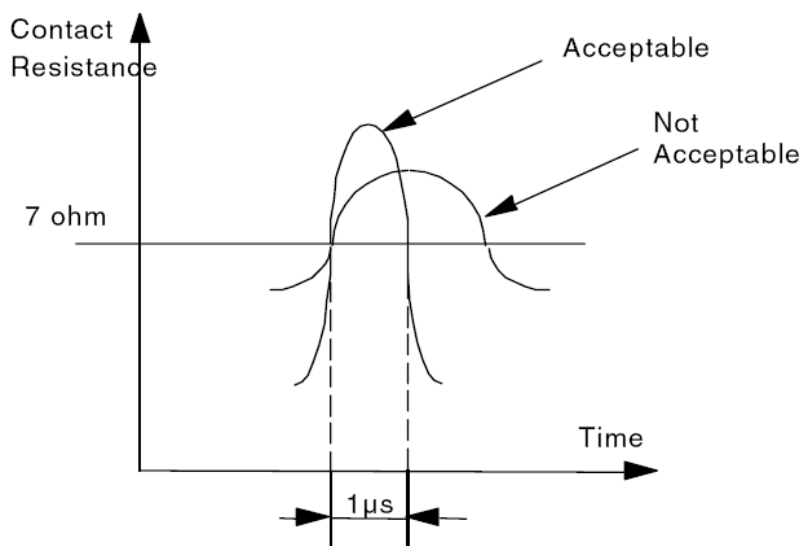


Figure 3 - Intermittency measurement