The product described in this document has not been fully tested to ensure conformance to the requirements outlined below. Therefore, TE Connectivity (TE) makes no representation or warranty, express or implied, that the product will comply with these requirements. Further, TE may change these requirements based on the results of additional testing and evaluation. Contact TE Engineering for further details.

MCP 2.8 8/4P PLUG ASSY

1. SCOPE

1.1. Content

This specification covers the requirements for product performance, test methods and quality assurance provisions of MCP 2.8 8/4P Plug Assy

Applicable product description and part numbers are as shown in Appendix 1

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. Qualification Test Results

Successful qualification testing on the subject product line has not been completed. The Qualification Test Report number will be issued upon successful qualification testing.

2. APPLICABLE DOCUMENTS AND FORMS

The following documents and forms constitute a part of this specification to the extent specified herein. Unless otherwise indicated, the latest edition of the document applies.

2.1. TE Documents

- 114-61047: Application Specification (INTERFACE FOR MCP 2.8 8P PLUG ASSY)
- 2109441: Customer Drawing(MCP 2.8mm 8P PLUG ASS'Y)

3. REQUIREMENTS

3.1. Design and Construction

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

3.2. Ratings

Voltage	Temperature	Humidity
12 V DC	23 ±5℃	Ambient

3.3. Test Requirements and Procedures Summary

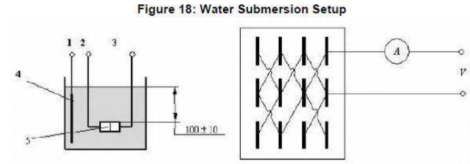
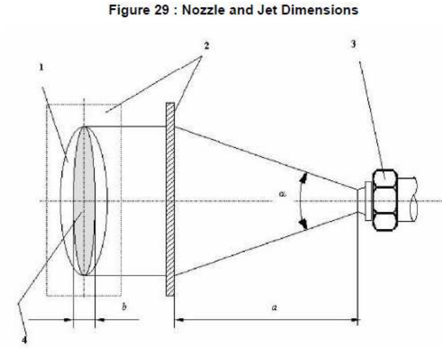
Unless otherwise specified, all tests shall be performed at ambient environmental conditions.

<table>
<tr><th>TEST DESCRIPTION</th><th colspan="3">REQUIREMENT</th><th>PROCEDURE</th></tr>
<tr><td rowspan="4">Dielectric Strength</td><td rowspan="2">Appearance</td><td rowspan="2">There shall be no corrosion, fretting corrosion, discoloration, cracks, etc. which could affect the functionality of the part. Swelling or physical distortion shall not exceed the tolerances specified on the Drawing.</td><td>Before test</td><td rowspan="4">Apply a 1000 VRMS AC at 50 HZ or 60 HZ, or 1600 V DV between the terminals and metal foil for at least 60s.</td></tr>
<tr><td>After test</td></tr>
<tr><td rowspan="2">No dielectric breakdown or flash-over</td><td colspan="2">Between cavities</td></tr>
<tr><td colspan="2">Between the cavities and the HSG</td></tr>
<tr><td rowspan="3">Terminal to Connector Engagement Force</td><td rowspan="2">Appearance</td><td rowspan="2">There shall be no corrosion, fretting corrosion, discoloration, cracks, etc. which could affect the functionality of the part. Swelling or physical distortion shall not exceed the tolerances specified on the Drawing.</td><td>Before test</td><td rowspan="3">A- TPA in Open Position
1. Mount the connector with the TPA in the “Open” position into a fixture.
2. Secure a terminated lead into a suitable fixture approximately 20 mm from the back of the terminal or seal. Take special care when securing he terminated lead so that the lead fixture does not interfere with full terminal insertion during the test.
3. Insert terminal into connector at a uniform rate of 50 ± 10 mm/min until fully seated and locked.
4. Record peak force and graph force versus distance from initial contact of terminal to connector body to final engaged position.
5. Insert terminal into connector at a uniform rate of 50 ± 10 mm/min until reaching the forward stop. Continue applying force until a minimum 50N of force is exerted or the wire buckles. Record the outcome.
6. Repeat steps 1 – 5 on each terminal cavity in the connector using a new terminal.
B- TPA in Fully Seated Position
1. Mount a connector with a fully seated TPA into a fixture.
2. Secure a terminated lead into a suitable fixture approximately 20 mm from the back of the terminal or seal. Take special care when securing he terminated lead so that the lead</td></tr>
<tr><td>After test</td></tr>
<tr><td colspan="2">A-TPA in Open Position</td><td>Max 15N</td></tr>
</table>

	B-TPA in Fully Seated Position	Min 30N		fixture does not interfere with full terminal insertion during the test. 3. Insert the terminal into the connector at a uniform rate of 50 ± 10 mm/min until it is either fully seated and locked into the cavity or all forward motion of the terminal ceases due to interference between the terminal and the TPA or the maximum test insertion force reaches 75 N. 4. Record peak force and graph force versus distance from initial contact of terminal to connector body to final engaged position.
Terminal from Connector Extraction Force	Appearance	There shall be no corrosion, fretting corrosion, discoloration, cracks, etc. which could affect the functionality of the part. Swelling or physical distortion shall not exceed the tolerances specified on the Drawing.	Before test	1. Assemble connectors and 10 of the terminals including all seals and other necessary components but without the TPA's. Designs using pre-staged TPA's shall have the TPA in the pre-staged position. 2. Condition tests samples per Section 3.3, Conditioning. 3. Secure the connector into a fixture. 4. Attach the conductor to the pull tester at a point less than 100 mm behind the rear of the terminal. 5. Pull the conductor at a uniform rate of 50 ± 10 mm/min until pull-out occurs. Note pull-out value and failure mode. 6. Record peak force required to pull the terminal out of the connector cavity. If the conductor breaks or pulls out of the terminal before the terminal pulls out of the cavity, record this force and note the failure mode. 7. Using new test samples repeat Steps 1 – 5 but with all TPA's fully seated. 8. Using new test samples and fully seated TPA's, repeat Steps 1 – 5 immediately after Thermal Aging. 9. Using new test samples and fully seated TPA's, repeat Steps 1 – 5 immediately after , Temperature/Humidity Cycling.
			After test	
	Primary lock only	Min 60N		
	Primary lock &TPA / PLR	Min 100N		
	Post-Moisture Conditioning	Min 100N		
Connector to Connector Engagement Force	Appearance	There shall be no corrosion, fretting corrosion, discoloration, cracks, etc. which could affect the functionality of the part. Swelling or physical distortion shall not exceed the tolerances specified on the Drawing.	Before test	1. Increase the mate force at a uniform rate of 50mm/min & 350~400mm/min until complete mating occurs. 2. Increase the mate force at a uniform rate of 50mm/minute until complete mating occurs from the first offset. 3. Increase the mate force at a uniform rate of 50mm/minute until complete mating occurs from the second offset.
			After test	
	Max 75N			
Locked Connector Disengagement Force	Appearance	There shall be no corrosion, fretting corrosion, discoloration, cracks, etc. which could affect the functionality	Before test	1- Make a fixture that will secure the connectors to be tested without distorting any of the parts either before or during the test.

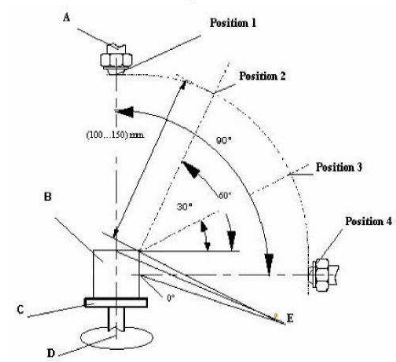
		of the part. Swelling or physical distortion shall not exceed the tolerances specified on the Drawing.	After test	2- Mount the mated connector housings in the fixture with the locking feature engaged. Ensure that all secondary locks and/or CPA's are either removed or disengaged. 3- Pull the mated connectors apart at a rate of 50 ± 10 mm/min. (For Slider Assist connectors, pull on the slider at a rate of 50 ± 10 mm/min.) 4- Record the force at which the connectors disengage or the slider begins retract.
	Max 120N			
Unlocked Connector Disengagement Force	Appearance	There shall be no corrosion, fretting corrosion, discoloration, cracks, etc. which could affect the functionality of the part. Swelling or physical distortion shall not exceed the tolerances specified on the Drawing.	Before test	1- Make a fixture that will secure the connectors to be tested without distorting any of the parts either before or during the test. 2- Mount 5 of the mated connector housings in the fixture with the locking feature disengaged. Ensure that all secondary locks and/or CPA's are either removed or disengaged. 3- Pull the mated connectors apart at a rate of 50 ± 10 mm/min. 4- Record the force at which the connectors disengage. 5- Mount 5 of the mated connector housings in the fixture with the locking feature engaged. 6- Measure the force required to disengage the primary locking feature. 7- Record the force required to disengage the lock.
			After test	
	Max 100N (the connector pairs with the locks properly disengaged)			
Connector Polarization (Coding) Feature Effectiveness	Appearance	There shall be no corrosion, fretting corrosion, discoloration, cracks, etc. which could affect the functionality of the part. Swelling or physical distortion shall not exceed the tolerances specified on the Drawing.	Before test	1- Using a suitable fixture, orient the connector halves with respect to one another in one or more incorrect orientations specified by the design engineer as most likely to defeat the index feature. 2- Engage the connector halves at a uniform rate of 50 mm/min until the forces specified under 4.3.4.5 are applied. Note whether electrical contact is made. 3- Repeat Steps 1 and 2 with every other possible mate within the same connector family.
			After test	
	Withstand a force of three times the engage force, and no terminal-terminal contact at a force of less than 150N.			
Terminal Position Assurance (TPA)	TPA Pre-lock to Lock Closing Force with Properly Assembled Terminals	Max 30N		**TPA Pre-lock to Lock Closing Force with Properly Assembled Terminals** 1- Insert terminals into all cavities of the connector per connector supplier's requirements. 2- Secure connector body and TPA into a holding fixture. 3- Insert TPA into connector body at a uniform rate of 50±10 mm/min.

	Seated TPA locking force	Min 25N	4- Record peak force and graph force vs. distance from initial position of TPA to connector body to final engaged position. **Seated TPA locking force** 1- Seat the TPA in its fully seated position in a fully populated connector. 2- Pull TPA at a uniform rate of 50 ± 10 mm/min from the fully seated position to the pre-staged position. Record the force.
Connector Position Assurance (CPA)	CPA Lock Force	Max 22N	**A. CPA Lock and Unlock Force** 1- Using a mated connector pair, close the CPA at a uniform rate of 50 ± 10 mm/min until fully seated and locked. Record the peak force. 2- Open the CPA at a uniform rate of 50 ± 10 mm/min until fully opened. Record the peak force.
	CPA Unlock Force	20-40N	
	CPA Closing Force on Unmated connectors	Min 80N	**B. CPA Closing Force on Unmated Connectors** Using an unmated connector, close the CPA at a uniform rate of 50 ± 10 mm/min until fully seated and locked. Record the peak force.
	CPA Extraction Force	Min 80N	**C. CPA Extraction Force** Using an unmated connector, apply a force to the CPA in the opposite direction to the normal closing direction at a uniform rate of 50 ± 10 mm/min until fully detached. Record the peak force.
Radial Seal to Connector Housing Retention	Min 9N		Pull radial seal using suitable equipment at a rate of 50 ± 10 mm/min and record the force needed to remove the radial seal from the female housing.
Isolation Resistance	Min 100MΩ at 500VDC for 15s		Note: For sealed connector pairs, complete all measurements in this test procedure within one hour after any previous environmental test. 1- Mate connector pairs. 2- Remove a minimal amount of insulation from the ends of the wires. 3- Separate wires under test with sufficient distance as to have no influence on isolation resistance between any two wire pairs. 4- Measure the isolation resistance by applying 500 VDC between all adjacent pairs of terminals. 5- Record the resistance after 15 seconds of stabilized readings. 6- Attach all the terminated wire leads to the positive lead of a Mega-Ohm meter. Attach the negative lead of the Mega-Ohm meter to the metal foil. 7– For connectors with Shorting Bars, measure the isolation resistance between the two terminals designed to be shorted together by the Shorting Bars. (Note:

<table>
<tr><td></td><td colspan="3"></td><td>Conduct this measurement with the Shorting Bar in the OPEN / UNSHORTED position.)
8- Record the resistance after 15 seconds of stabilized readings.</td></tr>
<tr><td>Water Submersion</td><td colspan="2">Leakage Current</td><td>5 μA</td><td>1- With the test samples immersed in the liquid, record any leakage current measurements between each terminal pair and the electrode at 14 VDC. Also, record the leakage current measurements between every two adjacent terminals pairs.
2- At the completion of the test, visually inspect each mated sample pair for any physical degradation, cracking, etc. per Section 4.1.7 taking special care not to allow any surface moisture to enter the interior of either connector. Disconnect the mated connectors and carefully inspect the interior of the connectors for any evidence of moisture ingress as evidenced by residue of the florescent dye.
Figure 18: Water Submersion Setup

1, 2, 3 - Test Points
4 – Electrode / 5 - Test samples</td></tr>
<tr><td rowspan="4"></td><td rowspan="2">Appearance</td><td rowspan="2">There shall be no corrosion, fretting corrosion, discoloration, cracks, etc. which could affect the functionality of the part. Swelling or physical distortion shall not exceed the tolerances specified on the Drawing.</td><td>Before test</td><td rowspan="4">Mount the test samples on a turntable with a rotation rate of 5 ± 1 revolutions per minute. Subject the connector samples to the high pressure water spray for in Positions 1 to 4 as illustrated in Figure 30, Test Arrangement, for 30 seconds each.
Let connectors dry through evaporation in still air at room temperature.
Perform the Isolation Resistance Test specified
Figure 29 : Nozzle and Jet Dimensions

1- Scatter area 2- Measuring area
3 -Nozzle 4 -Jet</td></tr>
<tr><td>After test</td></tr>
<tr><td colspan="2">Isolation Resistance</td><td>Min 100MΩ at 500VDC for 15s</td></tr>
<tr><td colspan="3">No traces of water</td></tr>
</table>

<table>
<tr>
<td></td>
<td colspan="3"></td>
<td>
Table 20: Spray Pattern
<table>
<tr><td>α</td><td>a</td><td>b</td></tr>
<tr><td>°</td><td>mm</td><td>mm</td></tr>
<tr><td>30 ± 5</td><td>100</td><td>8 ± 2</td></tr>
<tr><td>30 ± 5</td><td>150</td><td>10 ± 2</td></tr>
</table>

Figure 30: Test Arrangement



A- Nozzle B- Test sample
C- Turntable D- Rotating axis
E- Reference points (0°, 30°, 60° and 90°)
</td>
</tr>
<tr>
<td rowspan="2">Pressure/
Vacuum Leak</td>
<td rowspan="2">Appearance</td>
<td rowspan="2">There shall be no corrosion, fretting corrosion, discoloration, cracks, etc. which could affect the functionality of the part. Swelling or physical distortion shall not exceed the tolerances specified on the Drawing.</td>
<td>Before test</td>
<td rowspan="2">
1 Prepare terminated leads using the smallest conductor size and insulation type appropriate to the terminal and connector under test. Prepare enough samples of male and female terminals to assemble a minimum of 10 pairs of connector assemblies leaving one cavity open for each connector pair. Assembly must include all applicable TPA's, seals, etc. Number each mated connector pair.

Note: For convenience, and to minimize loose conductor ends, conductor lengths may be terminated on both ends and looped between samples.

2 Insert a loose wire seal into the open cavities of the connector pair.

3 For mat type seals only, select 10 cavities at random among the sample set and record the connector and cavity numbers. Remove and re-insert the terminals in the selected cavities. The purpose of this step is to ensure the terminal does not damage the seal during service operations.

4 Insert a tube of sufficient diameter and wall strength (to prevent leakage between the tube and the conductor seal) into the seal in the open cavity in each connector pair paying special attention that the tube is inserted far enough to engage the full sealing capability of the wire seal.
</td>
</tr>
<tr>
<td>After test</td>
</tr>
</table>

	No Bubble No loss in the applied pressure	5 Verify conformance of each mated sample connector assembly to the Isolation Resistance Test specified This establishes a reference for the concluding Isolation Resistance test. 6 After completing Steps 5 and 6 connect the free end of the tube to a regulated pressure source. 7 Prepare enough salt water solution to completely submerse all samples to a depth of 300 – 400 mm below the surface. Use tap water at 23 +/- 5℃ and 15 – 16 grams of table salt (NaCl) per liter. Add an appropriate ultraviolet (florescent) dye to aid in the visual inspection for any ingress of solution into the test samples. 10 ml of liquid dish washing soap per liter of water may also be added. Mix well before adding to test apparatus. 9 Bend all conductors in the same direction, 90 to the back of each sample connector half and secure them in this position, using actual conductor dress shields if available. This is to simulate dressing of the conductors as they exit the connector and is intended to stress the conductor seals(s) as in actual applications. If actual production dress shields are not available, simulate production application intent as closely as possible. Ensure that the tube is not kinked, squeezed shut or otherwise obstructed. The tube should be left out of the 900 bend if feasible. Seal all loose conductor ends to eliminate possible leakage through the conductor strands.

	Isolation Resistance	Min 100MΩ at 500VDC for 15s	10 Completely submerse all samples into the container of salt water solution prepared in Step 8 above. Use care to avoid submersing any wire ends or the open end of any tube. 11 Slowly increase the air pressure of the regulated pressure source supplying the tube in each sample until the gauge reads 48 KPa (7psig). 12 Observe samples for 15 seconds and verify that there are no air bubbles. 13 Switch the regulated source from pressure to vacuum and slowly apply 48KPa (7psig) of vacuum to the samples for 15 seconds. 14 Remove the samples from the salt water solution, shake off excess fluid and then carefully dry all exterior surfaces of the sample. 15 Strip 10 mm of insulation from the conductor ends of each terminal in one connector half and repeat the Isolation Resistance test specified 16 At the completion of the test, visually inspect each mated sample pair for any physical degradation, cracking, etc. taking special care not to allow any surface moisture to enter the interior of either connector. Disconnect the mated connectors and carefully inspect the interior of the connectors for any evidence of moisture ingress as evidenced by residue of the florescent dye. 17 Re-connect each sample to its original mate and re-seal all conductor ends. Place the samples in a temperature chamber stabilized at the maximum ambient temperature for the appropriate Temperature Class from Heat Soak all samples for 70 hours. 18 After the Heat Soak, remove the samples from the chamber and allow the samples to cool to Room Temperature. Repeat steps 9 – 15, except limit the pressure in Step 11 and the vacuum in Step13 to 28 KPa (4psig). 19 Verify conformance of all test samples to the Acceptance Criteria 20- Additional Test for connectors with mat type conductor seals.

<table>
<tr>
<td rowspan="3">Fluid Resistance</td>
<td>Isolation Resitance</td>
<td>Min 100MΩ
at 500VDC for 15s</td>
<td rowspan="3">1- Prepare a sufficient number of male and female terminal leads using the smallest size wire specified for the respective terminals to fully assemble at least 20 mated connector pairs. These terminated leads shall be built on design intent production crimp machines.

Note: For Header type connectors, prepare samples only for the mating connector.

2- Assemble a minimum of 20 pairs of fully populated mating connector pairs using the terminals prepared in Step 1. Assembly must include all applicable TPA's, seals, etc. Number each mated connector pair.

3- Condition test samples per Section 3.3, Conditioning.

4- Verify conformance of each mated connector assembly pair to Section 3.6, Visual Examination.

5- Perform the Isolation Resistance test, per Section 4.4.1. This establishes a reference for the concluding Isolation Resistance test

6- Completely submerse at least 2 test samples in each fluid listed in Table 10 for 60 minutes. Fluids are to be stabilized at the temperatures indicated in Table 10, Fluids.

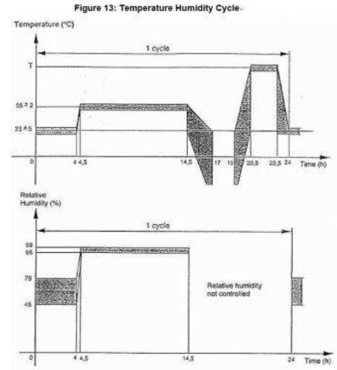
Note: A fresh test sample is to be used for each fluid and each test sample is to be submersed in one fluid only, unless otherwise requested by the Authorized Person.

7- At the conclusion of the submersion period, remove the sample from the fluid and store the wet test samples in suitable containers for one week. Do not allow test samples submersed in different fluids to touch each other and do not allow any dissimilar fluid drippings to intermingle.

Caution: Do NOT shake off any excess fluid. Use care not to splash any fluid on unintended surfaces.

8- After the one week storage period, perform the Isolation Resistance Test in Section 4.4.1 on the stored test samples.

Table 10: Fluids
<table><tr><th>Fluid</th><th></th><th>Temperature (°C)</th></tr><tr><td>Brake Fluid</td><td>DOT 4</td><td>+50</td></tr><tr><td>Engine Oil</td><td>ISO 1817, Oil No. 2</td><td>+85</td></tr><tr><td>Gasoline</td><td>ISO 1817, Liquid C</td><td>+25</td></tr><tr><td>Engine Coolant</td><td>50% Ethylene Glycol + 50% Distilled Water</td><td>+100</td></tr><tr><td>Automatic Transmission Fluid</td><td>Dextron VI</td><td>+85</td></tr><tr><td>Windshield Washer Solvent</td><td>50% Isopropanol + 50% Distilled Water</td><td>+25</td></tr><tr><td>Power Steering Fluid</td><td>ISO 1817, Oil No. 3</td><td>+50</td></tr><tr><td>Diesel Fuel</td><td>90% ISO 1817, Oil No. 3 + 10% P-Xylene</td><td>+25</td></tr><tr><td>E85 Ethanol Fuel</td><td>85% Ethanol + 15% ISO 1817, Liquid C</td><td>+25</td></tr><tr><td>Mineral Spirits</td><td>Aromatic Content ~ 17%</td><td>+25</td></tr><tr><td>Salt Water</td><td>5% NaCl by Weight</td><td>+25</td></tr><tr><td>Urea Fluid (DEF)</td><td>AUS 32 per ISO/DIS 22241 - NA</td><td>+25</td></tr></table></td>
</tr>
<tr>
<td>Dielectric Strength</td>
<td>No Breakdown
No Flash over</td>
</tr>
<tr>
<td>Terminal from Connector Extraction Force</td>
<td>Min 90N</td>
</tr>
</table>

<table>
<tr><td rowspan="4">Thermal Aging</td><td rowspan="2">Appearance</td><td rowspan="2">There shall be no corrosion, fretting corrosion, discoloration, cracks, etc. which could affect the functionality of the part. Swelling or physical distortion shall not exceed the tolerances specified on the Drawing.</td><td>Before test</td><td rowspan="4">1. Measure the dry circuit resistance
2. Set the temperature chamber to the maximum ambient temperature specified in Temperature Class, for the class rating of the connector under test.
3. Place the samples in the chamber and heat age for 1008 hours.
4. Remove the samples from the chamber and let rest at ambient temperature and humidity for at least 24 hours.
5. Measure the dry circuit resistance</td></tr>
<tr><td>After test</td></tr>
<tr><td colspan="2">Dry Circuit Resistance (unit: mΩ)</td><td>Max 5mΩ</td></tr>
<tr><td colspan="2">Voltage Drop (unit: mV/A)</td><td>Max 5mV/A</td></tr>
<tr><td rowspan="5">Temperature Humidity Cycling</td><td rowspan="2">Appearance</td><td rowspan="2">There shall be no corrosion, fretting corrosion, discoloration, cracks, etc. which could affect the functionality of the part. Swelling or physical distortion shall not exceed the tolerances specified on the Drawing.</td><td>Before test</td><td rowspan="5">1. Measure the dry circuit resistance
2. Determine the minimum and maximum temperatures for the temperature class of the component set being tested. Set the temperature chamber to 23 +/- 5℃ with the relative humidity between 45 ~ 75%
3. Place the samples in to the thermal chamber and allow the chamber temperature to stabilize. Soak the test samples for an additional 30 minutes after temperature stabilization.
4. Cycle the test samples 10 times per the cycling schedule shown in Figure 13, Temperature Humidity Cycle, using the minimum and maximum Ambient Operating Temperatures for the respective temperature class as specified, while continuously monitoring the current level in the test circuit.
5. At the completion of the 10 cycles, measure the dry circuit resistance.
Figure 13: Temperature Humidity Cycle
</td></tr>
<tr><td>After test</td></tr>
<tr><td colspan="2">Dry Circuit Resistance (unit: mΩ)</td><td>Max 5mΩ</td></tr>
<tr><td colspan="2">Voltage Drop (unit: mV/A)</td><td>Max 5mV/A</td></tr>
<tr><td colspan="2">Instant short circuit</td><td>Max 1 μs / 7Ω</td></tr>
<tr><td rowspan="2">Heavy Duty Test</td><td rowspan="2">Appearance</td><td rowspan="2">There shall be no corrosion, fretting corrosion, discoloration, cracks, etc. which could affect the functionality of the part. Swelling or physical distortion shall not exceed the tolerances specified on the Drawing.</td><td>Before test</td><td rowspan="2">1- Set the power supply to provide the maximum de-rated current for the terminal and cable taken from the border of Area 2 in Figure 11, Derating Curve, for the largest wire size at the specified test temperature, i.e., 80°C or 100°C.
2 Connect the thermocouple leads to a data logger.</td></tr>
<tr><td>After test</td></tr>
</table>

	Dry Circuit Resistance (unit: mΩ)	Max 5mΩ		3- Set the Temperature Chamber to 80°C for Temperature Classes 1-3 in Table 1 and 100°C for Temperature Class 4 in Table 1. 4- Run the maximum de-rated current through the test samples at the respective test temperature for 5 hours. 5- Transfer the samples to -40°C and cool for 2 hours at 0 Amps. 6- Repeat the above test procedure for a total of 5 cycles. 7- After 5 cycles, store the samples at room temperature for at least 24 hours.
	Voltage Drop (unit: mV/A)	Max 5mV/A		
	Temperature Rise	Max +50℃		
Thermal Shock	Appearance	There shall be no corrosion, fretting corrosion, discoloration, cracks, etc. which could affect the functionality of the part. Swelling or physical distortion shall not exceed the tolerances specified on the Drawing.	Before test After test	1. Solder the ends of the conductors to each other in the test sample set being monitored, to form a single series circuit with only two free ends. 2. Solder one of the free conductor ends to a 2 Watt 120 ± 1 Ohm resistor. 3. Solder the power supply negative lead to the free end of the resistor and the power supply positive lead to the remaining free conductor end of the test sample. 4. Preset the power supply to provide 100 mA to the circuit. 5. Connect the continuity monitoring equipment across the resistor, making sure that the negative lead of the continuity monitoring equipment is connected to the negative side of the resistor. Set the continuity monitoring equipment to monitor the current through the resistor. As an option, the continuity monitoring equipment may be used to monitor one or more terminal pairs instead of the resistor. 6. Measure the dry circuit resistance. 7. Place the test samples in the chamber so that there is no substantial air flow obstruction around the test samples. 8. Determine the minimum and maximum temperatures per the temperature class of the component set being tested. Set the temperature chamber to the minimum ambient temperature for that class. 9. Place the samples in the chamber and allow the Chamber temperature to stabilize. Soak the samples an additional 30 minutes. 10. Transfer the samples to the high temperature chamber set to the maximum ambient temperature for the class selected. Allow the test samples to soak for 30 minutes. (Chamber to chamber transfer time shall be less than 10 seconds.) 11. Transfer test samples between temperature extremes 300 total times while
	Dry Circuit Resistance (unit: mΩ)	Max 5mΩ		
	Voltage Drop (unit: mV/A)	Max 5mV/A		
	Instant short circuit	Max 1 μs / 7Ω		

<table>
<tr>
<td></td>
<td colspan="3"></td>
<td>continuously monitoring for any loss of electrical current level per the set-up described above.

12. At the end of the cycling schedule remove the test samples from the chamber and measure the dry circuit resistance.

<table>
<tr><th>Class</th><th>Ambient Operating Temperature in °C</th><th>Typical Installation Position</th></tr>
<tr><td>1</td><td>-40...+85</td><td>Passenger compartment or trunk</td></tr>
<tr><td>2</td><td>-40...+105</td><td>Under hood/chassis</td></tr>
<tr><td>3</td><td>-40...+125</td><td>On engine</td></tr>
<tr><td>4</td><td>-40...+155</td><td>On engine (hot locations)</td></tr>
</table>
</td>
</tr>
<tr>
<td rowspan="6">MECHANICAL SHOCK / VIBRATION</td>
<td rowspan="2">Appearance</td>
<td rowspan="2">There shall be no corrosion, fretting corrosion, discoloration, cracks, etc. which could affect the functionality of the part. Swelling or physical distortion shall not exceed the tolerances specified on the Drawing.</td>
<td>Before test</td>
<td rowspan="6">■ Mechanical shock

1. Divide the test samples into two groups of 5

2. The first group shall be set up and monitored continuously. Refer to Figure 14, Series Circuit Monitoring, and the following instructions:

A. Solder the ends of the conductors to each other in the sample set being monitored to form a single series circuit with only two free ends.

B. Solder the end of one of the free conductors to a 2 Watt 120 ± 1.2 Ohm resistor.

C. Solder the power supply negative lead to the free end of the resistor and the positive lead of the power supply to the other free conductor end.

D. Connect the continuity monitoring equipment across the resistor, making sure that the negative lead of the continuity monitoring equipment is connected to the negative side of the resistor. Set the continuity monitoring equipment to monitor the current through the resistor.

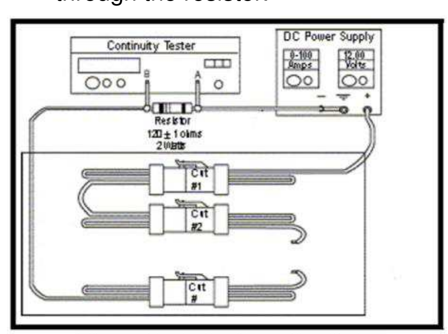


Figure 14: Series Circuit Monitoring

3. The second group shall not be monitored.

4. Construct a suitable mounting apparatus using the following design criteria:</td>
</tr>
<tr><td>After test</td></tr>
<tr><td colspan="2">Dry Circuit Resistance (unit: mΩ)</td><td>Max 5mΩ</td></tr>
<tr><td colspan="2">Voltage Drop (unit: mV/A)</td><td>Max 5mV/A</td></tr>
<tr><td colspan="2">Instant short circuit</td><td>Max 1 μs / 7Ω</td></tr>
<tr><td colspan="3"></td></tr>
</table>

A. The mounting apparatus shall be constructed and secured to minimize added effects, i.e., harmonics, dampening, resonances, etc.

B. For in-line connectors, mount the mated connector pair directly to the test fixture mounting bracket using the connector feature provided for mounting as shown in Method 1 in Figure 15, Vibration Mounting Fixture. Do not use a “Christmas Tree” or any similar type of mounting feature. Instead, the test fixture mounting bracket itself must be constructed so as to include a direct mounting feature to mate with the clip mount (dovetail) on the mated connector pair.

C. For device (panel mount) connectors, mount the device directly to the test fixture mounting bracket as shown in Method 2 in Figure 15, Vibration Mounting Fixture. Use the normal device mounting feature(s) used to secure the device in its intended vehicle location. The test fixture mounting bracket shall be fabricated to include any features necessary to mount the device directly to the fixture.

D. Secure the conductor bundle 100±5 mm from the rear surface of the conductors under test (CUT) as illustrated in Figure 15, Vibration Mounting Fixture.

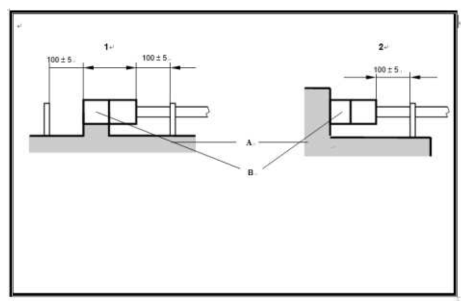


Figure 15: Vibration Mounting Fixture

5. Measure the dry circuit resistance

6. Set the power supply to provide 100 mA to the circuit throughout the Mechanical Shock Test.

7. Perform the Mechanical Shock Test according to EN 60068-2-27 and Table 11, Mechanical Shock.

Table 11: Mechanical Shock

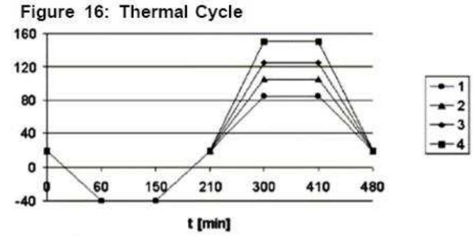
	Sealed	Unsealed	All
Acceleration [g]	25	12	100
Nominal Shock Duration [ms]	10	20	11
Nominal Shock Shape	half sine	half sine	half sine
Number of shocks per axis, (positive and negative).	400 X 6 = 2400	400 X 6 = 2400	3 X 6 = 18

8. Perform the Vibration with Thermal Cycling Test

■ Vibration with Thermal Cycling

		Using the same test samples and mounting fixtures utilized in the Mechanical Shock Test, vibrate the parts per the applicable vibration profiles defined in Figures 17 through 22 Vibration profiles and temperature settings are chosen based on the intended vehicle application. Engine and transmission mounted connector assemblies shall be subjected to both the sine and random vibration profiles. The sine and random vibration schedules may be run in any order. The test samples undergoing the appropriate vibration profile shall be simultaneously subjected to the thermal cycle as defined in Figure 16: Thermal Cycle and Table 12, Thermal Cycle Requirements. Refer to the appropriate vibration profile for specific test procedures, test duration, amplitude and frequency requirements. At the completion of the required vibration cycles, measure the dry circuit resistance.

Figure 16: Thermal Cycle



1 Temperature class 1

2 Temperature class 2

3 Temperature class 3

4 Temperature class 4

t Time in min

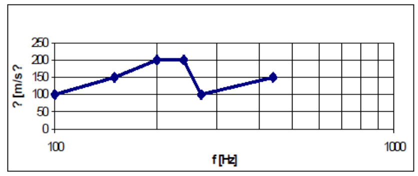
T Temperature in °C

Table 12: Thermal Cycle Requirements

Time in min	Temperature in °C			
	Class 1	Class 2	Class 3	Class 4
0	+20	+20	+20	+20
60	-40	-40	-40	-40
150	-40	-40	-40	-40
210	+20	+20	+20	+20
300	+85	+100	+125	+155
410	+85	+100	+125	+155
480	+20	+20	+20	+20

B – VIBRATION CLASS 2

Figure 23: Engine/Transmission Mount Sinusoidal Vibration Cycle - ISO 16750-3 Based – Vibration Class 2



â- Amplitude of acceleration [m/s²]

f- Frequency [Hz]

Test according to EN 60068-2-6, frequency sweep: 1 octave/min. Test duration = 22 – 24 hours for each X, Y, Z co-ordinate axis of the part. The specified test profile applies to both gasoline and diesel engines. This test is followed by the Random Vibration Test in Figure 24.

Table 14: Engine/Transmission Mount Sinusoidal Vibration Cycle - ISO 16750-3 based – Vibration Class 2

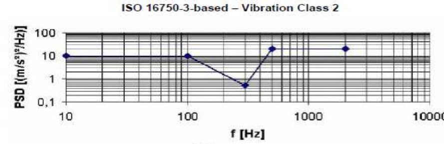
Frequency (Hz)	Amplitude of acceleration (m/s²)
100	100
150	150
200	200
240	200
270	100
440	150

â- Amplitude of acceleration [m/s²]

f- Frequency [Hz]

Test according to EN 60068-2-6, frequency sweep: 1 octave/min. Test Duration = 22 – 24 hours for each X, Y, Z co-ordinate axis of the part. The specified test profile applies to both gasoline and diesel engines. This test is followed by the Random Vibration Test in Figure 24.

Figure 24: Engine/Transmission Mount Random Vibration Cycle – ISO 16750-3-based – Vibration Class 2



PSD= Power Spectral Density [(m/s²)²/Hz]

F= Frequency [Hz]

Test according to EN 60068-2-64, RMS acceleration. Value = 181 m/s² Frequency Sweep: 1 octave/min for each X, Y, Z co-ordinate axis of the part.

Table 15: Engine/Transmission Mount Random Vibration Cycle - ISO 16750-3 based – Vibration Class 2

Frequency [Hz]	Power Spectral Density [(m/s²)²/Hz]
10	10
100	10
300	0.51
500	20
2000	20

Corrosion Sequence	Appearance	There shall be no corrosion, fretting corrosion, discoloration, cracks, etc. which could affect the functionality of the part. Swelling or physical distortion shall not exceed the tolerances specified on the Drawing.	Before test / After test	1. Mount connector pairs in both a vertical and horizontal orientation within the test chamber. 2. Perform the 6 cycles of '8hr salt mist / 16hr dry' in accordance with IEC 60068-2-52, Test Kb, Salt Mist. 3. Measure the dry circuit resistance / Appearance / Terminal retention force.
	Terminal Retention Force	Min 50N		

	Dry Circuit Resistance (unit: mΩ)	Max 5mΩ	
Terminal Push-Out Force	Min 15N	Pushing	Fix the connector body and move the connector pin pushing and pulling more than 0.2mm at a speed of 50mm/min to measure the peak force.
		Pulling	

3.4 Applied Part No List

TE Part no	Description
2109441-4	MCP 2.8 8/4P PLUG ASSY BLK/A
2-2109441-4	MCP 2.8 8/4P PLUG ASSY B-GRY/C
2-2109441-5	MCP 2.8 8/6P PLUG ASSY B-GRY/C
3-2109441-1	MCP 2.8 8/6P PLUG ASSY S-BLU/D
3-2109441-9	MCP 2.8 8/4P PLUG ASSY S-BLU/D
9-2109441-1	MCP 2.8 8/0P PLUG ASSY NAT/Z