



SURFACE VEHICLE RECOMMENDED PRACTICE

J2202™

JAN2024

Issued 1996-01
Revised 2019-12
Reaffirmed 2024-01

Superseding J2202 DEC2019

Heavy-Duty Wiring Systems for On-Highway Trucks

RATIONALE

The future of the heavy truck electrical systems will offer a multi-voltage electrical system, which will include voltages above a nominal 14 VDC electrical wiring system, along with new technologies and requirements not included in the current SAE J2202. With the need to include new technologies addressing higher voltage, it was decided to limit the scope of the SAE J2202 to a nominal 12 VDC and/or 24 VDC electrical system.

A revision was also made to this SAE Recommended Practice to reference USCAR-2 Revision 6 and remove reference to SAE J2223/2, which is a cancelled document.

SAE J2202 has been reaffirmed to comply with the SAE Five-Year Review policy.

1. SCOPE

This SAE Recommended Practice provides general guidelines on the material selection, construction, and qualification of components and wiring systems used to construct nominal 12 VDC and/or 24 VDC electrical wiring systems for heavy-duty vehicles. The guidelines are limited to nominal 12 VDC and/or 24 VDC primary wiring systems and includes cable sizes American Wire Gage 20 to AWG 4 on heavy-duty on-highway trucks. The document identifies appropriate operating performances requirements. This document excludes the male-to-female connection of the SAE J560 connectors.

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 J156	Fusible Links
SAE J163	Low Tension Wiring and Cable Terminals and Splice Clips
SAE J553	Circuit Breakers
SAE J560	Primary and Auxiliary Seven Conductor Electrical Connector for Truck-Trailer Jumper Cable

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SAE reviews each technical report at least every five years at which time it may be revised, reaffirmed, stabilized, or cancelled. SAE invites your written comments and suggestions.

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SAE WEB ADDRESS:

Full document details: SAE J2202_202401

For more information on this standard, visit
https://www.sae.org/standards/content/J2202_202401/

Documents

Document Sharing Hub

SAE J561	Electrical Terminals - Eyelet and Spade Type
SAE J1067	Seven Conductor Cable - Truck and Bus
SAE J1127	Low Voltage Battery Cable
SAE J1128	Low Voltage Primary Cable
SAE J1284	Blade Type Electric Fuses
SAE J1455	Recommended Environmental Practices for Electronic Equipment Design in Heavy-Duty Vehicle Applications
SAE J1493	Guarding of Starter System Energization
SAE J1614	Wiring Distribution Systems for Off-Road, Self-Propelled Work Machines
SAE J1678	Low Voltage Ultra Thin Wall Primary Cable
SAE J1811	Power Cable Terminals
SAE J1888	High Current Time Lag Electric Fuses
SAE J1908	Electrical Grounding Practice
SAE J1939	Serial Control and Communications Heavy Duty Vehicle Network - Top Level Document
SAE J1939/11	Physical Layer, 250 Kbps, Twisted Shielded Pair
SAE J1939/13	Off-Board Diagnostic Connector
SAE J1939/14	Physical Layer, 500 Kbps
SAE J1939/15	Physical Layer, 250 Kbps, Un-Shielded Twisted Pair (UTP)
SAE J2030	Heavy-Duty Electrical Connector Performance Standard
SAE J2191	Recommended Practice for Identification of Standardized Truck and Tractor Electrical Circuits
SAE J2222	Coiled Electrical Cable - Truck and Bus
SAE J2223/1	Connections for On-Board Road Vehicle Electrical Wiring Harnesses - Part 1: Single-Pole Connectors - Flat Blade Terminals - Dimensional Characteristics and Specific Requirements
SAE J2223/3	Connections for On-Board Road Vehicle Electrical Wiring Harnesses - Part 3: Multipole Connectors - Flat Blade Terminals - Dimensional Characteristics and Specific Requirements
SAE J2247	Truck Tractor Power Output for Trailer ABS
SAE J2394	Seven Conductor Cable for ABS Power - Truck and Bus
SAE J2497	Power Line Carrier Communications for Commercial Vehicles
SAE J2549	Single Conductor Cable for Heavy-Duty Applications - Truck and Bus
SAE/USCAR-2 Rev 6	Performance Specification for Automotive Electrical Connector Systems

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 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 Standard Method of Salt Spray (Fog) Testing

ASTM D471 Standard Test Method for Rubber Property-Effect of Liquids

2.2.2 Federal Publications

Available from the Document Automation and Production Service (DAPS), Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, Tel: 215-697-6257, <http://assist.daps.dla.mil/quicksearch/>.

Federal Motor Carrier Safety Regulations 393.27

MIL-STD-1344A Method 3002/Low Voltage Dry Circuit

2.2.3 IPC - Association Connecting Electronics Industries Publications

Available from IPC, 3000 Lakeside Drive, 309 S, Bannockburn, IL 60015, Tel: 847-615-7100, www.ipc.org.

IPC/WHMA-A-620 Requirements and Acceptance for Cable and Wire Harness Assemblies

2.2.4 ISO Publications

Copies of these documents are available online at <http://webstore.ansi.org/>.

ISO 22241 NOx Reduction Agent AUS 32 - Part 1: Quality Requirements

3. DEFINITIONS

3.1 ELECTRICAL CIRCUITS

An electrical circuit includes all of the components and connecting cables, starting from the electrical energy source, going to the functional component(s) and the return route through the energy source.

3.2 ELECTRICAL COMPONENT

An electrical component is normally a combination of parts, subassemblies, or assemblies creating a self-contained element intended to store, generate, distribute, alter, or consume electrical energy or affect an electrical junction.

3.3 CONDUCTOR

The current carrying element of an electrical cable.

3.4 ELECTRICAL CABLE

Insulated stranded electrical conductor used to establish a single current path.

3.5 HARNESS

A group of two or more cables bundled together.

3.6 TERMINAL

An electrically conductive device attached to a cable to facilitate connection to an electrical component, cable, or termination.

3.7 CONNECTION

An electrical and/or mechanical junction between two connectors, cables, or between a cable(s) and an electrical component.

3.8 WIRING

The cables, terminations, and supporting accessories collectively used in the electrical distribution system.

3.9 CONNECTOR

A separable coupling device which contains the electrical interface and mechanical interface components.

3.10 POINT OF ELECTRICAL CONNECTION

The point where the conductor and terminal are crimped or joined together.

3.11 SEALED

A condition which provides a non-leaking 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.

3.12 SIGNAL LEVEL CIRCUIT

A circuit in which open circuit voltages are low and the currents are low (100 mA and 20 mV open circuit) and at the levels where the current is not able to break through the film of oxides, sulfides, or other films or contaminants which may build up on the contact surfaces.

4. TESTS

4.1 Test Procedures

The testing shall validate the appropriate design and performance characteristics of the primary wiring distribution system, including the connector interfaces of mating devices, but not the mating device itself. Conformance to the requirements of this document shall be determined by subjecting each component to the test procedure listed in this document. Unless otherwise stated, the tests are to be performed at $25\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ and at $12.5\text{ VDC} \pm 0.1\text{ VDC}$, or per the manufacturers' recommendations. The tests shall be conducted as defined in the following test procedures. Minimum sample size to be six parts, unless otherwise specified by customer requirements.

- 4.1.1 Voltage Drop
- 4.1.2 Low Voltage Resistance (Dry Circuit)
- 4.1.3 Oil Absorption
- 4.1.4 Thermal
 - 4.1.4.1 Thermal Cycle
 - 4.1.4.2 Thermal Shock
- 4.1.5 Humidity
- 4.1.6 Salt Fog *
- 4.1.7 Saltwater Immersion *
- 4.1.8 Spray Wash *
- 4.1.9 Vibration
- 4.1.10 Insulation Resistance - Multi-Conductor Assemblies
- 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 Mis-Engagement Force
- 4.1.15 Connector Terminal Retention Force
- 4.1.16 Chemical Exposure
- 4.1.17 Circuit Identification (Standalone Test)

* Tests conducted on sealed connector systems.

NOTICE: Some test procedures are potentially dangerous. SAE Technical Reports do not purport to address all of the safety problems, if any, associated with their use. It is the responsibility of the user of an SAE Technical Report to establish and employ appropriate safety practices. Tests should only be conducted by individuals who have been properly trained in the test procedure and who are aware of any hazards which may be present. Appropriate safety and health precautions must be employed when conducting any test.

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.

4.1.2 Low-Voltage Dry Circuit Resistance

4.1.2.1 Signal Level Circuit (Refer to MIL-STD-1344A; Method 3002.1)

Test with applied voltage not exceeding 20 mV open circuit and the test current shall be limited to 100 mA. Utilizing Figure 1, record connection resistance.

4.1.3 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 D471, IRM-902 engine oil at $50\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ for a period of 20 hours. 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.

4.1.4 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 minutes at a temperature of $-40\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$, followed by 30 minutes at a temperature of $80\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$, with a transfer time of 2 minutes maximum.

4.1.4.1 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. The assemblies shall be energized with test voltage commencing at $20\text{ }^{\circ}\text{C}$ and transferring to $-40\text{ }^{\circ}\text{C}$ for 1 hour, and then transfer to $+70\text{ }^{\circ}\text{C}$ within 10 minutes. Hold $+70\text{ }^{\circ}\text{C}$ for 1 hour, and then transfer to $+20\text{ }^{\circ}\text{C}$ within 30 minutes. This completes the cycle. The current shall be limited to 1 A.

4.1.5 Humidity (Refer to SAE J1455)

Temperature/humidity test samples to be placed in a temperature/humidity chamber and shall be subjected to 42 cycles described as follows:

- a. Chamber temperature raised to $55\text{ }^{\circ}\text{C}$ at $3\text{ }^{\circ}\text{C}/\text{min} \pm 1\text{ }^{\circ}\text{C}/\text{min}$.
- b. Chamber temperature held for 16 hours at a relative humidity of $95\% \pm 5\%$.
- c. Chamber temperature lowered to $-55\text{ }^{\circ}\text{C}$ at $3\text{ }^{\circ}\text{C}/\text{min} \pm 1\text{ }^{\circ}\text{C}/\text{min}$.
- d. Chamber temperature held for 2 hours.
- e. Chamber temperature raised to $125\text{ }^{\circ}\text{C}$ at $3\text{ }^{\circ}\text{C}/\text{min} \pm 1\text{ }^{\circ}\text{C}/\text{min}$.

- f. Chamber temperature held for 2 hours.
- g. Chamber temperature lowered to 25 °C at 3 °C/min $\pm$ 1 °C/min.
- h. Chamber temperature held for remainder of 24 hour cycle.

4.1.6 Salt Fog

Testing shall be performed per ASTM B117-73 test method for 240 hours. During the test, each circuit shall be operating at the test currents specified in Table 2.

4.1.7 (Voltage Drop) Saltwater Immersion (for Sealed Connection Systems Only)

The wired mated sealed connectors shall be placed in an oven at 125 °C $\pm$ 3 °C for 1 hour, then immediately be placed in water with a 5% salt in weight content and 0.1 g/L wetting agent, to a depth of 1 m for 4 hours. Water temperature is to be 23 °C $\pm$ 3 °C. Non-terminated ends of the test cable are not to be immersed in saltwater bath.

4.1.7.1 Cable-to-Cable Assembly (Splice)

- 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 with 1 A minimum current flowing.
- d. Energize the splice for 30 minutes each hour.
- e. Terminate test after 60 hours.

4.1.7.2 Electrical Harness 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 power source set at component rated voltage or test voltage. The current flowing shall be at the rated current.
- d. Energize the assembly for 30 minutes each hour.
- e. Terminate test after 60 hours.

4.1.8 Spray Wash

4.1.8.1 Test Method (Refer to SAE J1455)

The mated and cabled connectors under test shall be mounted in its normal operating position with drain holes, if used, open. The test apparatus should be designed to provide 100% coverage of the exposed surface of the mated and cabled connectors using flat fan spray nozzles located 20 to 30 cm (7.9 to 11.8 inches) away. This apparatus should provide a source pressure of approximately 7000 kPa gauge (1020 lbf/in² gauge) with a flow rate of approximately 9460 cm³/min (150 gal/h). The test item should be exposed to the spray for 3 seconds of a 6 second period for a total of 375 cycles. The test should be run at 40 °C (104 °F) with water/detergent. An insulation resistance test (4.1.10) shall be conducted after this test.