
Truck Lighting Connector System

1. SCOPE

1.1. Content

This specification covers performance, tests and quality requirements for the Tyco Electronics 2 and 3 position Truck Lighting Connector System composed of a cap connector assembly, a plug connector assembly and wire covers. The system utilizes the Tyco Electronics AMP MCP2.8 contact system with crimped wire termination. Terminals are configured in either a Ag/Ag or Ag/Sn configuration to meet high cycle count durability requirements of 25 cycles, or in a Sn/Sn configuration to meet a standard durability requirement of 10 cycles. The assembly is designed to meet the needs of the electrical interface(s) between the heavy duty lighting device(s) and the truck and truck/trailer wiring harness system. This specification excludes forward lighting devices (i.e. fog lamps) but includes stop lamps, back up lamps, tail lamps, side-turn signal lamps, turn signal/hazard warning lamps, work lamps, side marker lamps, license lamps, clearance lamps and chassis component status (ABS) lamps.

1.2. Qualification

When tests are performed on the subject product line, procedures specified in Figure 1 shall be used. All inspections shall be performed using the applicable inspection plan and product drawing.

1.3. Successful qualification testing on the subject product line was completed on 27Jan10. The Qualification Test Report number for this testing is 501-730. This documentation is on file at and available from Engineering Practices and Standards (EPS).

2. APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the latest edition of the document applies. In the event of conflict between the requirements of this specification and the product drawing, the product drawing shall take precedence. In the event of conflict between the requirements of this specification and the referenced documents, this specification shall take precedence.

2.1. Tyco Electronics Document

501-730: Qualification Test Report (Truck Lighting Connector System)

2.2. Industry Documents

- ASTM B117: Standard Practice for Operating Salt Spray (Fog) Apparatus
- SAE J1455: Recommended Environmental Practices for Electronic Equipment Design in Heavy-Duty Vehicle Applications
- SAE J2030: Heavy-Duty Electrical Connector Performance Standard
- SAE J2139: Tests for Signal and Marking Devices Used on Vehicles 2032 mm or More in Overall Width
- SAE J2577: Heavy Duty Lamp Electrical Connector Standard

2.3. Government Document

MIL-STD-1344A: Test Methods for Electrical Connectors

3. REQUIREMENTS

3.1. Design and Construction

Product shall be of the design, construction and physical dimensions specified on the applicable product drawing.

3.2. Materials

Materials used in the construction of this product shall be as specified on the applicable product drawing.

3.3. Ratings

- Voltage: 24 volts DC maximum
- Current: 7.5 amperes maximum
- Temperature: -40 to 85°C

3.4. Performance and Test Description

Product is designed to meet the electrical, mechanical and environmental performance requirements specified in Figure 1. Unless otherwise specified, all tests shall be performed at ambient environmental conditions.

3.5. Test Requirements and Procedures Summary

| Test Description | Requirement | Procedure | | | | | | | | |
|---------------------------------------|---|---|----------------------------|-----|-----|-----|-----|-----|-----|---|
| Examination of product. | Meet requirements of the product drawing. | SAE J2577, Paragraph 6.1. Visually inspect samples prior to testing ensure they are of production intent. | | | | | | | | |
| Visual examination. | Specimens shall be free of cracked plastic, ingress of fluids, torn seals, arcing, charring, finish deterioration, melting or any other damage that could effect product performance. | SAE J2577, Paragraph 6.21. Visually inspect samples after testing to ensure they are not damaged to the point that performance is effected. | | | | | | | | |
| ELECTRICAL | | | | | | | | | | |
| Low voltage (dry circuit) resistance. | <table border="1" style="display: inline-table; vertical-align: top;"> <thead> <tr> <th>Conductor (mm²)</th> <th>Resistance (milliohms max)</th> </tr> </thead> <tbody> <tr> <td>0.8</td> <td>7.5</td> </tr> <tr> <td>1.0</td> <td>6.5</td> </tr> <tr> <td>2.0</td> <td>5.0</td> </tr> </tbody> </table> | Conductor (mm ²) | Resistance (milliohms max) | 0.8 | 7.5 | 1.0 | 6.5 | 2.0 | 5.0 | SAE J2577, Paragraph 6.16; MIL-STD- 1344A , Method 3002.1 Measure connection resistance across mated terminals under an applied maximum test voltage of 20 millivolts and a maximum applied test current of 100 milliamperes. Subtract bulk resistance of Equal Wire Lengths (EWL). |
| Conductor (mm ²) | Resistance (milliohms max) | | | | | | | | | |
| 0.8 | 7.5 | | | | | | | | | |
| 1.0 | 6.5 | | | | | | | | | |
| 2.0 | 5.0 | | | | | | | | | |

Figure 1 (continued)

| Test Description | Requirement | Procedure | | | | | | | | | | | | | | | | |
|------------------------------|--|--|--------------------------|-----|----|-----|----|-----|----|--|------------------------------|-------------------|-----|----|-----|----|-----|----|
| Specified rated resistance. | <table border="1"> <thead> <tr> <th>Conductor (mm²)</th> <th>Resistance (megohms max)</th> </tr> </thead> <tbody> <tr> <td>0.8</td> <td>20</td> </tr> <tr> <td>1.0</td> <td>20</td> </tr> <tr> <td>2.0</td> <td>15</td> </tr> </tbody> </table> | Conductor (mm ²) | Resistance (megohms max) | 0.8 | 20 | 1.0 | 20 | 2.0 | 15 | SAE J2577, Paragraph 6.3. Measure connection resistance across mated terminals under specified current load. <table border="1"> <thead> <tr> <th>Conductor (mm²)</th> <th>Current (amperes)</th> </tr> </thead> <tbody> <tr> <td>0.8</td> <td>10</td> </tr> <tr> <td>1.0</td> <td>15</td> </tr> <tr> <td>2.0</td> <td>20</td> </tr> </tbody> </table> Subtract bulk resistance of Equal Wire Lengths (EWL). | Conductor (mm ²) | Current (amperes) | 0.8 | 10 | 1.0 | 15 | 2.0 | 20 |
| Conductor (mm ²) | Resistance (megohms max) | | | | | | | | | | | | | | | | | |
| 0.8 | 20 | | | | | | | | | | | | | | | | | |
| 1.0 | 20 | | | | | | | | | | | | | | | | | |
| 2.0 | 15 | | | | | | | | | | | | | | | | | |
| Conductor (mm ²) | Current (amperes) | | | | | | | | | | | | | | | | | |
| 0.8 | 10 | | | | | | | | | | | | | | | | | |
| 1.0 | 15 | | | | | | | | | | | | | | | | | |
| 2.0 | 20 | | | | | | | | | | | | | | | | | |
| Insulation resistance. | 20 megohms minimum. | SAE J2030, Paragraph 6.3. Measure insulation resistance at 1000 volts DC after 60 seconds or until stabilization occurs. Check each contact to all other contacts and to a grounded metal foil surrounding the housing. | | | | | | | | | | | | | | | | |
| Current cycling. | See Note. | SAE J2577, Paragraph 6.19. Subject specimens to 500 cycles at a specified current of 7.5 amperes as follows: 200 cycles of current ON for 45 minutes and current OFF for 15 minutes at 85°C; 50 cycles of current ON for 20 minutes at 85°C and current OFF for 60 minutes at 21°C. Repeat to complete 500 cycles. | | | | | | | | | | | | | | | | |
| Current test. | See Note. | SAE J2577, Paragraph 6.15. Subject specimens to a temperature of 85 ± 3°C and a current of 7.5 amperes applied to all terminals for 24 hours. | | | | | | | | | | | | | | | | |
| MECHANICAL | | | | | | | | | | | | | | | | | | |
| Vibration. | No discontinuities of 1 microsecond or longer duration during the last hour of vibration in each axis. See Note. | SAE J2577, Paragraph 6.13.3 and SAE J1455, Paragraph 4.10, Figure 11 (Chassis Vibration Data, PSD). Eight hours in each of 3 mutually perpendicular planes. Apply current as stated in the section for specified current rating at a voltage of 12 volts for the first 3 hours in each axis. | | | | | | | | | | | | | | | | |
| Shock. | No discontinuities of 1 microsecond or longer duration. See Note. | SAE J2577, Paragraph 6.13.1. Subject mated specimens to 50 G's half-sine shock pulses of 11 milliseconds duration. Ten shocks in each direction applied along 3 mutually perpendicular planes, 30 total shocks. | | | | | | | | | | | | | | | | |

Figure 1 (continued)

| Test Description | Requirement | Procedure |
|----------------------|--|--|
| Durability. | See Note. | SAE J2577, Paragraph 6.8. For Ag/Ag and Ag/Sn terminal combinations, manually mate and unmate non-powered specimens for 25 cycles. For Sn/Sn terminal combinations, manually mate and unmate non-powered specimens for 10 cycles. |
| Mating force. | 70 N maximum. | SAE J2577, Paragraph 6.14.2. Measure force necessary to mate specimens at a maximum rate of 50 mm per minute. |
| Unmating force. | 70 N maximum. | SAE J2577, Paragraph 6.14.3. Measure force necessary to unmate specimens with latch mechanism disengaged at a maximum rate of 50 mm per minute. |
| Maintenance aging. | See Note. | SAE J2577, Paragraph 6.5. Subject at least 10% of the cavities to 10 cycles of inserting and removing its respective contact. Terminal removal in accordance with 408-TBD. |
| Terminal retention. | Terminal shall maintain its original position in the connector throughout the test. Overcoming the terminal latches and allowing for terminal movement shall constitute a failure. | SAE J2577, Paragraph 6.7. Subject terminals to a direct pull of 110 N for a minimum of 1 minute. |
| Connector retention. | No damage to the specimen or release of the latch. | SAE J2577, Paragraph 6.14.1. Subject specimens with latch mechanism engaged to a force of 110 N for a minimum of 1 minute. |
| Side load force. | No damage or permanent distortion of the connector or its components. | SAE J2577, Paragraph 6.14.5. Apply a minimum load of 65 N for 1 minute to each of 4 sides. |
| Drop test. | Specimens shall not become detached, loosened or cracked which would impair the operation of the connector. Small chips and dents that would not adversely affect the operation or function of the connector shall be disregarded. See Note. | SAE J2577, Paragraph 6.13.2. Drop specimens with a 2.0 m long cable, fully extended from a wall attachment at a height of 1.0 m. |

Figure 1 (continued)

| Test Description | Requirement | Procedure |
|----------------------------------|--|--|
| ENVIRONMENTAL | | |
| Thermal shock. | See Note. | SAE J1455, Paragraph 4.1.3.2, Figure 2C. Presoak specimens at -40°C for 2 hours and then subject them to 5 cycles between -40 and 85°C with 2 hour dwells at temperature extremes. |
| Temperature/humidity. | See Note. | SAE J2577, Paragraph 6.18., Figure 4. Subject specimens to 42, 8 hour cycles between -40 and 85°C at 0 to 90% RH. |
| Temperature life. | See Note. | SAE J2577, Paragraph 6.6. Subject mated and unpowered specimens to 85°C for 1008 hours. |
| Corrosion. | See Note. | SAE J2139, Paragraph 4.4. and ASTM B117. Subject specimens to salt fog exposure for 240 hours. |
| Steam cleaning/pressure washing. | No evidence of water ingress. See Note. | SAE J2577, Paragraph 6.22. Subject specimens to 100% water coverage using a flat fan spray from a distance of 20 to 30 cm at source pressure of 7000 kPa gage and source flow rate of 9460 cm ³ /min. Specimens shall be exposed to the spray for 3 of every 6 seconds for a single cycle with total exposure of 375 cycles. For pressure washing, water temperature shall be 40°C with detergent added. For steam cleaning, water temperature shall be 93°C with a source pressure of 14000 kPa and source flow rate of 9460 cm ³ /min. |

Figure 1 (continued)

| Test Description | Requirement | Procedure |
|-------------------|--|--|
| Fluid immersion. | See Note. | SAE J2577, Paragraph 6.11. Submerge 1 specimen in 1 fluid only for 5 minutes, remove and allow to dry, repeat every 24 hours for 5 days. 1. Motor oil 30 wt (ASTM D 471, IRM-902). 2. Brake fluid (disc type 1- SAE RM66-04). 3. Diesel fuel #2 (90/10% - IRM-903/T-xylene). 4. 50/50 antifreeze mixture (ASTM D 471 service fluid 104). 5. Gear oil 90 wt (ASTM STP 512, API GL-5). 6. Windshield washer fluid (methyl alcohol, SAE J1944). 7. Magnesium chloride (5% - SAE J 2174). 8. Muratic acid (diluted 1:8 parts water by volume). 9. Calcium chloride (5% - SAE J2174). 10. Cleaning fluid (85% mineral spirits/15% xylene trisodium phosphate). |
| Water submersion. | No evidence of water ingress. See Note. | SAE J2577, Paragraph 6.10.2. Presoak specimens at 85°C for 96 hours. Specimens shall be removed and submerged into a salt water solution to a depth of 30 to 40 cm and held for 30 minutes. After 5 minutes of submersion, apply a 31 N pull for 30 seconds on each wire in all 4 directions. Examine for air bubbles. |
| Dust test. | No evidence of dust ingress. See Note. | SAE J2139, Paragraph 4.3. Subject specimens to a dust environment for a minimum of 5 hours. |

NOTE

Shall meet visual requirements, show no physical damage, and meet requirements of additional tests as specified in the Product Qualification and Requalification Test Sequence shown in Figure 2.

Figure 1 (end)

3.6. Product Qualification and Requalification Test Sequence

| Test or Examination | Test Group (a) | | | | | |
|--------------------------------------|-------------------|-------------|---------------|-----|-------------|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| | Test Sequence (b) | | | | | |
| Examination of product | 1 | 1 | 1 | 1 | 1 | 1 |
| Visual examination | 18 | 13 | | 11 | 17 | 7 |
| Low voltage (dry circuit) resistance | | | 2,4,6,8,10,15 | | 3,6,8,10,12 | |
| Specified rated resistance | | | | 2,8 | 4,14,16 | |
| Insulation resistance | 2,7,9,11,13,15,17 | 2,6,8,10,12 | | | | 2,6 |
| Current cycling | | | | | 13 | |
| Current test | | | | | 15 | |
| Vibration | 3 | 5 | 11 | | 9 | |
| Shock | 4 | | 12 | | | |
| Durability | | 3 | 3 | 3 | 2 | |
| Mating force | | | 14 | 7 | | |
| Unmating force | | | 13 | 6 | | |
| Maintenance aging | | | | 4 | | |
| Terminal retention | | | | 10 | | |
| Connector retention | | | 16 | 9 | | |
| Side load force | | | | | | 4 |
| Drop test | 5 | | | | | |
| Thermal shock | 6 | | 9 | | 7 | |
| Temperature/humidity | 8 | | 7 | | 11 | |
| Temperature life | | 4 | 5 | | 5 | 3 |
| Corrosion | 12 | 7 | | | | |
| Steam cleaning/pressure washing | 16 | 11 | | | | |
| Fluid immersion | 14 | 9 | | | | |
| Water submersion | 10 | | | | | 5 |
| Dust test | | | | 5 | | |

NOTE

- (a) See paragraph 4.1.A.
 (b) Numbers indicate sequence in which tests are performed.

Figure 2

4. QUALITY ASSURANCE PROVISIONS

4.1. Qualification Testing

A. Specimen Selection

Specimens shall be prepared in accordance with applicable instruction sheets and shall be selected at random from current production. Test groups 1 and 2 shall each consist of 10 specimens. Test groups 3, 4, 5 and 6 shall each consist of 6 specimens.

For each test group, 50% of the population shall be 2 position specimens and the remaining 50% of the population shall be 3 position specimens. For each test group, the distribution of wired terminals among the specimens shall be configured as follows:

| Wire Size | Test Group | | | | | |
|-------------------------|------------|----|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Quantity per Test Group | | | | | | |
| 2.00 mm ² | 15 | 10 | 9 | 9 | 6 | 6 |
| 0.80 mm ² | 10 | 15 | 6 | 6 | 9 | 9 |

Figure 3

Wire sizes shall be distributed for each test group, among the 2 and 3 position specimens, using only one wire size for each specimen. Plating combinations shall be configured as follows:

- Ag plated blades and Ag plated receptacles.
- Sn plated blades and Ag plated receptacles.
- Sn plated blades and Sn plated receptacles.

The specific plating combinations used for each test group are defined per the product test order listed in paragraph 4.1.B.

B. Test Sequence

Qualification inspection shall be verified by testing specimens as specified in Figure 2, using the following product test order:

- 1 Specimens using Ag plated blades and Ag plated receptacles requires the completion of all test groups of Figure 2 (Sn/Sn plating combinations can be substituted for test groups 1 and 6).
- 2 Specimens using Sn plated blades and Ag plated receptacles requires only the completion of test group 5 of Figure 2.
- 3 Specimens using Sn plated blades and Sn plated receptacles requires only the completion of test group 5 of Figure 2.

4.2. Requalification Testing

If changes significantly affecting form, fit or function are made to the product or manufacturing process, product assurance shall coordinate requalification testing, consisting of all or part of the original testing sequence as determined by development/product, quality and reliability engineering.

4.3. Acceptance

Acceptance is based on verification that the product meets the requirements of Figure 1. Failures attributed to equipment, test setup or operator deficiencies shall not disqualify the product. If product failure occurs, corrective action shall be taken and specimens resubmitted for qualification. Testing to confirm corrective action is required before resubmittal.

The performance of the 1.0 mm² wire shall be considered qualified by similarity upon the successful completion of testing for all test groups using specimens with Ag/Ag plated terminals (as defined above) with 2.00 mm² and 0.80 mm² wire sizes.

The performance of specimens with Ag (receptacle)/Sn (blades) terminal plating shall be considered qualified by similarity upon successful completion of testing under test group 5 and successful completion of all other tests using specimens with Ag/Ag plated terminals (as defined above).

The performance of specimens with Sn (receptacle)/Sn (blades) terminal plating shall be considered qualified by similarity upon successful completion of testing under test group 5 and successful completion of all other tests using specimens with Ag/Ag plated terminals (as defined above).

4.4. Quality Conformance Inspection

The applicable quality inspection plan shall specify the sampling acceptable quality level to be used. Dimensional and functional requirements shall be in accordance with the applicable product drawing and this specification.