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**AMPSEAL 16\* Connector System**

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**1. SCOPE**

## 1.1. Content

This specification covers performance, tests and quality requirements for the AMPSEAL 16\* Connector System.

## 1.2. Qualification

When tests are performed on the subject product line, procedures specified in Figure 2 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 25Nov03. The Qualification Test Report number for this testing is 501-708. 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. TE Connectivity (TE) Document

501-708: Qualification Test Report (AMPSEAL 16\* Connector System)

## 2.2. Industry Standards

- ASTM B117: Standard Practice for Operating Salt Spray (Fog) Apparatus
- EIA-364: Electrical Connector/Socket Test Procedures Including Environmental Classifications
- IEC 60512: Electromechanical Components For Electronic Equipment; Basic Testing Procedures and Measuring Methods Part 1: General
- SAE J1455: Recommended Environmental Practices for Electronic Equipment Design in Heavy-Duty Vehicle Applications
- SAE J2030: Heavy-Duty Electrical Connector Performance Standard

## 2.3. Reference Documents

- 109-197: Test Specification (TE Test Specifications vs EIA and IEC Test Methods)
- 114-13045: Application Specification (HDSF Size 16 Pin and Socket Contacts)
- 114-13065: Application Specification (AMPSEAL 16 Connector System)

**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: 250 volts DC
- Current: See Figure 1 (all readings in amperes)

Connector Loading	Wire Size (AWG)		
	14	18	20
Single Circuit Energized	16.0	10.0	7.0
All Circuits Energized (12 position connector)	9.0	6.0	5.0

Figure 1

- Temperature: -40 to 125°C
- Ingress Protection (IP) level: IP67, IP68, IP69K (with rear protection)
- Flammability: UL94HB

3.4. Performance and Test Description

Product is designed to meet the electrical, mechanical and environmental performance requirements specified in Figure 2. Unless otherwise specified, all tests shall be performed at ambient environmental conditions.

3.5. Test Requirements and Procedures Summary

Test Description	Requirement	Procedure
Visual inspection.	Meets requirements of product drawing.	Visual inspection of product before (and after) unmating connectors for conditions such as torn seals, cracked plastic, evidence of fluid or dust ingress in sealed connector systems, arcing, charring, melting, or anything that affects the performance or serviceability of the product as deemed by qualified Engineer.

Figure 2 (continued)

Test Description	Requirement	Procedure												
<b>ELECTRICAL</b>														
Low signal termination resistance.	6 milliohms maximum for 14 and 16 AWG wire. 9 milliohms maximum for 18 AWG wire.	SAE J2030 6.2. Measure connection resistance across mated terminals and subtract bulk resistance of Equal Wire Lengths (EWL).												
Voltage drop.	<table border="1" style="display: inline-table; vertical-align: top;"> <thead> <tr> <th>Wire Size (AWG)</th> <th>Test Current (amperes)</th> <th>Voltage Drop (millivolts maximum)</th> </tr> </thead> <tbody> <tr> <td>14</td> <td>13</td> <td>100</td> </tr> <tr> <td>16</td> <td>10</td> <td>100</td> </tr> <tr> <td>18</td> <td>8</td> <td>100</td> </tr> </tbody> </table>	Wire Size (AWG)	Test Current (amperes)	Voltage Drop (millivolts maximum)	14	13	100	16	10	100	18	8	100	SAE J2030 6.4. Averaged measurements after 30 seconds, 15 minutes and 30 minutes of current being applied. EWL subtracted.
Wire Size (AWG)	Test Current (amperes)	Voltage Drop (millivolts maximum)												
14	13	100												
16	10	100												
18	8	100												
Insulation resistance.	20 megohms minimum.	SAE J2030 6.3. Insulation resistance at 1000 volts DC adjacent terminals measured after 60 seconds or until stabilization occurs.												
<b>MECHANICAL</b>														
Random vibration.	No discontinuities. See Note.	EIA-364-28. Subject mated specimens to 21 G's rms between 25 to 2000 Hz. Twenty hours in each of 3 mutually perpendicular planes.												
Durability.	See Note.	SAE J2030 6.11. 50 cycles.												
Terminal retention, axial.	Contacts shall not dislodge more than 0.8 mm.	IEC 512-8, Test 51a. Apply axial load of 111 N to contacts at a maximum rate of 10 N per second (or 50 mm per minute) and hold for 10 seconds.												
Mating/unmating force.	135 N maximum.	SAE J2030 6.9. and 6.10. Measure force necessary to mate and unmate specimens at a maximum rate of 50 mm per minute.												
Polarizing mismating force.	220 N minimum.	SAE J2030 6.21. Attempt to mate specimen against polarizing or keying feature.												
Maintenance aging.	See Note.	SAE J2030 6.6. Insert and remove terminal for 8 cycles on 20% of the terminals.												
<b>ENVIRONMENTAL</b>														
Temperature life.	See Note.	EIA-364-17. Subject specimens to 120 ± 3° C for 500 hours.												

Figure 2 (continued)

Test Description	Requirement	Procedure
Thermal shock.	See Note.	SAE J2030 6.13. Subject specimens to 10 cycles between -40 and 120°C . with 1 hour dwells at temperature extremes.
Sealing pressure.	35 kPa, pre-test, no bubbles. 35 kPa, post-test, no bubbles.	EIA-364-2. Subject specimens to specified pressure for 30 minutes.
Pressure washing.	See Note.	SAE J2030 6.5. and SAE J1455 4.5. Subject specimens to spray for 3 seconds of a 6 second period for a total of 375 cycles consisting of a volume of 9.46 liters per minute at a pressure of 7000 kPa and a temperature of 40°C from a distance of 20 to 30 cm. No detergent.
Chemical exposure.	See Note.	SAE J2030 6.14. Subject specimens to 5 cycles of a 5 minute dip in the following chemicals followed by air drying for 24 hours: 1) Diesel fuel at 60 ± 3°C; 2) Engine oil at 100 ± 3°C; 3) Transmission drive train oil at 100 ± 3°C; 4) Final drive axle oil at 100 ± 3°C; 5) Ethylene glycol (50%) and water (50%) at 100 ± 3°C; 6) Propylene glycol (50%) and water (50%) at 100 ± 3°C; 7) Brake fluid at 25 ± 3°C.
Salt exposure.	See Note.	SAE J2030 6.12. and ASTM B117. Subject specimens to a 5% salt solution at 35°C for 96 hours.
Steam cleaning.	See Note.	SAE J1455 4.5. Subject specimens 375 cycles lasting 18.75 minutes of pressure washing at 85°C consisting of a volume of 9.46 liters per minute at a pressure of 1400 kPa from a distance of 20 to 30 cm. No detergent.
Water Ingress (IPX7)	See Note.	IEC 60529 Submerge the wired mated connector in room temperature freshwater tank to a depth of 1.00 m ± 50 mm for 30 ± 5 minutes.

Test Description	Requirement	Procedure
Water Ingress (IPX8)	See Note.	IEC 60529 Perform thermal conditioning test (i.e. temperature life, thermal shock, thermal cycle). Submerge the wired mated connector in room temperature freshwater tank to a depth of 1.00 m $\pm$ 50 mm for 4 hours $\pm$ 15 minutes.
High Pressure Spray (IPX9K)	See Note.	ISO 20653 and DIN 40050-9 Mount the test sample onto the device holder such that the connector lays flush against the turntable. Position the sprayer at a 0° and initiate spray and turntable rotation. With the table rotating, spray the test sample for 30 seconds. Repeat at each spray angle Turntable speed = 5 $\pm$ 1 rpm, Position angle of (0°, 30°, 60° and 90°) $\pm$ 5°, Distance of 100-150 mm, Fan jet nozzle $\alpha$ =30° $\pm$ 10°, Water Flow 14-16 L/min, Water Pressure Approx. 8,000 to 10,000 Kpa, Water Temperature 80 $\pm$ 5°C, Exposure Time 30 sec/ position of spray angle
Dust Protection (IP6X)	See Note.	ISO 20653 and DIN 40050-9 Use Arizona Fine Road Dust per SAE J726. Mount the test sample in the dust chamber in its normal operating position. One cycle is 6 seconds of air/dust mixture then 15-minute pause. Repeat 20 cycles (approx. 5 hours test time).
2-hr Temperature Life	Conditioning Only.	Subject specimens to 125 $\pm$ 3° C for 2 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 3.*

Figure 2 (end)

## 3.6. Product Qualification and Requalification Test Sequence

Test or Examination	Test Group (a)							
	1	2	3	4	5	6	7	8
	Test Sequence (b)							
Visual inspection	1,13	1,6	1,11	1,11	1,6	1,7	1,8	1,7
Low signal termination resistance	2,6		3,6	2,6,9				
Voltage drop	3,7		4,7	3,7,10				
Insulation resistance	10,12					2,4,6	2,5,7	2,4,6
Random vibration	5							
Durability			9					
Terminal retention, axial		2	8					
Mating/unmating force			2					
Polarizing mismating force			10					
Maintenance aging				4	5			
Temperature life				5	3			
2-hr Temperature life							3	
Thermal shock	4		5					
Sealing pressure, pre-test		3			2			
Sealing pressure, post-test	8	5			4			
Pressure washing	9							
Chemical exposure		4						
Salt exposure				8				
Steam cleaning	11							
Water Ingress (IPX7)						3		
Water Ingress (IPX8)							4	
High Pressure Spray (IPX9K)								3
Dust Protection (IP6X)						5	6	5

**NOT**

(a) See paragraph 4.1.A.

(b) Numbers indicate sequence in which tests are performed.

Figure 3

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#### 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. Specimens shall consist of 2, 3 and 8 position connectors with TE HDSF size 16 gold plated pin and socket contacts and 14, 16 and 18 AWG GXL wire.

Test Groups 6, and 7 consisted of 2, 3 and 6 position standard diameter wire seal connectors with TE HDSF size 16 pin and socket contacts with 16 AWG GXL wire. Test Group 8 consisted of all positions.

###### B. Test Sequence

Qualification inspection shall be verified by testing specimens as specified in Figure 3.

##### 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 2. 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.

##### 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.