

(R) Seven Conductor Electrical Connector for Truck-Trailer Jumper Cable

Foreword—This Document has also changed to comply with the new SAE Technical Standards Board format.

The seven conductor electrical connector is the electrical interface between highway tractors and trailers. The use of this connector makes it possible to pull any trailer with any tractor without the use of adapters.

This connector is comparable to only one unit currently being considered as an ISO Standard. In addition to the seven conductor unit, ISO is considering twelve, thirteen, and fifteen conductor units. All of these may be included in any ISO Standard which will require a number of adapters to achieve universal compatibility of tractors and trailers.

1. **Scope**—This SAE Standard provides the minimum requirements for the jumper cable plug and receptacle for the truck-trailer jumper cable system. It includes the test procedures, design, and performance requirements.

2. **References**

2.1 **Applicable Publications**—The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of the publications shall apply.

2.1.1 SAE PUBLICATION—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001

SAE J1067—Seven Conductor Jacketed Cable for Truck-Trailer Connections

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

ASTM B 117-94—Standard Method of Salt Spray (Fog) Testing

3. **Definitions**

3.1 **Receptacle**—The receptacle consists of the connector socket, its housing, and a cover which latches the cable plug in place. The socket contains the male contacts. See Figures 1 and 2.

3.2 **Cable Plug**—The cable plug is part of the jumper cable assembly. The cable plug contains the female contacts. See Figure 3.

3.3 **Coupling Cycle**—Coupling and uncoupling the plug and receptacle is one coupling cycle.

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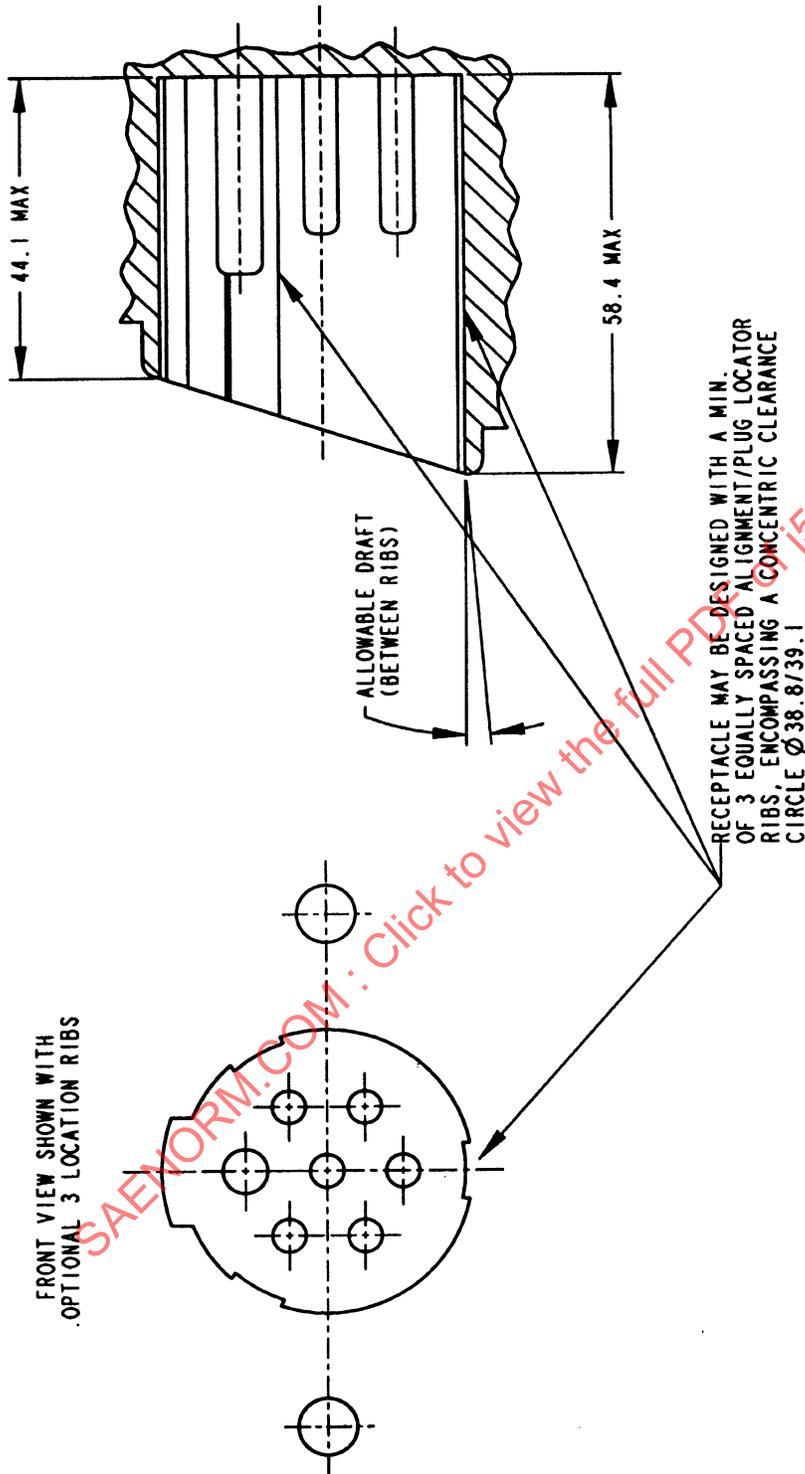
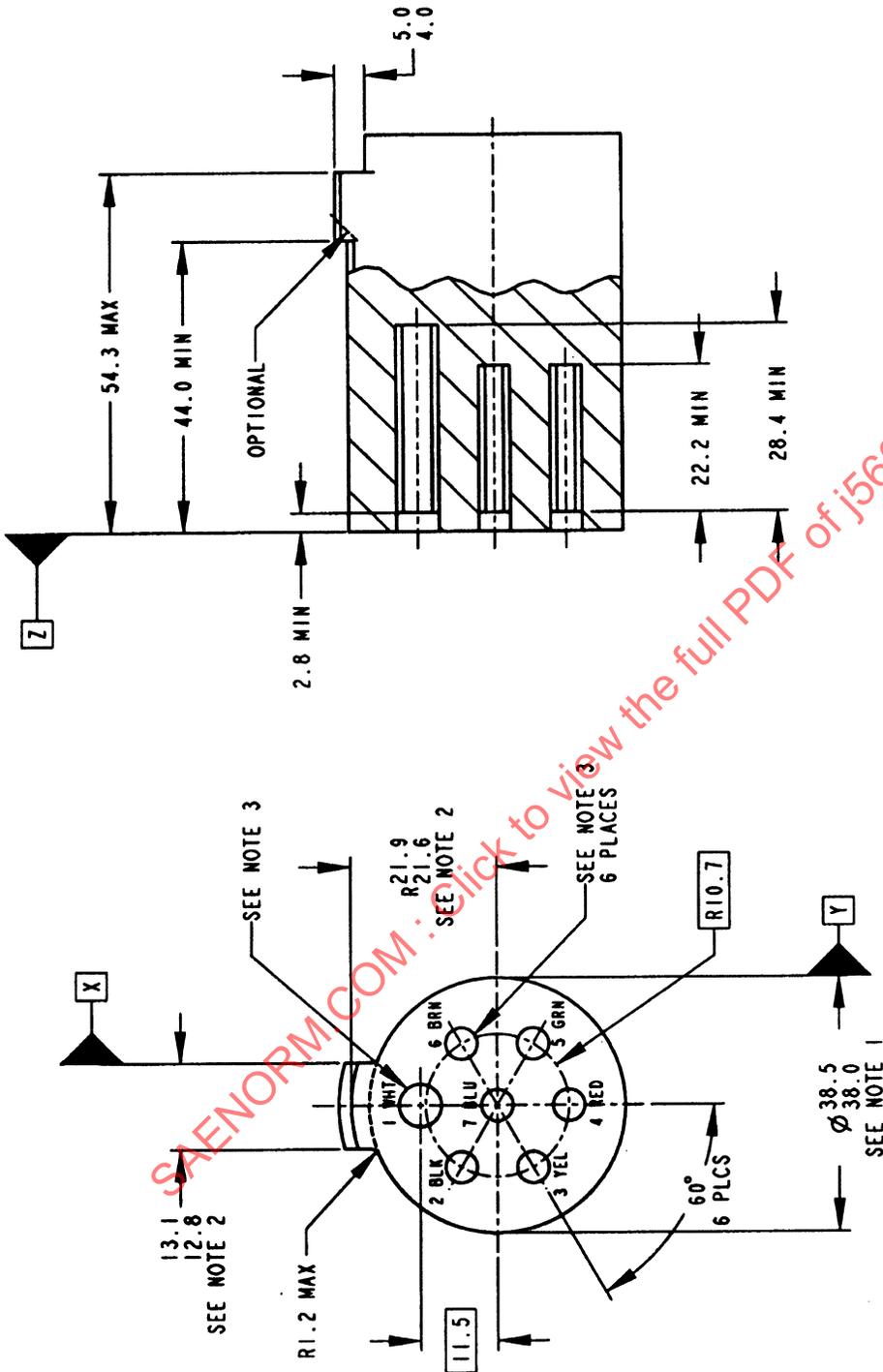


FIGURE 2—ALTERNATE CONSTRUCTION RECEPTACLE SOCKET

ALL DATUMS, NOTES AND DIMENSIONS ON FIGURE 1 APPLY TO THIS FIGURE



- NOTES:
1. DIMENSIONS MUST BE MAINTAINED FOR 58.4 FROM DATUM 'Z'.
 2. DIMENSION MUST BE MAINTAINED FOR 44.0 FROM DATUM 'Z'.
 3. TERMINAL POSITION $\phi 0.1 | X | Y | Z$
TERMINAL FLOAT OF 0.25 AROUND ITS AXIS RECOMMENDED PER GUIDELINE 8.3.

FIGURE 3—CABLE PLUG

4. **Identification Code Designation**—Devices conforming to this document shall be identified with the manufacturer's identification, model or part number, and shall be identified with SAE J560 and the revision (month and year) of the document to which the device conforms. For example:

XYZ Corp.
9999
SAE J560
May 1998

5. Technical Requirements

5.1 Test Equipment and Instrumentation

- 5.1.1 THE POWER SUPPLY—The power supply shall be capable of supplying the continuous current required to perform all tests.

- 5.1.2 VOLTMETER—A d-c voltmeter with an input resistance greater than 1000 Ω/V and with a resolution of 0.1 V shall be used. To achieve this resolution, the full-scale deflection shall be appropriate to the voltage rating of the system being tested.

A digital meter having at least a 3-1/2-digit readout with an accuracy of $\pm 1\%$ plus one digit is recommended for millivolt readings.

- 5.1.3 AMMETER—A d-c ammeter shall be used for current measurements. The meter range resolution shall be 0.1 A.

- 5.1.4 MILLIAMMETER—A d-c ammeter shall be used for current measurements. The meter range resolution shall be 1.0 mA.

- 5.1.5 HIPOT—Capable of detecting leakage currents of 0.5 mA at 500 VAC.

5.2 Test Procedures

- 5.2.1 VOLTAGE DROP—The test is to be conducted in a draft-free room maintained at an ambient temperature of $25^\circ\text{C} \pm 5^\circ\text{C}$.

5.2.1.1 Connectors without Circuit Breakers

- Connect a 1000 to 2000 mm long SAE J1067 type cable to the receptacle terminals and another 1000 to 2000 mm long SAE J1067 type cable to the cable plug terminals.
- Mate the cable plug and receptacle.
- Connect a power supply to the two cable ends in such a way that it applies 35 A to each circuit having a 4.75 mm (0.188 in) diameter terminal and 70 A to the circuit having a 6.35 mm (0.25 in) diameter terminal.
- Turn on power supply and wait 5 min for the circuits to stabilize.
- Measure the voltage drop across each circuit of the assembly at a convenient point on the wire at least 25 mm (1 in) from the terminal.

5.2.1.2 Connectors with Circuit Breakers

- Same as in 5.2.1.1
- Devices with circuit breakers may be certified using the noncircuit breaker version provided their construction is otherwise identical. If this is not possible, devices with circuit breakers may be tested by installing low-resistance shunts across their circuit breakers.

5.2.2 ISOLATION RESISTANCE—This test is to be performed with a hipot tester at 500 VAC with a leakage current setting of 0.5 mA. Connect the hipot tester from terminal “x” to all the other terminals in parallel for one minute and observe for failure (breakdown). Perform this test for the following terminal combinations:

- #1 terminal to all other terminals
- #2 terminal to all other terminals
- #3 terminal to all other terminals
- #4 terminal to all other terminals
- #5 terminal to all other terminals
- #6 terminal to all other terminals
- #7 terminal to all other terminals

If applicable, this test should be performed after salt residue has been washed off and the parts have been dried.

5.2.3 COUPLING FORCE

5.2.3.1 *Mounting*—Mount the assembled cable plug and receptacle on a suitable fixture and measure with a 0 to 445 N (100 lb) force gage.

5.2.3.2 *Measurement*—Measure and record the peak force to fully mate the receptacle and cable plug until the receptacle’s cover latch feature has engaged. Measure and record the peak force to disconnect the cable plug after manually disengaging the receptacle’s cover latch feature.

5.2.4 STRAIGHT PULL - (CABLE PLUG)—A cable plug and SAE J1067 cable assembly shall be securely mounted in a suitable fixture. A pull force of 667 N (150 lb) shall be exerted on the J1067 cable along the axis of the cable plug for a duration of 24 h at 25 °C ± 5 °C.

5.2.5 SALT SPRAY

5.2.5.1 With the plug inserted into the receptacle and with the assembly mounted in normal truck-trailer position, subject the normally exposed portion of the assembly to a 48 h salt spray test per ASTM B 117.

5.2.5.2 Subject the uncoupled units to a 48 h salt spray test per ASTM B 117. Mount the receptacle in a normal vehicle position with the cover closed, and the cable plug protected by the docking device of 8.2 in normal vehicle position.

5.2.6 COUPLING CYCLE

5.2.6.1 25 °C ± 5 °C *Test*—Perform 2500 coupling cycles. Measure coupling and uncoupling force for informational purposes of the first cycle.

5.2.6.2 82 °C *Test*—Subject each assembly to a temperature of 82 °C ± 5 °C. After the assembly has stabilized at 82 °C, perform 250 coupling cycles. Measure coupling and uncoupling force for informational purposes of the first cycle.

5.2.6.3 -40 °C *Test*—Subject each assembly to a temperature of -40 °C ± 5 °C. After the assembly has stabilized at -40 °C, perform 250 coupling cycles. Measure coupling and uncoupling force for informational purposes of the first cycle.

5.2.7 VIBRATION

- 5.2.7.1 *Mounting*—Connectors (Cable plug and receptacle mated) under test are to be mounted to the vibrating plane with the SAE J1067 wire harness end fixed to a nonvibrating object no closer than 100 mm and not farther than 300 mm from the rear of the connector. Connectors under test shall be wired in series and connected to a DC power supply source, with a current flow of 10 A in each terminal.
- 5.2.7.2 *Vibration Test Characteristics*—Connectors under test shall be subjected to a sine motion sweep having an initial displacement of 1.78 mm double amplitude. The frequency shall be varied between limits of 15 to 2000 Hz. The entire frequency range (15 to 2000 back to 15 Hz) shall be traversed in 15 min. (Acceleration levels not to exceed 20 Gs).
- 5.2.7.3 *Test Duration*—Test to last a total of 12 h. X, Y, and Z axis are to be tested 4 h in each direction. Monitor for discontinuity in excess of 100 ms at 100 mA during the last hour of vibration in each axis.
- 5.2.8 THERMAL SHOCK—The mated connectors shall be subjected to 10 cycles of thermal shock. One cycle shall consist of 30 min at $-40\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$, followed by 30 min at $82\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ with a transition time of 2 min maximum.
- 5.2.9 TERMINAL CRIMP STRENGTH—This test pertains to the mechanical connection between the connector pins and the SAE J1067 cable wires. (Usually a crimped, welded, or set screw design). The strength of the connection shall be tested by using a suitable apparatus at a constant speed within the range of 50 to 100 mm/min. If the terminal has a cable insulation crimp, it shall be rendered mechanically ineffective. Minimum acceptable values are shown in Table 1. All samples are to be pulled to destruction.

TABLE 1—MINIMUM TENSILE STRENGTH FOR CRIMPED CONNECTIONS

Cable Size mm ²	Minimum Tensile N
8.0	445
5.0	375
3.0	335

- 5.2.10 TERMINAL PIN RETENTION—Both the receptacle and cable plug pins shall be subjected to a direct pull and push force of 175 N for 1 min. The force is to be exerted on each pin without sudden or jerking forces during the test.

NOTE—Secondary lock devices should be utilized if part of the design.

- 5.2.11 CYCLE COVER SPRING—The cover spring integrity shall be tested to 5000 cycles by cycling the cover open/closed to the full extend of its motion. The torque to move the cover for the initial 10 degrees of motion shall be measured before and after test.

- 5.3 **Durability Test Sequence**—This test sequence is to be performed on six production level connector assemblies in the order listed as follows. No supplemental lubrication or other cleaning of the terminal pins prior or during the test sequence is permitted.

- a. Coupling Force, Reference 5.2.3
- b. Voltage Drop, Reference 5.2.1
- c. Isolation Resistance, Reference 5.2.2
- d. Room Temperature Coupling Cycles, Reference 5.2.6.1
- e. 82 °C Coupling Cycles, Reference 5.2.6.2
- f. Salt Spray, Reference 5.2.5.1

- g. Voltage Drop, Reference 5.2.1
- h. Isolation Resistance, Reference 5.2.2
- i. Salt Spray, Reference 5.2.5.2
- j. Room Temperature Coupling Cycles, Reference 5.2.6.1
- k. -40 °C Coupling Cycles, Reference 5.2.6.3
- l. Voltage Drop, Reference 5.2.1
- m. Isolation Resistance, Reference 5.2.2
- n. Coupling Force, Reference 5.2.3

5.4 Mechanical Test Sequence—This test sequence is to be performed on six production level connector assemblies in the order listed as follows. No supplemental lubrication or other cleaning of the terminal pins prior or during the test sequence is permitted.

- a. Coupling Force, Reference 5.2.3
- b. Straight Pull, Reference 5.2.4
- c. Isolation Resistance, Reference 5.2.2
- d. Terminal Retention, Reference 5.2.10
- e. Terminal Crimp Strength, Reference 5.2.9
- f. Cycle Cover Spring, Reference 5.2.11

5.5 Environment Test Sequence—This test sequence is to be performed on six production level connector assemblies in the order listed below. No supplemental lubrication or other cleaning of the terminal pins prior or during the test sequence is permitted.

- a. Voltage Drop, Reference 5.2.1
- b. Thermal Shock Test, Reference 5.2.8
- c. Vibration Test, Reference 5.2.7
- d. Voltage Drop, Reference 5.2.1
- e. Isolation Resistance, Reference 5.2.2

6. Performance Requirements

6.1 Electrical

- 6.1.1 **VOLTAGE DROP**—The voltage drop for each circuit shall not exceed 3 mV/A when tested in accordance with 5.2.1.
- 6.1.2 **ISOLATION RESISTANCE**—The leakage current between each circuit and the other six circuits shall not exceed 0.5 mA, reference 5.2.2.
- 6.1.3 **VIBRATION**—The connector assembly under test shall show no signs of damage and shall not exceed 100 ms discontinuity when monitored during the last hour of test in each of the three axis in accordance with 5.2.7.

6.2 Mechanical

- 6.2.1 **COUPLING FORCE** —The unlatched coupling and uncoupling force shall not exceed 223 N (50 lbs) and the latched uncoupling force shall not be less than 110 N (25 lbs) in accordance with 5.2.3.
- 6.2.2 **DURABILITY TEST**—The connector assembly shall conform to the electrical and mechanical requirements outlined in 5.3 Durability Test Sequence.
- 6.2.3 **STRAIGHT PULL**—An assembled cable plug and trailer jumper cable shall not be damaged when tested in accordance with 5.2.4.