SAE International™

SURFACE VEHICLE STANDARD

SAE J2174 APR2009

Issued 1993-10
Revised 2009-04

Superseding J2174 FEB2002

Heavy-Duty Wiring Systems for Trailers 2032 mm or More in Width

RATIONALE

This revision brought this standard in alignment with current practice by increasing salt fog to 240 h, moving voltage drop and insulation resistance to the beginning and end of the test sequence, removing salt water immersion and salt fog testing of the SAE J560 connector to be consistent with the SAE J560 standard, and added references to SAE J2549 and SAE J2577. Clerical corrections were also made.

1. SCOPE

This SAE Standard establishes the minimum performance requirements for electrical distribution systems for use in dollies and trailers in single or multiple configurations.

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 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 J163	Low Tension Wiring and Cable Terminals and Splice Clips
SAE J560	Primary and Auxiliary Seven Conductor Electrical Connector for Truck-Trailer Jumper Cable
SAE J1128	Low Voltage Primary Cable
SAE J1455	Recommended Environmental Practices for Electronic Equipment Design in Heavy-Duty Vehicle Applications
SAE J2139	Tests for Signal and Marking Devices Used on Vehicles 2032 mm or more in Overall Width
SAE J2202	Heavy-Duty Wiring Systems for On-Highway Trucks
SAE J2394	Seven Conductor Cable for ABS Power—Truck and Bus
SAE J2549	Single Conductor Cable for Heavy-Duty Applications—Truck and Bus
SAE J2577	Heavy Duty Lamp Electrical Connector Standard

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: http://www.sae.org

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 B 117 Standard Method of Salt Spray (Fog) Testing

ASTM D 471 Standard Test Method for Rubber Property-Effect of Liquids

2.2 Related Publications

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

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 J575 Test Methods and Equipment for Lighting Devices and Components for Use on Vehicles Less than 2032 mm in Overall Width

SAE J2247 Truck Tractor Power Output for Trailer ABS

2.2.2 TMC Publications

Available from the Technology and Maintenance Council, American Trucking Associations, 950 North Glebe Road, Suite 210, Arlington, VA 22203-4181, Tel: (703) 838-1763, www.truckline.com.

TMC RP 110 Low Tension Cable for Heavy Duty Truck-Trailer Wiring Systems (sizing and color only)

TMC RP 114 Wiring Harness Protection

TMC RP 137 Antilock Electrical Supply from Tractors through the SAE J560 Seven Pin Connector

TMC RP 141 Trailer ABS Power Supply Requirements

TMC RP 153 Lamp to Connector Interface

2.2.3 TTMA Publications

Available from Truck Trailer Manufacturers Association, 1020 Princess Street, Alexandria, VA 22314-2247, Tel: 703-549-3010, www.ttmanet.org.

TTMA RP97-97 Trailer Antilock Braking System Wiring

TTMA RP111 Electrical System Maintenance and Repair for Trailers Without Sealed Wiring Harness Systems

TTMA RP119 Electrical Interface for Truck-Trailer Interconnection

Design and Installation of Lighting Systems for Trailers

2.2.4 Military Specification

Available from IHS Global Engineering Documents, 15 Inverness Way East, Englewood, CO 80112-5704, Tel: 877-413-5184, www.global.ihs.com.

MIL-STD-1344A Test Methods for Electrical Connectors

3. DEFINITIONS

3.1 Connector

A coupling device which provides an electrical and mechanical junction between two multiconductor cables, or between a cable and an electrical component.

3.2 Terminal

A device attached to a wire or cable to provide the electrical interface between two cables or a cable and an electrical component.

3.3 Dolly

A chassis equipped with one or more axles, a fifth wheel and/or equivalent mechanism, and drawbar, the attachment of which converts a semitrailer to a full trailer.

3.4 Electrical Distribution System

The electrical wiring system includes all cables and wiring, connectors and terminations, coverings, seals, any other incorporated items to maintain the integrity and performance of the electrical system, and the connector to any mating device with the exception of the SAE J560 connector where only the electrical performance requirements apply. The electrical wiring system does not include the functional devices to which the wiring system is attached such as lamps, ABS electronic control modules or sensors.

3.5 Sealed

A condition which provides a nonleaking union between two mechanical components or any place within an electrical distribution system. A sealed union is defined as one which does not allow the ingress of moisture.

4. TESTS

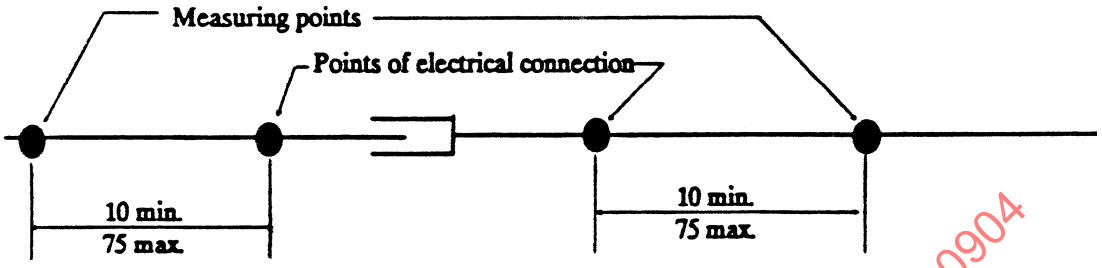
4.1 Test Procedures

Conformance to the requirements of this document shall be determined by subjecting each device to each test procedure listed in this document. Unless otherwise stated, the tests are to be performed at 25 °C ± 5 °C and at 12.5 V DC ± 0.1 V DC or per the manufacturers recommendations. Sample sizes shall be statistically valid. The tests shall be conducted in the sequence as follows:

4.1.1 Voltage Drop
4.1.10 Insulation Resistance - Multiconductor Assemblies
4.1.2 Connector Durability
4.1.3 Salt Fog
4.1.4 Thermal Cycle
4.1.5 Thermal Shock
4.1.6 Oil Absorption
4.1.7 Salt Water Immersion
4.1.8 Steam Clean and Pressure Wash
4.1.9 Vibration
4.1.11 Tensile Strength - Wire to Terminal
4.1.12 Tensile Strength - Wire to Wire
4.1.13 Connector Pull Force
4.1.14 Connector Misengagement Force
4.1.15 Connector Terminal Retention Force
4.1.1 Voltage Drop
4.1.10 Insulation Resistance - Multiconductor Assemblies

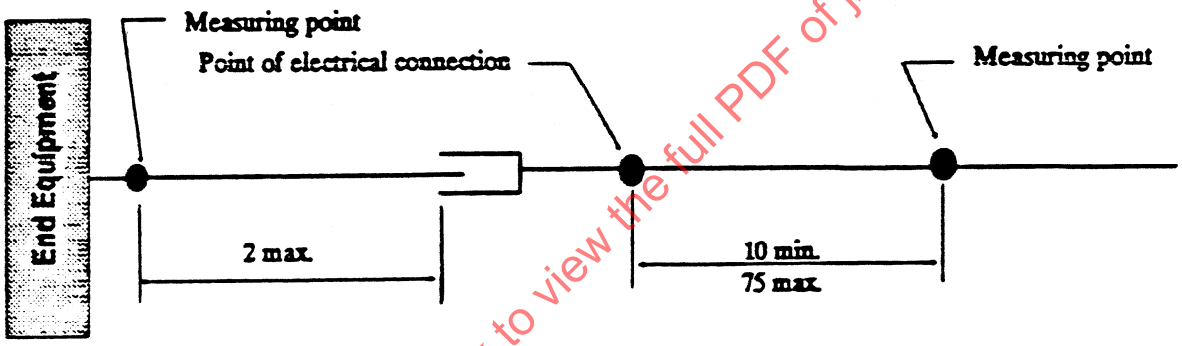
4.1.1 Voltage Drop

The measurement of connection voltage drop shall be per SAE J163 and Figures 1 and 2. The voltage drop of the cables shall be subtracted from the measured values. Except for connectors specified by SAE J560, the voltage drop shall be measured at the current specified in Table 1 of this document.



NOTE—All dimensions are in millimeters.

FIGURE 1 - CABLE TO CABLE ASSEMBLY



NOTE—All dimensions are in millimeters.

FIGURE 2 - CABLE TO COMPONENT ASSEMBLY

4.1.2 Connector Durability

a. An assembled connector with terminals shall be mated and unmated 25 times.

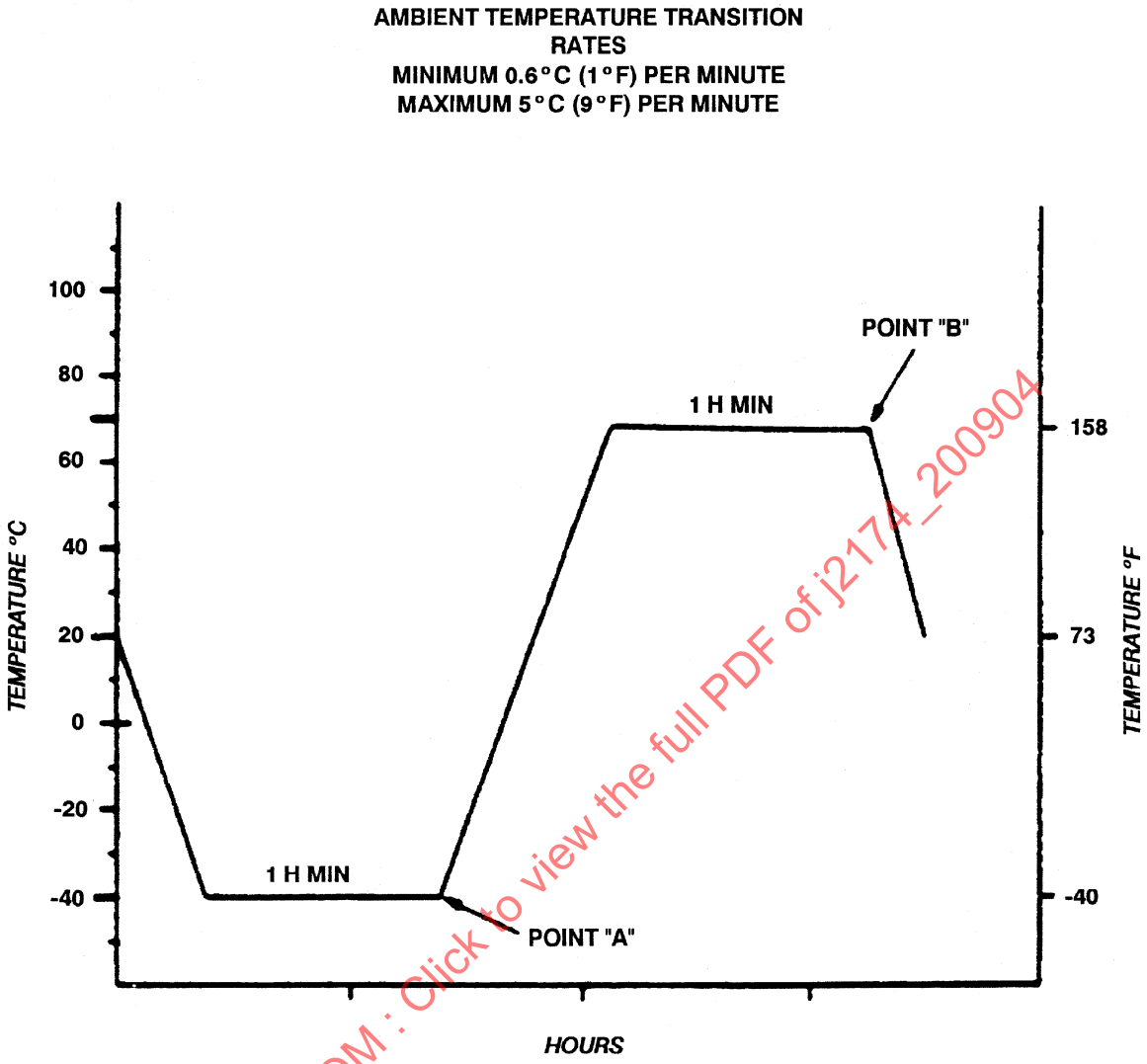
b. Using the procedure described in 4.1.1, measure the millivolt drop of the mated terminal pair.

4.1.3 Salt Fog

Testing shall be performed per ASTM B 117-73 test method for 240 h. During the test, each circuit shall be operating at the test currents specified in Table 1. The SAE J560 connector plug-to-receptacle interface shall be tested to the SAE J560 requirements.

4.1.4 Thermal Cycle

Connector and cable assemblies shall be connected to their mating parts. The assemblies shall be exposed to 25 cycles of the thermal cycle profile shown in Figure 3. The assemblies shall be energized with test voltage commencing at point “A” of Figure 3 and de-energized at point “B” of each cycle. The current shall be limited to 1.0 A.



NOTE—The period is dependent upon the temperature transition rate.

FIGURE 3 - THERMAL CYCLE PROFILE

4.1.5 Thermal Shock

The cable to cable or cable to component connector assemblies shall be subjected to 10 cycles of thermal shock. One cycle shall consist of 30 min at a temperature of –40 °C ± 2 °C followed by 30 min at a temperature of 80 °C ± 2 °C with a transfer time of 2 min maximum.

4.1.6 Oil Absorption

Connectors shall be capped prior to testing to prevent entry of oil into the connector cavities during the test. The wiring assembly shall be immersed in ASTM D 471, IRM-902 engine oil at 50 °C ± 3 °C for a period of 20 h. After removal from the engine oil, remove excess oil from the surface and allow sufficient time for excess oil trapped in the assembly to drain completely.

4.1.7 Salt Water Immersion

Salt water immersion shall not be performed on the SAE J560 connector plug-to-receptacle interface.

4.1.7.1 Cable to Cable Assembly

a. Immerse the assembly at a minimum depth of 300 mm in a 5% solution of salt (sodium chloride) water.

b. Extend the cable ends out of the solution.

c. Connect the assembly to a source set at test voltage. The current flowing shall be a minimum of 1.0 A.

d. Energize the assembly for 30 min each hour.

e. Terminate test after 60 h.

4.1.7.2 Cable to Component Assembly

a. Immerse the assembly at a minimum depth of 300 mm in a 5% solution of salt (sodium chloride) water.

b. Extend the ends of the cable assembly out of the solution.

c. Connect the assembly to a source set at component rated voltage or test voltage.

d. Energize the assembly for 30 min each hour.

e. Terminate test after 60 h.

4.1.8 Steam Cleaning and Pressure Washing

Conduct testing per SAE J1455. The addition of detergents or other additives to the water is recommended. The sample should be oriented in an as installed condition, simulating normal operating conditions.

4.1.9 Vibration

4.1.9.1 Applicability

It is difficult to subject a complete trailer wiring system to a vibration test due to its size. To accomplish a meaningful test, individual sections need to be tested alone or along with other sections. Each connector system as well as each mounting support location must be tested. Unsupported sections routed around tight corners or passing through cutouts should also be tested.

4.1.9.2 Test Set Up

The section of wiring under test shall be attached to the shaker table simulating the actual installation. The remainder of the wiring shall be free and unsupported for a minimum of one vertical meter, draped off the test table. If the section under test may accumulate ice during actual usage, a 2 kg weight shall be added to the free wiring, one half meter below the surface of the shaker table.

4.1.9.3 Test Method

Alternative test methods, 4.1.9.3.1 or 4.1.9.3.2, may be applied depending upon availability of equipment. Method 4.1.9.3.1 is recommended.

With 100 mA flowing through the circuits under test during the last thirty minutes of the test, monitor each circuit for discontinuities.

Measure millivolt drop at the termination of the test using the procedure described in 4.1.1.

4.1.9.3.1 Vibration testing shall be performed by the procedure described in SAE J2139.

4.1.9.3.2 Vibration testing shall be performed by the procedure described in SAE J1455 4.10.4.1 – Swept Sine Vibration Tests using a sweep profile from 10 to 1000 Hz, single axis for 6 h.

4.1.10 Insulation Resistance—Multiconductor Assemblies

Using a 500 V megohmmeter or 500 V, AC or DC, hipotential tester, check each terminal to all other terminals and any conducting shells or conduits.

4.1.11 Tensile Strength—Wire to Terminal

If insulation crimps are present, the crimp wings shall be opened before testing. The terminal and wire assembly shall be placed in a wire terminal pull tester. Sufficient force shall be applied to pull the wire out of the terminal or break the wire. All testing is to be conducted at a uniform rate of speed not to exceed 305 mm/min.

4.1.12 Tensile Strength—Wire to Wire

The wire to wire splice shall be placed in a pull tester. Sufficient force shall be applied to break the wire or break the wire to wire splice. All testing is to be conducted at a uniform rate of speed not to exceed 305 mm/min.

4.1.13 Connector Pull Force

All mated connectors that may be subjected to disconnection forces during use shall have a force of 100 N applied in the axis of engagement of the connector pair in the direction of disengagement. The force shall be applied at a rate not to exceed 5 N/s.

4.1.14 Connector Misengagement Force

Unmated multicavity connector pairs shall have a force of 178 N applied in the axis of and in the direction of engagement. The connectors shall be oriented to test the mechanical strength of the connector system's polarization features.

4.1.15 Terminal Retention Tensile Force

The terminal retention force within the connector cavity shall be determined by applying and measuring a tensile load along the axis of the terminal. The load should be applied to the attached conductor.

5. REQUIREMENTS

5.1 Voltage Drop

The voltage drop shall not exceed the values tabulated in Table 1:

TABLE 1 - VOLTAGE DROP

SAE Cable Size (mm^2)	Test Current (Amperes)	Maximum Millivolt Drop (cable to device) (cable to cable)
0.5	5	100
0.8	10	100
1.0	15	100
2.0	20	100
3.0	30	100
5.0	40	100
8.0	50	100
13.0	60	100

5.2 Tensile Strength—Wire to Terminal

The tensile strength shall exceed the values listed in Table 2 for an effective electrical and mechanical connection.

TABLE 2 - MINIMUM TENSILE STRENGTH

SAE Cable Size (mm^2)	Force (N) (Wire to Terminal) (Wire to Wire)
0.5	70
0.8	80
1	124
2	155
3	177
5	200
8	222
13	355

5.3 Tensile Strength—Wire to Wire

The tensile strength shall exceed the values listed in Table 2 for an effective electrical and mechanical connection.

5.4 Connector Durability

The millivolt drop shall not exceed the values listed in Table 1 for the wire size under evaluation. At the conclusion of the test, there shall be no evidence of cracking, breaking or physical deformation that would affect performance in the other required tests.

5.5 Vibration

The millivolt drop shall not exceed the values listed in Table 1 for the wire size under consideration. There shall be no apparent loosening of terminals within a connector. There shall have been no electrical discontinuities greater than 100 Ω for greater than 10 µs in the last half hour of the test. There shall be no signs of mechanical or electrical damage or defects upon visual examination.

5.6 Thermal Cycle

Upon completion of the thermal cycle exposure, there shall be no cracking, warping, or rupture of any of the components. The connectors shall remain serviceable.

5.7 Thermal Shock

There shall be no evidence of damage detrimental to the normal operation of the assembly.

5.8 Oil Absorption

Upon completion of the oil absorption tests, the connectors must remain serviceable. A serviceable part is one that can be removed with reasonable force and reinstalled without visible damage. A visual inspection shall reveal no cracks, splits, or other damage to the items used in the construction of the assembly.

5.9 Insulation Resistance

The insulation resistance shall be in excess of 1 MΩ. The leakage current shall be less than 50 mA.

5.10 Salt Water Immersion

At the completion of the test, there shall be no visual evidence of corrosion residue on any of the electrical terminals and the terminals shall be intact in their original condition.

Allow the assembly to dry for 4 h after concluding the test and check each circuit for shorting between circuits and grounding to any conducting shell or conduit.

5.11 Salt Fog

At the completion of the test, there shall be no visual evidence of corrosion residue on any of the electrical terminals and the terminals shall be intact in their original shape.

Allow the assembly to dry for 4 h after test and check each circuit for shorting between circuits and grounding to any conducting shell or conduit.

5.12 Spray Wash

Upon visual examination at the conclusion of the test, there shall be no evidence of water ingress into any sealed cavities, particularly connector cavities and sealed cables.

5.13 Connector Pull Force

The mated connectors shall withstand the specified load for a minimum of 30 s without any damage or disengagement.

5.14 Connector Misengagement Force

The connectors shall withstand the specified load for a minimum of 30 s without any damage, without connector engagement, and without electrical connection in any terminal position.

5.15 Terminal Retention Tensile Force

The minimum terminal retention tensile force shall meet the minimum requirements as specified in Table 3. Note that the retention force includes secondary locking devices if provided. The harness designer shall be responsible for determining the application of Standard or Heavy-Duty ratings.