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.

MTII SLD 2P

1. SCOPE

1.1. Content

This specification covers the requirements for product performance, test methods and quality assurance provisions of MTII SLD 2P

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

- 1743695 : CUSTOMER DRAWING FOR HOOD S/W SLD 2P PLUG ASSY

3. REQUIREMENTS

3.1. Design and Construction

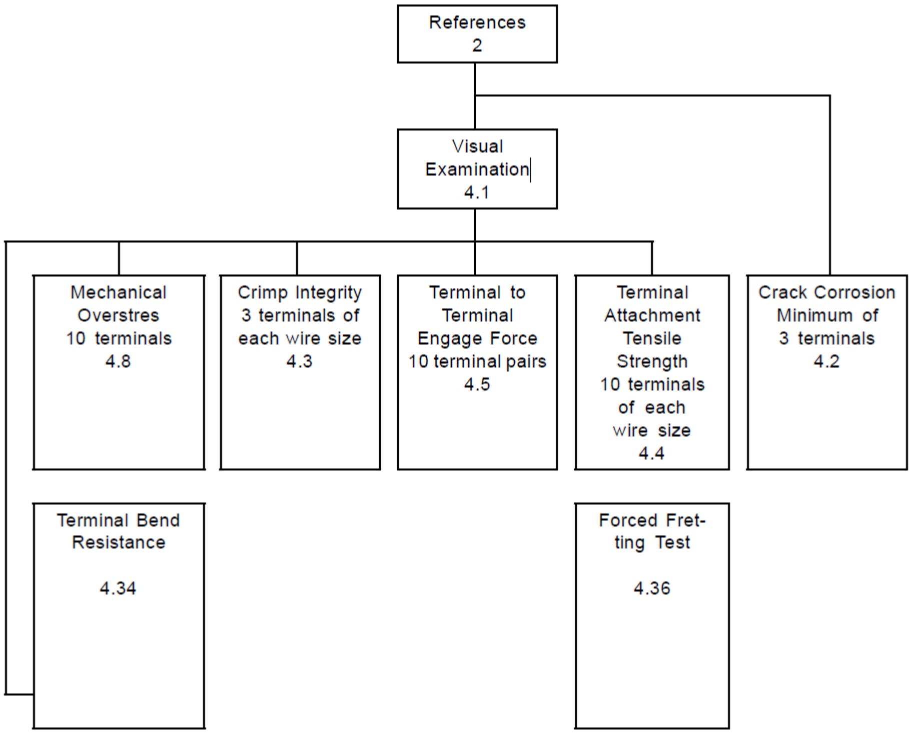
Product shall be of the design, construction, materials and physical dimensions specified on the applicable product drawing.

3.2. Ratings

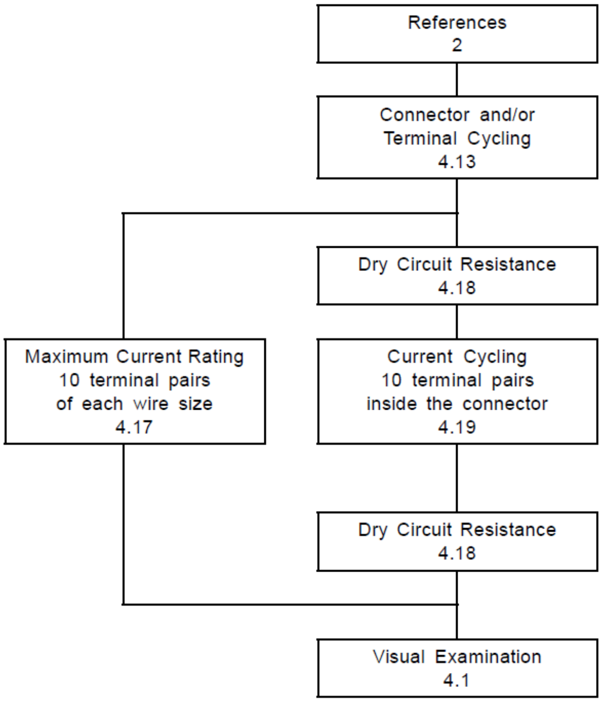
Voltage	Temperature	Humidity
12V DC	25±5℃	60±20%

3.3. Test Sequence

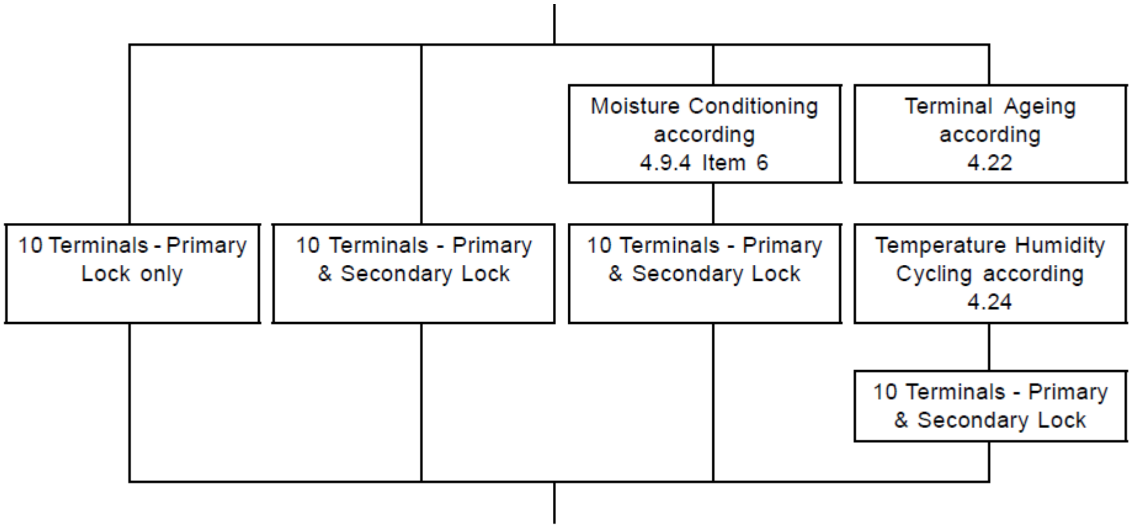
1) Terminal – Mechanical tests



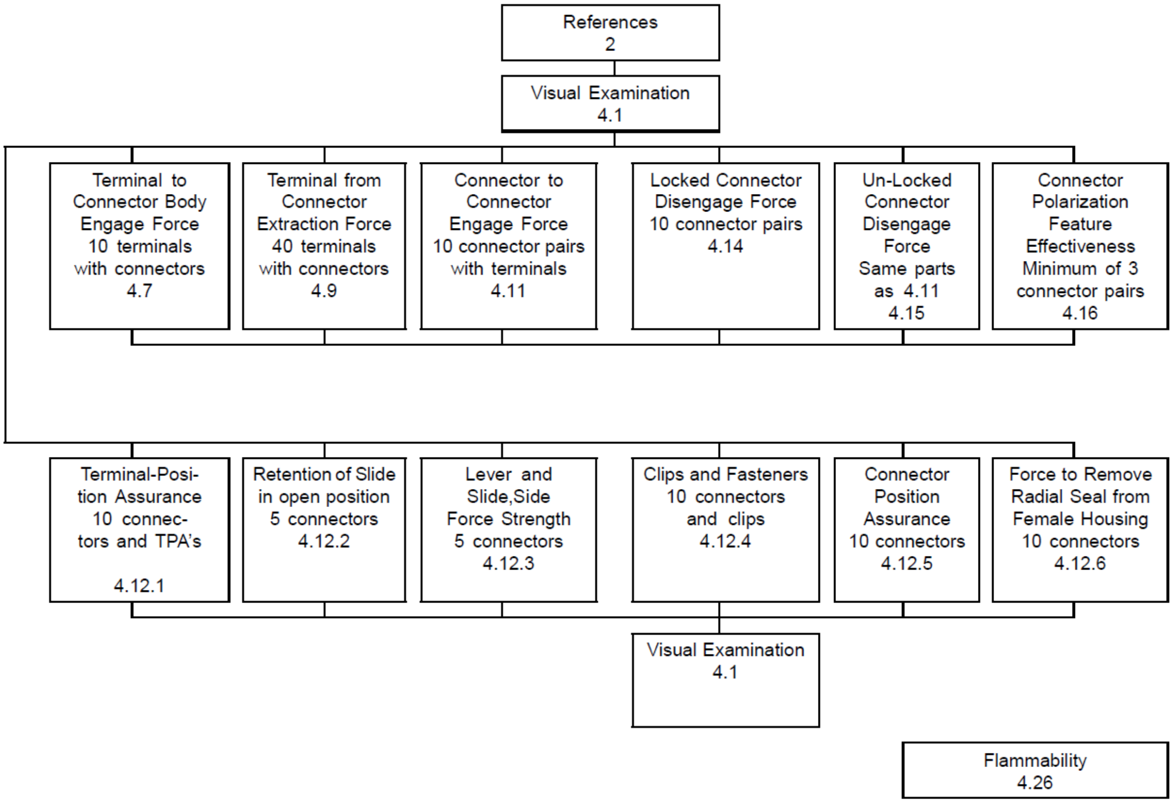
2) Terminal – Electrical test



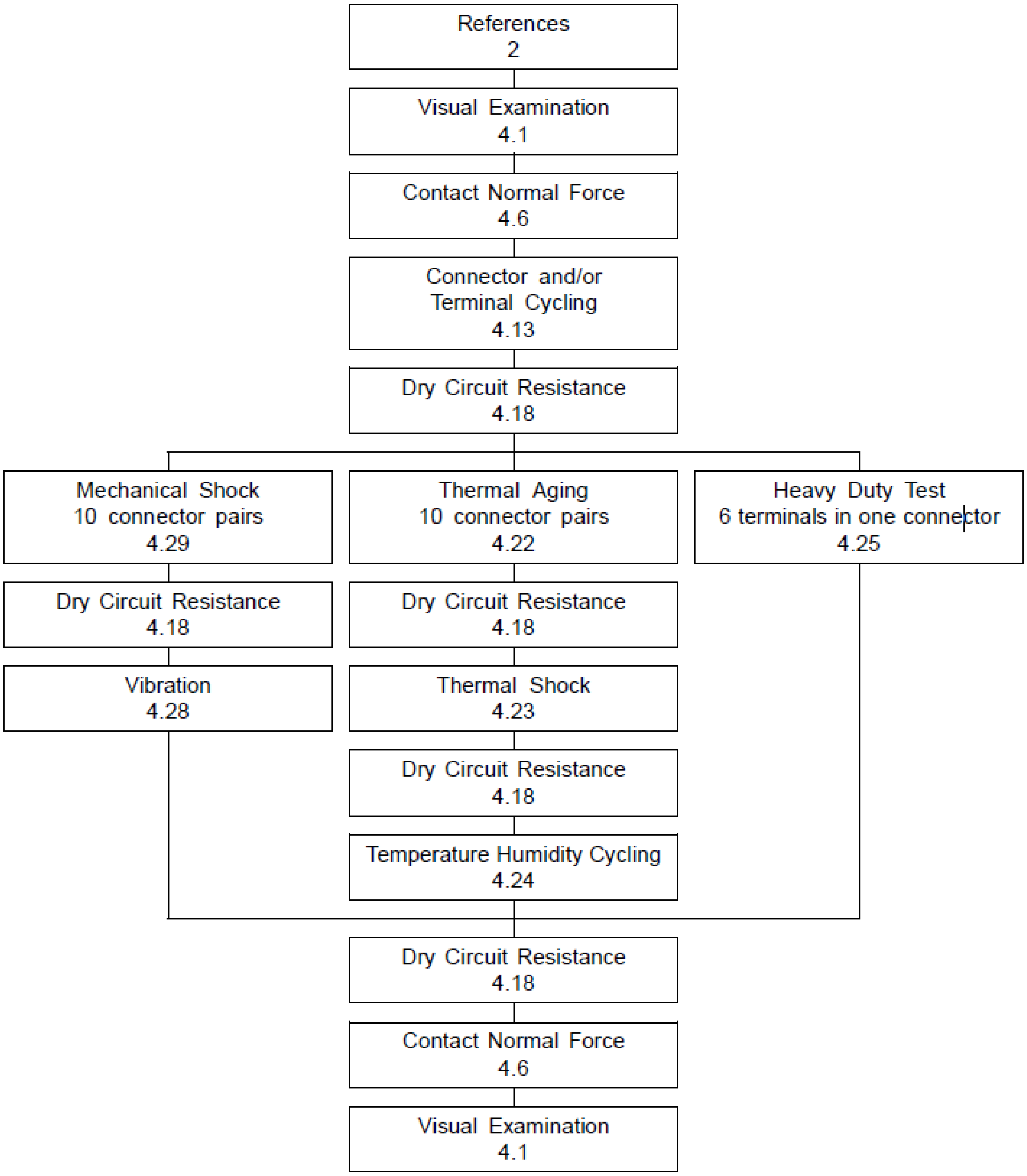
3) Terminal from connector extraction force, section 4.9



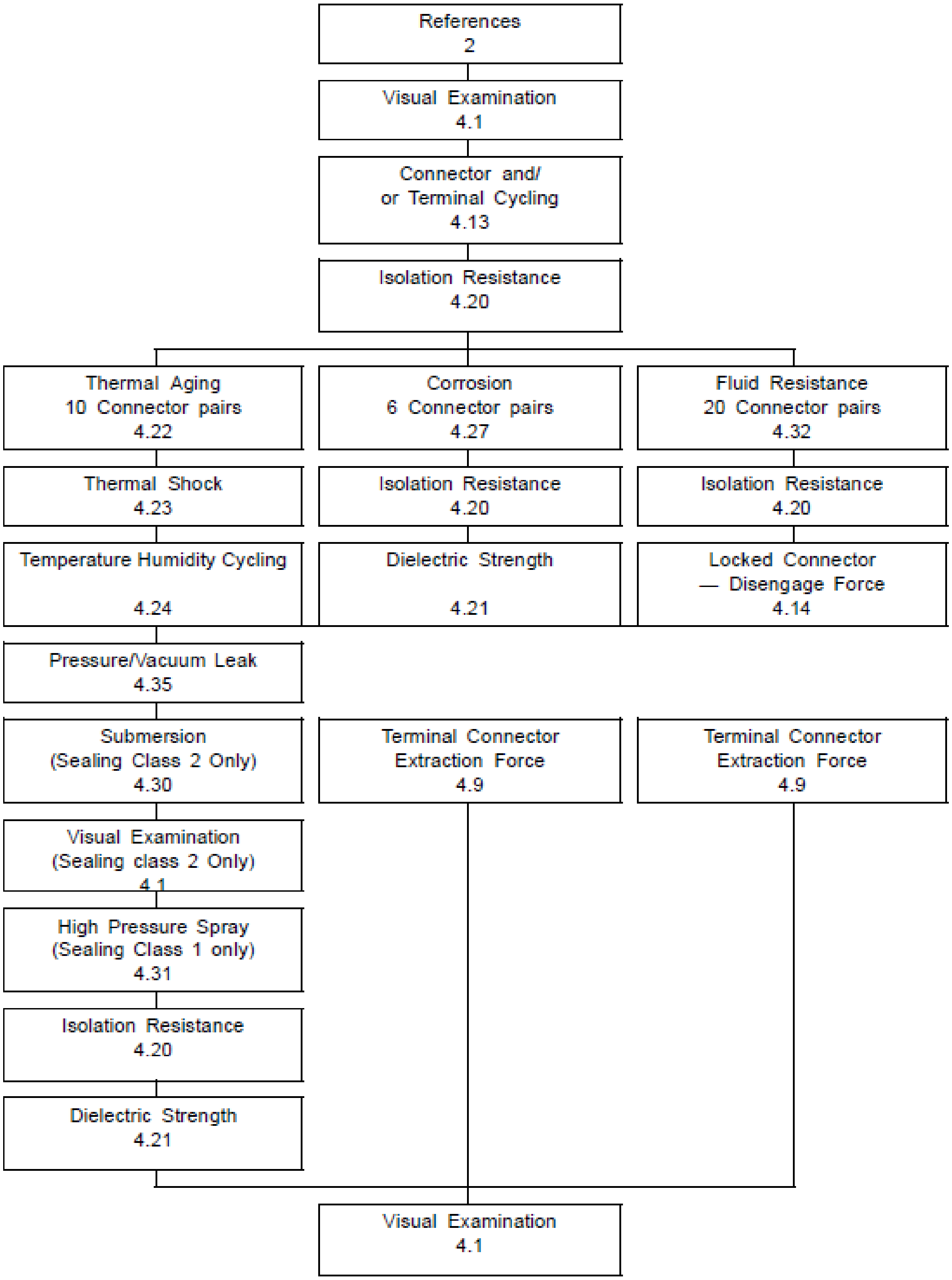
4) Connector system – Mechanical tests



5) Connector system – Electrical tests (Dry circuit))



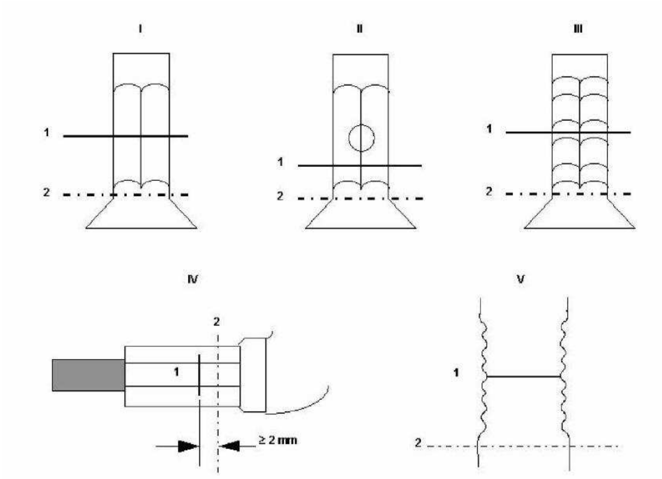
6) Sealed connector – Environmental tests



3.4. Test Requirements and Procedures Summary

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

TEST DESCRIPTION	REQUIREMENT	PROCEDURE
4.1 Visual Examination	There shall be no corrosion, discoloration, cracks, etc., which could affect the functionality of the part. Swelling or physical distortion shall not exceed the tolerances specified on the part drawing.	Normal lighting, photographic equipment as required. **Visual Examination before Testing.** Visually examine each test sample before testing and/or conditioning. Note, in detail, any manufacturing or material defects such as cracks, tarnishing, flash, etc. A control sample shall be retained. Photographs and/or video recordings of the test samples shall be taken. **Visual Examination of the Crimp Area.** The insulation grip shall not cut through the insulation and shall firmly enclose the cable, if the electrical connector has a cable insulation support. Both insulation and conductor shall be visible between the conductor crimp and the insulation support on the tab and the female connector, with the exception of insulation displacement connection. Conductors shall protrude from the conductor crimp but shall not interfere with the mating part. All wire strands shall be enclosed by the conductor crimp. There shall be no damaged wire strands. No insulation material shall be inside the conductor crimp. A mouth (flaring) is required on the cable side (rear) of the core crimp. This performs a strain relieving function for the core crimp. A mouth (flaring) is acceptable, but not required for the terminal body side (front) of the core crimp. **Visual Examination after Testing.** After testing and/or conditioning, re-examine each test sample and note in detail any observable changes, such as swelling, corrosion, discoloration, physical distortions, cracks, etc. Compare the tested and/or conditioned test samples to the following items, noting any differences
4.2 **Crack Corrosion.**	The surface shall be free of cracks.	Glass test vessel of suitable size (≈ 150 mm high) to contain test samples and requisite volume of test medium. The test vessel shall be fitted with a gas tight glass lid and suitable glass grid or frame to allow suspension of the test samples above the test medium. Magnification equipment to provide at least 10× magnification. Test samples: Finished terminals crimped to wires. Number of test samples: Min. 3pcs Clean contacts or material to be tested by degreasing in a suitable alkaline cleaner or organic solvent. If necessary, immerse parts for ≈ 30 s in either sulfuric acid (10 % by mass) or nitric acid (30% by mass) and then rinse in clean running water to remove any surface oxides. Dry the parts thoroughly. Prepare the test medium using G.P.R. grade reagents and distilled or deionized water. Composition of testmedium: Ammonia solution (25% by mass) diluted with water to a ratio of 1 to 1 (density at +20ºC: (0.946…0.950) g/cm3) Unless otherwise specified, the test shall be performed at an ambient temperature of (+23 ± 5)ºC. Fill the test vessel with the ammonia solution to a depth of ≈ 30 mm. Suspend the cleaned test samples at a height of 50 mm above the

		surface of the ammonia solution and seal the test vessel. Expose the test samples for (24 ± 1) h total. Deviations from the time requirement shall be noted on the test report. If it is necessary to interrupt the test, test samples may be removed from the vessel and stored in deionized water for ≤ 16 h, dried and then re-exposed to the ammonia medium for the remainder of the time required. Following the 24 h exposure, pickle the test samples in either sulfuric acid (10 % by mass) or nitric acid (30 % by mass) at (+23 ± 5)ºC for (30…60) s. Examine the parts using at least 10× magnification. Observe and note any cracks.
4.3 **Crimp Integrity.**	All wire strands shall be uniformly deformed and the crimp shall show a honeycomb like structure with minimal cavities. All wire strands shall be enveloped by the crimp wings. The wire strands shall be evenly distributed on both sides of the crimp. The crimp shall be generally symmetrical with minimal burrs. <u>Shape of the Crimping Area</u> The sheet metal shall be bent symmetrically and both ends of the crimp wings shall touch each other. The sheet metal shall show no cracks. There shall be no excessive burring. For welded connections, each individual wire strand shall be compressed. The welding (metallurgical adhesion) of all neighboring single wire strands shall be recognizable. Small cavities are permitted.	Test samples: 3 of each cable, stranding type and crimp configuration The degree of compression shall be shown in a cross-section through the middle of the cable connection. A method for the metallographical fine sanding and polishing shall be chosen which generates a smooth surface without any deformation. Small cavities shall be easily recognized. The zone to be polished and photographed shall be chosen in the area of maximum compression of the wire strands as shown in Figure 2 . The distance between the cutting zone and the polishing zone shall be large enough so that there is no change in structure of the polishing zone due to sample preparation. In cases where the crimp or attachment structure varies significantly from these examples, alternate sectioning methods may be required. Figure 2: Cutting Zone and Polishing Zone  **I** Standard Crimp Connections and Splices The polishing zone (**1**) is located in the middle of the crimp. The cutting zone (**2**) is located outside the crimp area. For larger crimps, the inital cut may be located within the crimp area, but the distance between cutting and polishing zone shall be Min. 2 mm to assure that the sawing action does not dislocate or deform the strands. **II** Cutting and Polishing Zones for Punched Crimp wings The polishing zone (**1**) is located between the hole and the cutting zone. The cutting zone (**2**) is located outside of the crimp area. **III** Multiple Divided Crimping Area The polishing zone (**1**) is located in the middle of one (ideally the middle) of the single crimping areas. The cutting zone (**2**) is located outside of the crimp area.

<table>
<tr>
<td></td>
<td></td>
<td>IV Crimped Battery Connectors
The polishing zone (1) and the cutting zone (2) are located as shown, cable side embedded, grind to the marked polishing zone.

V Ultrasonically Welded Splices and Terminal Attachments
The polishing zone (1) is located in the middle of the welded nugget through an area of maximum compression (valley). The cutting zone (2) are located outside the welded area. The test samples shall be mounted each in an individual casting. The potted test samples shall be ground to the polishing zone.

For welded test samples, weld settings and finished product measurements shall be documented.

<u>Examining the Polished Test Samples</u>
Each test sample shall be examined by using a microscope with direct lighting and photographs taken to document the results. Magnification shall be appropriate for the size of the test sample.</td>
</tr>
<tr>
<td>4.4 Terminal-Conductor Attachment Tensile Strength</td>
<td>The tensile strength of the conductor attachment shall withstand the minimum values specified in Table 5. Soldered or welded connections shall meet the same values in Table 5.

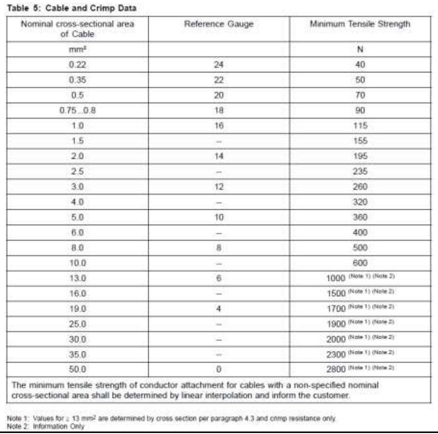



Table 5: Cable and Crimp Data
<table>
<tr><th>Nominal cross-sectional area of Cable</th><th>Reference Gauge</th><th>Minimum Tensile Strength</th></tr>
<tr><td>mm²</td><td></td><td>N</td></tr>
<tr><td>0.22</td><td>24</td><td>40</td></tr>
<tr><td>0.35</td><td>22</td><td>50</td></tr>
<tr><td>0.5</td><td>20</td><td>70</td></tr>
<tr><td>0.75...0.8</td><td>18</td><td>90</td></tr>
<tr><td>1.0</td><td>16</td><td>115</td></tr>
<tr><td>1.5</td><td>–</td><td>155</td></tr>
<tr><td>2.0</td><td>14</td><td>195</td></tr>
<tr><td>2.5</td><td>–</td><td>235</td></tr>
<tr><td>3.0</td><td>12</td><td>260</td></tr>
<tr><td>4.0</td><td>–</td><td>320</td></tr>
<tr><td>5.0</td><td>10</td><td>360</td></tr>
<tr><td>6.0</td><td>–</td><td>400</td></tr>
<tr><td>8.0</td><td>8</td><td>500</td></tr>
<tr><td>10.0</td><td>–</td><td>600</td></tr>
<tr><td>13.0</td><td>6</td><td>1000 $^{\text{(Note 1) (Note 2)}}$</td></tr>
<tr><td>16.0</td><td>–</td><td>1500 $^{\text{(Note 1) (Note 2)}}$</td></tr>
<tr><td>19.0</td><td>4</td><td>1700 $^{\text{(Note 1) (Note 2)}}$</td></tr>
<tr><td>25.0</td><td>–</td><td>1900 $^{\text{(Note 1) (Note 2)}}$</td></tr>
<tr><td>30.0</td><td>–</td><td>2000 $^{\text{(Note 1) (Note 2)}}$</td></tr>
<tr><td>35.0</td><td>–</td><td>2300 $^{\text{(Note 1) (Note 2)}}$</td></tr>
<tr><td>50.0</td><td>0</td><td>2800 $^{\text{(Note 1) (Note 2)}}$</td></tr>
<tr><td colspan="3">The minimum tensile strength of conductor attachment for cables with a non-specified nominal cross-sectional area shall be determined by linear interpolation and inform the customer.</td></tr>
</table>
Note 1: Values for ≥ 13 mm² are determined by cross section per paragraph 4.3 and crimp resistance only.
Note 2: Information Only</td>
<td>Push/Pull tester, (25 ~ 100) mm/min

Disable cable insulation support (when applicable) or request test samples without cable insulation support.

Test samples: 10 per each conductor (i.e. 20 test samples if 2 conductors are attached to one terminal)

Using test apparatus, apply force until separation occurs
.
Record velocity, tensile strength and location of failure for each test sample.

If more than one conductor is attached to one terminal, test each wire individually.

Ring terminals requiring dip brazing (dip soldering) shall be pull tested before dipping.</td>
</tr>
<tr>
<td>4.5 Terminal-Terminal Engage Force</td>
<td>None.</td>
<td>Push/Pull tester with peak reading feature

Test samples: male and female terminals with wires attached
Number of Test samples: Min. 10 male terminals + Min. 10 female terminals

Secure terminals to be tested onto a fixture. Insert terminals at a uniform rate of (50 ± 10) mm/min until fully engaged. Record peak force and graph force versus distance from initial terminal to terminal contact to fully engaged position.</td>
</tr>
<tr>
<td>4.6 Normal Force of Contact.</td>
<td>The normal force shall be at least 75 % of the initially measured value.</td>
<td>Test pin with strain gage or any other suitable equipment.

Test samples: male and female terminals with wires attached
Number of Test samples: Min. 10 male terminals + Min. 10 female terminals

Measure the normal force with the test pin.</td>
</tr>
<tr>
<td>4.7</td>
<td>The maximum force for terminals with < 1.0 mm2 wires attached is 15 N (to reach full engagement). The</td>
<td>Push/pull tester with peak reading feature

Test samples: Terminals with wires incl. seals (if applicable)</td>
</tr>
</table>

<table>
<tr>
<td>Terminal to Connector-Engage
Force.</td>
<td>maximum force for terminals with > 1.0mm2 wires attached is 30 N (to reach full engagement). For terminals with 1.0 mm2 wires attached, the maximum force is 20 N (to reach full engagement).</td>
<td>attached and suitable connector body
Number of Test samples: Min. 10 terminals + appropriate number of connector bodies

1 Secure connector to be mated into fixture.
2 Attach conductor with terminal into fixture (≤ 2 츠 from back of terminal).

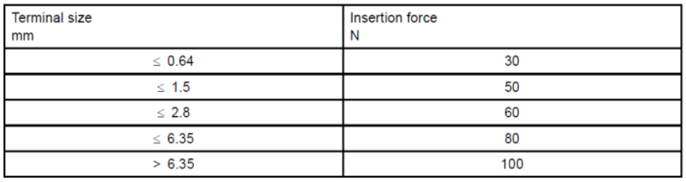
3 Insert terminal into connector at a uniform rate of (50 ± 10) mm/min until fully seated and locked.

4 Record peak force and graph force versus distance from initial contact of terminal to connector body to final engaged position.

5 The insertion of a terminal with TPA or PLR in place shall be either not possible or at least double the force as specified in requirement.</td>
</tr>
<tr>
<td>4.8
Mechanical overstress test</td>
<td>$R_{\text{Total Connection}}$ measured shall be according 4.18 Dry Circuit</td>
<td>Push/pull tester with peak reading feature Micro-ohmmeter that limits the open circuit voltage to 20 mV and limits the current applied to 100 mA. The micro-ohmmeter must also use either offset compensation or current reversal methods to measure resistance. Prepare a test tab that has the front shaped the same as the original male terminal but with a thickness 20% larger than the nominal original thickness. In case of terminals with contact points on the “sides” of the male terminal enlarge the tabs also in that direction.

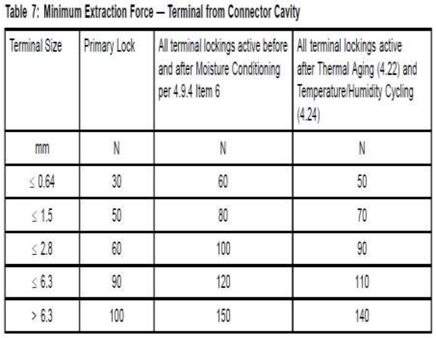
Obtain 10 samples of each terminal with 300 mm wires.

• Connect the original male and female terminals.
• Perform a dry circuit test according section 4.18.
• Disconnect male and female terminal.
• Push the test tab inside the female terminal to the normal end position with the max force according Table 6 keep it there for 60-70 sec. If the tab stops before the end position keep it there for the same amount of time.

Table 6: Mechanical overstress test

<table>
<tr><th>Terminal size
mm</th><th>Insertion force
N</th></tr>
<tr><td>≤ 0.64</td><td>30</td></tr>
<tr><td>≤ 1.5</td><td>50</td></tr>
<tr><td>≤ 2.8</td><td>60</td></tr>
<tr><td>≤ 6.35</td><td>80</td></tr>
<tr><td>> 6.35</td><td>100</td></tr>
</table>

• Disconnect test tab and female terminal.
• Push in the original male terminal again and store it in room temperature for at least 24 hours.
• Perform a dry circuit test according section 4.18 and record the results for each terminal pair.

Note: Note, it is important that no mechanical disturbance of the terminal-to-terminal interface occurs prior to, or during the last test. Relative movement of the metal terminals could rupture any insulating film that may have formed.</td>
</tr>
</table>

<table>
<tr>
<td>4.9
Terminal
from
Connector
Extraction
Force.</td>
<td>
Table 7: Minimum Extraction Force – Terminal from Connector Cavity
<table>
<tr><th>Terminal Size</th><th>Primary Lock</th><th>All terminal lockings active before and after Moisture Conditioning per 4.9.4 Item 6</th><th>All terminal lockings active after Thermal Aging (4.22) and Temperature/Humidity Cycling (4.24)</th></tr>
<tr><td>mm</td><td>N</td><td>N</td><td>N</td></tr>
<tr><td>≤ 0.64</td><td>30</td><td>60</td><td>50</td></tr>
<tr><td>≤ 1.5</td><td>50</td><td>80</td><td>70</td></tr>
<tr><td>≤ 2.8</td><td>60</td><td>100</td><td>90</td></tr>
<tr><td>≤ 6.3</td><td>90</td><td>120</td><td>110</td></tr>
<tr><td>> 6.3</td><td>100</td><td>150</td><td>140</td></tr>
</table>
</td>
<td>• Pull tester with peak reading feature
• Climatic chamber, (95~98) % RH at +40ºC

All test samples shall be maintained at an ambient temperature of (+23 ± 5)ºC for Min. 24 h before the start of any test sequence.

Test samples: Terminals with max. possible wire cross section attached and appropriate connectors with sufficient cavities
Number of Test samples: Min. 40 terminals
Note: All cavities of a connector must be tested.

1 Assemble connectors and terminals using all seals, etc., without TPA's. Designs using pre-staged TPA's shall have TPA's in pre-staged position.

2 Secure connector to be tested into fixture by gripping the conductor max. 10 cm behind the back edge of the terminal.

3 Pull the conductor at a uniform rate (50 ± 10) mm/min until pull-out occurs. Note pull-out value and failure mode.

4 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 with a note as to failure mode.

5 Using new test samples, repeat the above procedure but with all TPA's in place.

6 Repeat step 5 using moisture conditioned parts. Parts are brought to their practical limit of moisture content by exposing "dry as molded" parts to (95~98) % RH at +40ºC for 6 h, then immediately completing the extraction test.

7 Repeat step 5 immediately after 4.22 – thermal aging and 4.24 - Temperature/Humidity Cycling.
Test Flow see Table 30.</td>
</tr>
<tr>
<td>4.11
Connector
to
Connector
Engage
Force</td>
<td>The maximum force for a manually assembled connector is according to Table 4 (to reach full engagement). This requirement also applies to lever locks or other similar locking features.</td>
<td>Push tester with peak reading feature

Test samples: Mating pairs of connectors with a full compliment of terminals and wires Number of Test samples: Min. 10 pairs

1 Secure connector to be mated into fixture.

2 Attach connector assembly into fixture.

3 Insert mating connectors together 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 connectors to final engaged position.</td>
</tr>
<tr>
<td>4.12
Miscellaneous
Connector
Components.</td>
<td>1) CPA lock and unlock force.
The CPA locking force must be below 30 N. The CPA opening force must be between 20 N and 30 N.

2) Accidental CPA closing force prior to locking with mating part.
The closing force with not mated connector must be more than 50 N for</td>
<td>4.12.1 Terminal-Position Assurance. : Non application
4.12.2 Retention of slide in open position. : Non application
4.12.3 Lever and slide, side force strength. : Non application
4.12.4 Clips and fasteners. : Non application : Non application

4.12.5 Connector Position Assurance (CPA).
Push/pull tester with peak reading feature

Obtain a minimum of 10 samples of connectors to be tested. No</td>
</tr>
</table>

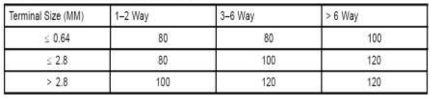
<table>
<tr>
<td></td>
<td>1 to 3 way connectors and more than 80 N for > 3 way connectors.

3) Accidental CPA removal from connector in pre locked position.
The removal force of the CPA must be more than 60 N for 1 to 3 way connectors and more than 80 N for > 3 way connectors.</td>
<td>special sample preparation is required.

1) CPA lock and unlock force.
Mate connector to be tested. Close the CPA at a uniform rate of (50 ± 10) mm/min until fully seated and locked. Record peak force Open the CPA at a uniform rate of (50 ± 10) mm/min until fully opened. Record peak force.

2) Accidental CPA closing force prior to locking with mating part.
With an unmated connector, close the CPA at a uniform rate of (50 ± 10) mm/min until fully seated and locked. Record peak force.

3) Accidental CPA removal from connector in pre locked position.
With an unmated connector, pull the CPA (to the opposite direction of the normal closing direction) at a uniform rate of (50 ± 10) mm/min until fully detached. Record peak force.</td>
</tr>
<tr>
<td>4.13
Connector and/or Terminal Cycling.</td>
<td>None.</td>
<td>• Crimp wires of appropriate gage size to terminals and insert into connector housing.
• Completely mate and unmate each connector or terminal pair 10×.
• Remate connectors or terminals for one last time in preparation for future test sequences.</td>
</tr>
<tr>
<td>4.14
Locked Connector
-
Disengage Force.</td>
<td>The primary locking mechanism shall withstand the minimum force specified in Table 10

Table 10: Locked Connector - Disengage Force

<table>
<tr><td>Terminal Size (MM)</td><td>1–2 Way</td><td>3–6 Way</td><td>> 6 Way</td></tr>
<tr><td>≤ 0.64</td><td>80</td><td>80</td><td>100</td></tr>
<tr><td>≤ 2.8</td><td>80</td><td>100</td><td>120</td></tr>
<tr><td>> 2.8</td><td>100</td><td>120</td><td>120</td></tr>
</table>
</td>
<td>Push/pull tester with peak reading Feature

Test samples: Mating pairs connector without wires and terminals. Number of Test samples: Min. 10 pairs

Make a fixture which can be secured to the connectors to be tested. Securing of the connector shall not distort either mated connector during testing. Mount the housing in the fixture with the locking feature engaged but without any secondary lock (CPA) in place. Apply force at a rate of (50 ± 10) mm/min in the disconnect direction. Record the force at which the connectors disengage.</td>
</tr>
<tr>
<td>4.15
Unlocked Connector
-
Disengage Force.</td>
<td>The maximum force required to disengage the primary lock and to disconnect the connector pairs with the locks properly disengaged shall be ≤ 100 N each.
Note: In case of housings without locking feature or in case of connectors without housing, the minimum retention force shall be 20 N.</td>
<td>Push/pull tester with peak reading Feature

On 5 of the test samples, physically remove or otherwise disable connector locks. Test samples: Mating pairs connector and components. Number of Test samples: Min. 10 pairs

Make a fixture which can be used to secure to the connectors to be tested. The fixture shall not distort any of the parts. Mount 5 of the test samples in the fixture without the locking feature engaged and without any secondary lock (CPA) in place. Pull the connector from its mate at a rate of (50 ± 10) mm/min and record the peak force required to disengage the mated pair. Mount 5 of the test samples in the fixture with the locking feature engaged. Disengage the primary locking feature and record the force required to disengage the lock.</td>
</tr>
<tr>
<td>4.16
Connector Polarization (Coding) Feature Effectiveness.</td>
<td>The connection system shall withstand three times the force measured under 4.11 procedure, the force shall be minimum 150 N, without making electrical contact. There must be no physical damage to either connector half sufficient to prevent its subsequent correct mating and function.</td>
<td>Push/pull tester with peak reading Feature

Test samples may be fitted with a mechanical or electrical means to detect penetration of one half of the connector into the other to a depth sufficient to contact any male terminal in any position, if that male terminal was installed. All existing coding combinations are to be tested.
Test samples: Completely assembled mating pairs of connectors with a full compliment of terminals and cables.</td>
</tr>
</table>

		Number of Test samples: Min. 3 pairs 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. Engage the connector halves at a uniform rate ≤ 50 mm/min until the force specified under 4.16 requirement is applied. Note whether electrical contact is made.
4.17 Maximum Current Rating.	The measured data shall meet or exceed the intended terminal design current capability and temperature rise.	• DC Power Supply, (0…20) V • Current shunts • Thermocouples • Thermal Imaging equipment (optional) • Data Logger (as required) • Draft Free Enclosure Attach thermocouples to the terminal's hottest spot with thermal conductive paste or Attach test leads A, B, and C to test samples as shown in Figure 8. Turn on the power supply, and adjust to 0 A and 14 V. Complete the Connector Cycling Procedure (section 4.13). Perform this procedure only once when the terminal/connector pair is used in multiple tests. Slowly increase the power supply in 5% increments until it is providing 50 % of the intended terminal design current capability. Wait at least 15 min for the circuit temperature to stabilize (defined as a variation of < 1ºC for 1 min), then record the ambient temperature and the temperature of each terminal pair interface. **Note:** Throughout this entire procedure, when using DC current for testing, thermocouple readings shall be grease or by soldering or welding as close as possible to the hottest spot on the surface of the terminal. If the hottest spot is unknown, perform an independent test. An optional measurement method is with thermal imaging equipment. Test samples: Mating pairs of terminals attached to wires. Number of Test samples: 10 pairs for every wire size Maximum terminal current measurements are done in a draft free enclosure. Construct a draft free enclosure as shown in Figure 5. The thermocouple for measuring ambient temperature is fixed in the middle of the test chamber at a point (50 ± 5) mm from the lower surface of the lid. taken with polarity on the test samples in both directions and then averaged to eliminate error due to thermocouple effect. Increase the current by 10 % increments, until 80% of the intended terminal design capability ismet. At each step wait at least 15 min and until thermal stability (defined as a variation of < 1ºC for 1 min) has been achieved, then record the ambient temperature and the temperature of each terminal pair interface. From 80 % of design capability, increase the current in increments of 5 % of the intended terminal design capability until thermal stability can no longer be met within 15 min. Wait 15 min at each step, and record ambient temperature and the temperature of each terminal pair interface. For showing the base curve the mean value of the temperature differences of the 10 test samples are **Note:** The measured contact temperature is proportionally related to the square of the test currents I_T multiplied by the total sum of the resistances (including crimp and cable resistances). Graph the data with the temperature on the X-axis and the current

(in A) on the Y-axis for all wire sizes and types tested. Reduce the current values of the base curve by 20 % to create the derating curve (reduced base curve) as shown in Figure 7. The derating curve is also limited by the related current carrying capability (ampacity) of the cable used as shown as hatched area in Figure 7.

Figure 5: Draft Free Enclosure

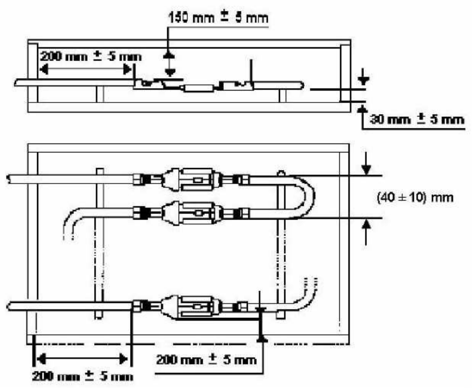
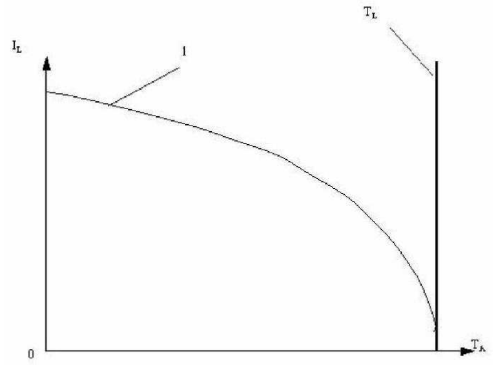
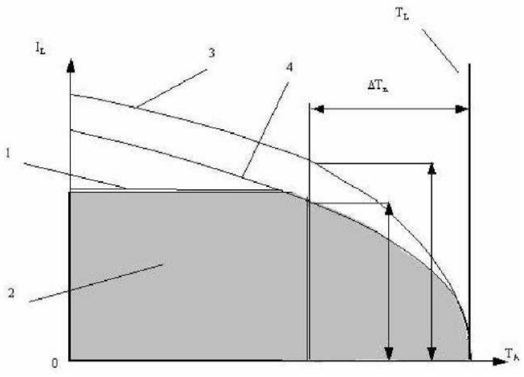


Figure 6: Base Curve



1 Current load I_L
2 Temperature limit of contact material T_L
3 Ambient Temperature T_A

Figure 7: Derating Curve



1 Current load capacity of cable used
2 Allowable current load of terminal and cable
3 Base curve
4 Derating curve (80 % of base curve)
I_L Current load
T_AAmbient temperature
T_LTemperature limit of terminal

4.18
Dry Circuit.

The “Initial” and “After Conditioning” RTOTAL CONNECTION shall be ≤ the values listed in Table 11. Values for terminal sizes not shown in Table 11 may be calculated by interpolation.
The “Initial” and “After Conditioning” RCRIMP shall be ≤ the values listed in Table 12.

Table 12: Allowable Crimp Resistance

Nominal Crosssectional Area of Cable	Single Crimp Resistance
mm^2	mΩ
0.22	4.5
0.35	2.9
0.5	2.0
0.75 ... 0.8	1.3 ... 1.2
1.0	1.0
1.5	0.7
2.0	0.7
2.5	0.6
3.0	0.5
4.0	0.4
5.0	0.4
6.0	0.4
8.0	0.3
10.0	0.3
13.0	0.2
16.0	0.2
19.0	0.2
25.0	0.1
30.0	0.1
35.0	0.1
50.0	0.1

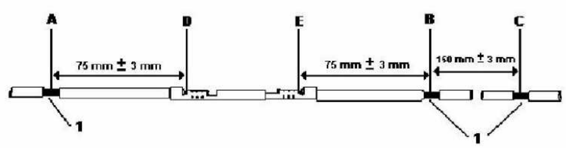
Micro-ohmmeter which limits the open circuit voltage to 20 mV and limits the current applied to a maximum of 100 mA. The micro-ohmmeter must also use either offset compensation or current reversal methods to measure resistance.

Test samples: Mating terminal pairs attached to maximum possible wires cross section.
Number of Test samples: 10 pairs

Attach test leads at locations A, B, and C to wires.
Note: It is important that no mechanical disturbance of the terminal to terminal interface occurs prior to, or during the test. Relative movement of the metal terminals could rupture any insulating film that may have formed.

Measure and record the resistance across (150 ± 3)mm of the conductor to be used for the test. Measure resistance across A to B and B to C using instruments which determine resistance by either the offset compensation or current reversal methods. Calculate the combined resistance of the terminal conductor attachments and the interface with the following formula:
RTotal Connection = RDE = RAB – RBC

Figure 8: (a) In-Line Dry Circuit Test Lead Location



b : under development

Table 11: $R_{Total\ Connection\ Dry\ Circuit}$

Terminal Size (mm)	$R_{Total\ Connection\ Dry\ Circuit}$ Maximum (mΩ)
≤ 0.64	15.0
≤ 1.5	8.0
≤ 2.8	5.0
≤ 6.35	3.5
> 6.35	2.5

4.19
Current Cycling.

For the first 504 cycles, the measured temperature of any mated terminal pair shall not exceed the temperature limit of the terminal and cable size combination under test. For the second 504 cycles a temperature rise of 70ºC at the terminal shall not be exceeded. The Total Connection Resistance according 4.18 procedure shall not exceed the values specified in Table 11

- DMM
- DC Power Supply (timer controlled)
- Current shunts
- Thermocouples
- Data Logger

Attach thermocouples to the terminal’s hottest spot with thermal conductive paste or grease as close as possible to the hottest spot on the surface of the terminal. If the hottest spot is unknown, perform an independent test. An optional measurement method is with thermal imaging equipment. Only perform the mate/unmate cycling on a mated pair once when the pair is used in multiple tests.
Test samples: Mating connector pairs filled with terminals attached to 300 mm of the largest wire size to be validated.
Number of Test samples: 10 terminal pairs with largest wire size inside the connector, but only with 2 adjacent cavities filled.

Note: Throughout this entire procedure, when using DC current for testing, thermocouple readings shall be taken with polarity on the test samples in both directions and then averaged to eliminate error due to thermocouple effect.
Attach test leads A, B, and C to test samples as shown in Figure 8. Set the power supply to provide 45 min ‘ON’ and 15 min ‘OFF’ at the +80ºC rated current of the terminal from paragraph 4.17,

		Figure 7. Also, connect a data logger to the voltage drop and thermocouple leads. After 30 min into the first ‘ON’ cycle record the following readings for each terminal pair: • RTOTAL CONNECTION • thermocouple readings Cycle at +80ºC for 504 h (45 min ON and 15 min OFF), taking readings at least once daily, or as specified by the test requestor, 30 min into the ‘ON’ cycle, and at the conclusion of the test. Subsequently with the same test samples, 504 cycles with 45 min ‘ON’ and 15 min ‘OFF’ at + 23ºC and 1.5 times the current are performed.
4.20 **Isolation Resistance.**	All measured isolation resistances shall be > 100 M .	Precision M meter (capable of measuring at 500 VDC) Mate connector pairs. Wrap metal foil around the exterior of the connector without contacting any terminals or wires. Remove a minimal amount of wire insulation from the ends of the wires. Test samples: Mating connector pairs filled with terminals attached to 300 mm of the largest wire size to be validated. Number of Test samples: 4 pairs For sealed connector pairs, complete all measurements in this test procedure within one hour after any prior environmental test. For unsealed connector pairs, test samples shall rest in ambient environment for ≥ 3 h prior to measuring isolation resistance after any prior environmental test. Separate exposed ends of wires with sufficient distance as to have no influence on isolation resistance between any two wire pairs. Measure the isolation resistance by applying 500 VDC between all adjacent pairs of terminals. Record the resistance after 15 s of stabilized readings. Connect all exposed wires at one end to positive lead of Mega-Ohm meter. Connect metal foil to negative lead of M meter. Measure the isolation resistance by applying 500 VDC between the terminals and the metal foil. Record the stabilized reading.
4.21 **Dielectric Strength.**	No current leakage (dielectric breakdown) shall flow between cavities or between cavities and outside of connector at any time during the test.	High potential tester with load Meter Mate connector pairs. Wrap metal foil around the exterior of the connector without contacting any terminals or wires. Remove a minimal amount of wire insulation at ends of wires. Test samples: Mating connector pairs filled with terminals attached to 300 mm of the largest wire size to be validated. Number of Test samples: 3 pairs For sealed connector pairs, all measurements in this test procedure shall be completed within one hour after any prior environmental test. For unsealed connector pairs, test samples shall rest in ambient environment for Min. 3 h prior to measuring dielectric strength after any prior environmental test. Separate exposed ends of wires with sufficient distance as to have no influence on isolation resistance between any two wire pairs. Using the high potential (hi-pot) tester, apply an AC voltage of 1000 V r.m.s.(50 Hz or 60 Hz) or a DC voltage of 1600 V across each adjacent cavity for Min. 60 s and record current leakage. Connect all exposed wires at one end to the positive lead of the hi-pot tester . Connect metal foil to the negative lead of the hi-pot tester. Apply an AC voltage of 1000 V r.m.s.(50 Hz or 60 Hz) or a DC voltage of 1600 V between the terminals and the metal foil for Min. 60 s and record the current leakage.

4.22
Thermal
Aging.

The Test samples shall meet the requirements specified in 4.18.5, Table 11 - Dry Circuit, before and after the environmental tests. All test samples shall meet the visual requirements of paragraph 4.1. Lock pump handles or other elements required to separate connectors for service must function without breakage.

Temperature Chamber(s), (-40 ~ +155) oC (Note 1)
Note 1: As required by the Temperature Class of the component to be tested

Test samples: Complete test samples fitted with all terminals and wires connected.
Number of Test samples: 10 pairs

Set the temperature chamber to the maximum ambient temperature per the class rating of the connector in Table 1. Leave the test samples in the chamber for 1008 h.

Table 1: Temperature Class

Class	Ambient Temperature (Operating Ambient) ºC	Test Temperature ºC	Typical Installation Position
1	-40...+85	+105	passenger compartment or trunk
2	-40...+100	+120	underhood
3	-40...+125	+145	on engine
4	-40...+155	+175	on engine (hot locations)

4.23
Thermal
Shock.

During the entire time of the temperature cycling, there must be no loss of electrical continuity (resistance > 7Ω for > 1 µs).
Test samples shall meet the dry circuit requirements of paragraph 4.18, Table 11 both before and after conditioning. All test samples shall meet the visual requirements of paragraph 4.1. Lock pump handles or other elements required to separate connectors for service must function without breakage.

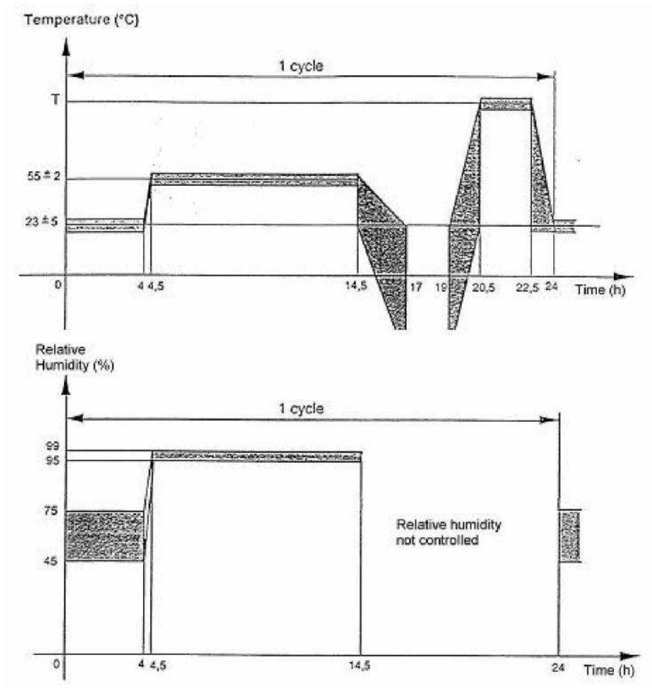
- DC Power Supply, (0~ 20) V
- Continuity monitoring equipment
- Temperature Chamber(s), (-40~+155)ºC (Note 2)

Note 2: As required by the Temperature Class of the component to be tested.

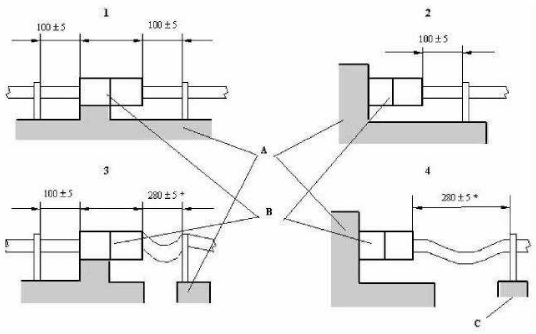
Test samples: Complete connector test samples fitted with all terminals and wires connected.
Number of Test samples: 10 pairs

Divide the test samples into two groups. The first group shall be set up and monitored continuously, as follows:
On connectors with ≤10 cavities, all cavities shall be monitored.
On connectors with more than 10 cavities, the test requestor shall determine the exact number and location of the cavities to be monitored. The chosen cavities shall be evenly distributed across the connector.
The second group shall not be monitored. Solder the ends of the conductors to each other in the test sample set being monitored, to form one continuous current path with only two free ends.
Solder one of the free conductor ends to a 2 W, (120 ± 1,2) Ω resistor. Preset the power supply to provide 100 mA to the circuit. Solder the "-" (negative) lead to the free end of the resistor and the "+" (positive) lead to the remaining free conductor end of the test sample. 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 continuitymonitoring equipment may be used to monitor one or more terminal pairs instead of the resistor. Place the test samples in the chamber so that there is no substantial air flow obstruction around the test samples.
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. Allow the chamber to stabilize, then soak the test samples an additional 30 min. Transfer the test samples to the high temperature chamber set to the maximum ambient temperature for the class selected. Maximum transfer time shall be < 10 s. Allow the test samples to soak for 30 min.

- Cycle 300 total times while continuously monitoring for any loss of electrical current level per the set-up described above. At the

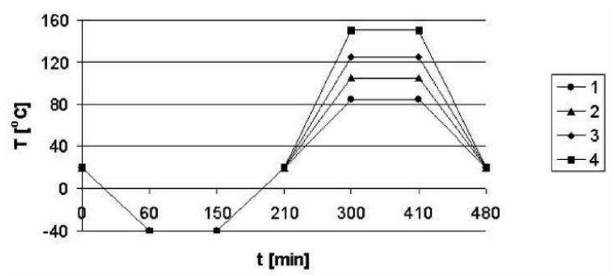
		end of the cycling schedule complete the following steps: • Remove the test samples from the chamber.
4.24 **Temperature** **Humidity** **Cycling.**	Test samples shall meet the dry circuit requirements of paragraph 4.18, Table 11 both before and after conditioning. All test samples shall meet the visual requirements of paragraph 4.1. Lock pump handles or other elements equired to separate connectors for service must function without breakage.	• DC Power Supply, (0~20) V • Continuity monitoring equipment • Temperature Chamber(s), (-40~ 155)ºC (Note 3) Note 3: As required by the Temperature Class of the component to be tested. Test samples: Complete connector test samples fitted with all terminals and wires connected. Number of Test samples: 10 pairs Place the test samples in the chamber so that there is no substantial air flow obstruction around the test samples. 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. Allow the chamber to stabilize, then soak the test samples an additional 30 min. Cycle the test samples 10× using the cycling schedule shown in Figure 9. Use the Test Temperature as determined from Table 1 while continuously monitoring the current level in the test circuit. **Figure 9: Temperature Humidity Cycle**  **Note:** Hatched areas indicate allowed temperature/ humidity tolerance. **T** Test temperature (see Table 1) **Note:** Test parameters must remain within shaded regions. At the end of the cycling schedule perform the following steps: **1** Remove the test samples from the chamber.
4.25 **Heavy** **duty** **test.**	Max allowed temperature rise on the terminal at the end of each cycle is 50ºC. $R_{\text{Total Connection}}$ measured shall be according 4.18 Dry Circuit.	• DMM • DC Power Supply (timer controlled) • Current shunts • Thermocouples • Data Logger • Temperature Chamber(s) (-40ºC to 155ºC*)

		*As required by the Temperature Class of the component to be tested Obtain at least 6 mating terminal pairs attached to wires of the largest wire size to be validated. Attach thermocouples to the female terminals with thermal conductive paste or grease as close to the hottest spot as possible without compromising the possibility to insert the terminal into the connector. Insert the terminals into the connectors in 6 adjacent cavities. (If the number of cavities is lower, perform the test at the max configuration) Connect all terminals in series. Complete the dry circuit test per paragraph 4.18 Dry Circuit and record results for each terminal pair. Set the power supply to provide the rated allowable current load of terminal and cable taken from the border of area 2 in 4.17.4, Figure 7 : Derating Curve for largest wire size at the specific test temperature. (80ºC or 100ºC) Also, connect a data logger to the thermocouple leads. Set the Temperature Chamber to 80ºC for temperature classes 1-3 in Table 1 and 100ºC for temperature (Ambient -40~+155 ºC / Test +175 ºC) in Table 1 for 5 hours with current as specified above. Transfer the samples to -40ºC for 2 hours without current. Cycle 5 times. After the 5 cycles store the samples in room temperature for at least 24 hours. Perform a dry circuit test per paragraph 4.18 Dry Circuit and record the results for each terminal pair. Note, it is important that no mechanical disturbance of the terminal-to-terminal interface occurs prior to, or during the last test. Relative movement of the metal terminals could rupture any insulating film that may have formed.
4.27 **Corrosion.**	After the test, RTOTAL CONNECTION shall be ≤ the values specified in paragraph 4.18, Table 11. The Terminal retention force shall meet the requirement in paragraph 4.9, Table 7 after ageing. No deformation, cracks, or breaking shall be evident on the connector body.	Test samples: Complete connector test samples fitted with all terminals and the smallest and largest wire sizes. End of wires shall be sealed. Number of Test samples: 6 pairs Test samples are tested in an un-powered condition. Place test samples in vertical and horizontal direction in the chamber. At the beginning the test samples are stored at (+80 ± 3)ºC for (60 ± 10) min. Subject the test samples to the following week cycle. • 24 h storage in salt spray fog to GMI 60206 • 6 h storage in test chamber at (+40 ± 3)ºC • 18 h storage in salt spray fog to GMI 60206 • 6 h storage in test chamber at (+40 ± 3)ºC • 18 h storage in salt spray fog to GMI 60206 • 6 hour storage in test chamber at (+40 ± 3)ºC • 24 hour storage in salt spray fog to GMI 60206 • 65 h storage in test chamber at (+40 ± 3)ºC Expose Sealing Class 1 and 2 parts to a 4 week cycle and Sealing Class 3 parts to a 1 week cycle. Refer toTable 3.
4.28 **Vibration.**	During the entire time of the vibration test with temperature cycling, there shall be no loss of electrical continuity (resistance > 7 Ω for Min. 1 μs). Test samples shall meet the dry circuit requirements of paragraph 4.18, Table 11 before and after the test. Test samples shall not have any base metal apparent at the contact surface, or fretting corrosion products,	Test samples: Complete connector test samples fitted with all terminals and the largest gage wires for the intended production application. Number of Test samples: 10 pairs Construct a suitable mounting apparatus using the following design criteria: • The mounting apparatus shall be constructed and secured to minimize added effects (harmonics, dampening, resonance, etc.). • For in-line connectors, mount the mated connector pair directly

	when viewed under suitable (10 ~ 40) × magnification.	to the test fixture mounting bracket using the connector feature provided for mounting as shown in Figure 10. 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 mounting feature on the mated connector. For device (panel mount) connectors, mount the device directly to the test fixture mounting bracket as shown in Figure 10. 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. Method 1 and 2 are preferred. Methods 3 and 4 are optional. Should an application arise that does no lend itself to either situation described above, consult the authorized person. It is his or her responsibility to devise a suitable method for attaching the connector as directly and firmly as possible to the mounting bracket consistent with the intended vehicle mounting. Divide the test samples into two groups. The first group shall be set up and monitored continuously, as follows: On connectors with ≤10 cavities, all cavities shall be monitored. On connectors with more than 10 cavities, the test requestor shall determine the exact number and location of the cavities to be monitored. The chosen cavities shall be evenly distributed across the connector. The second group shall not be monitored. Solder the ends of the conductors to each other in the test sample set being monitored, to form one continuous current path with only two free ends. Solder one of the free conductor ends to a 2 W, (120 ± 1,2)Ω resistor. Preset the power supply to provide 100 mA to the circuit. Solder the "-" (negative) lead to the free end of the resistor and the "+" (positive) lead to the remaining free conductor end of the test sample. 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. Vibrate the parts per the schedule below. Vibration profiles and temperature settings are chosen based on the expected application in the vehicle. There are two required schedules for the engine/transmission cycle (sine and random). The sine schedule shall be run first, followed by the random schedule. During vibration load testing the DUT shall be simultaneously subjected to the following temperature cycle as shown in Figure 11 and Table 13. co-ordinate axis of the part. The specified test profile apply to both gasoline and diesel engines. This test is followed by the random vibration test Figure 17. **Figure 10: Vibration Mounting Fixture** 

A Test bench
B Test sample
C fixed
* Actual cable length: (300 ± 5) mm

Figure 11: Temperature Cycle Specification



1 Temperatur Class 1
2 Temperatur Class 2
3 Temperatur Class 3
4 Temperatur Class 4
t Time [min]
T Temperature [ºC]

Table 13: Temperature Cycle Specification

Time	Temperature			
	Class 1	Class 2	Class 3	Class 4
min	ºC	ºC	ºC	ºC
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

Mounting Location: engine, transmission

Figure 12: Engine/Transmission Mount Sinusoidal Vibration Cycle (ISO 16750-3 based)

â Amplitude of acceleration [m/s2]
f Frequency [Hz]

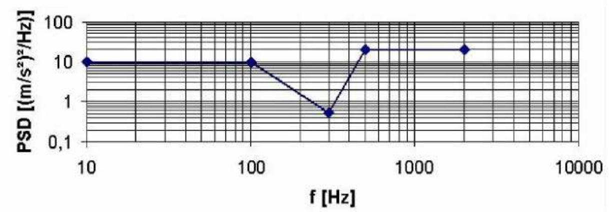
Test according to EN 60068-2-6, frequency sweep ≤ 1 octave/min. Test duration: (22 + 2) h for each X,Y, Z

Table 14: Engine/Transmission Mount Sinusoidal Vibration Cycle (ISO 16750-3 based)

Frequency	Amplitude of acceleration
Hz	m/s²
100	100
150	150
200	200
240	200
255	150
440	150

Random Vibration Cycle

Figure 13: Engine/Transmission Mount Random Vibration Cycle (ISO 16750-3 based)



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

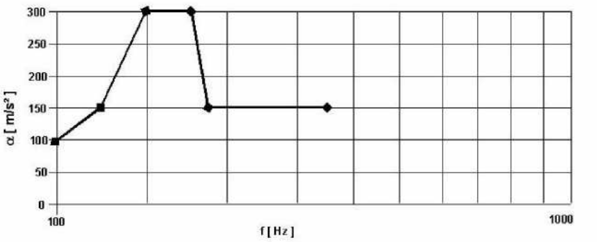
Test according to EN 60068-2-64, RMS acceleration value = 181 m/s². Test duration: (22 + 2) h for each X,Y, Z co-ordinate axis of the part.

Table 15: Engine/Transmission Mount Random Vibration Cycle (ISO 16750-3 based)

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

Mounting Location: engine, transmission

Figure 16: Engine/Transmission (severe applications; ISO 16750-3 based)



â Amplitude of acceleration [m/s^2]

f Frequency [Hz]

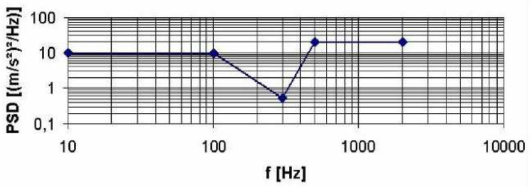
Test according to EN 60068-2-6, frequency sweep ≤ 1 octave/min. Test duration: (22 + 2) h for each X,Y, Z co-ordinate axis of the part. The specified test profile apply to both gasoline and diesel engines. This test is followed by the random vibration test Figure 17.

Table 18: Engine/Transmission (Mount Sinusoidal Vibration Cycle (severe applications; ISO 16750-3 based)

Frequency	Amplitude of acceleration
Hz	m/s²
100	100
150	150
200	300
240	300
255	150
440	150

Random Vibration Cycle

Figure 17: Engine/Transmission Mount Random Vibration Cycle (severe appilcations; ISO 16750-3 based)



PSD Power Spectral Density [(m/s^2)^2/Hz]

f Frequency [Hz]

Test according to EN 60068-2-64, RMS acceleration value = 181 m/s².Test duration: (22 + 2) h for each X,Y, Z co-ordinate axis of the part.

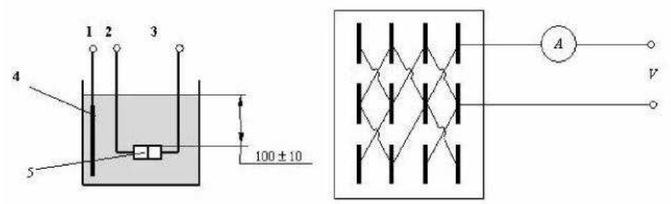
Table 19: Engine/Transmission Mount Random Vibration Cycle (severe applications; ISO 16750-3 based)

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

4.29 Mechanical Shock.	During the duration of the test, there shall be no loss of electrical continuity (resistance > 7 Ω for Min. 1 µs). Test samples shall meet the dry circuit requirements of paragraph 4.18.5, Table 11 before and after the test. Test samples shall not have any base metal apparent at the contact surface, or fretting corrosion products, when viewed under suitable (10 ~ 40) × magnification.	Test samples: Complete connector test samples fitted with all terminals and the largest gage wires for the intended production application. Number of Test samples: 10 pairs This test shall be done in sequence with the vibration test. Divide the test samples into two groups. The first group shall be set up and monitored continuously, as follows: On connectors with ≤10 cavities, all cavities shall be monitored. On connectors with more than 10 cavities, the test requestor shall determine the exact number and location of the cavities to be monitored. The chosen cavities shall be evenly distributed across the connector. The second group shall not be monitored. Solder the ends of the conductors to each other in the test sample set being monitored, to form one continuous current path with only two free ends. Solder one of the free conductor ends to a 2 W, (120 ± 1,2)Ω resistor. Preset the power supply to provide 100 mA to the circuit. Solder the “-“ (negative) lead to the free end of the resistor and

<table>
<tr>
<td></td>
<td></td>
<td>the “+” (positive) lead to the remaining free conductor end of the test sample. 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. Perform shock test according to EN 60068-2-27 Ea. After both the shock and vibration tests are complete, perform the examination steps listed in the vibration test.
Table 20: Mechanical Shock
<table>
<tr><th></th><th colspan="2">Test No.</th></tr>
<tr><td></td><td>1</td><td>2</td></tr>
<tr><td>Acceleration [g]</td><td>100</td><td>25</td></tr>
<tr><td>Nominal shock duration [ms]</td><td>11</td><td>15</td></tr>
<tr><td>Nominal shock shape</td><td>half sine</td><td>half sine</td></tr>
<tr><td>Number of shocks per axis (positive and negative)</td><td>3 × 6 = 18</td><td>500 × 6 = 3000</td></tr>
</table>
</td>
</tr>
<tr>
<td>4.30
Water
Submersion.</td>
<td>The leakage current shall be ≤ 5 µA and no traces of water shall be visible inside the connector.</td>
<td>For mat type cable seals, insert and remove the terminal from its cavity twice.
Test samples: Mated connector pairs fitted with all terminals and the smallest and largest wires size.
3 pairs with largest wire size
4 pairs with smallest wire size
3 pairs mixed with smallest, largest and not used cavities.

Number of Test samples: 10 pairs

Heat test samples to rated high temperature of connection system for 30 min. Immerse the test sample (mated sealed connectors) immediately after preconditioning in (+23 ± 5)ºC water to a depth of 100 mm for 1 h. With the test samples immersed in the liquid, record the leakage current measurements at 14 V between each terminal and the electrode. Also, record the leakage current measurements between every two adjacent terminals as shown in Figure 18. Complete the visual test per paragraph 4.1.
Figure 18: Water Submersion Setup


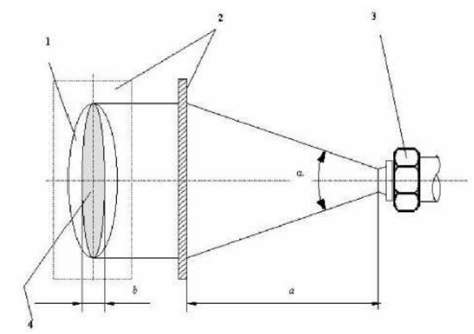
1, 2, 3 Test Points
4 Electrode
5 Test sample</td>
</tr>
<tr>
<td>4.31
High
Pressure
Spray.</td>
<td>All parts shall meet the isolation resistance acceptance criteria specified in paragraph 4.20. Upon examination of the interior of the electrical connection system, no traces of water shall be visible inside the connector. All parts shall meet the visual examination acceptance criteria specified in paragraph 4.1.</td>
<td>Prepare complete test samples fitted with all terminals, seals, TPA’s and grommets or shields intended for the production application. For mat type cable seals, insert and remove the terminal from its cavity twice.
Test samples: Mated connector pairs fitted with all terminals and the smallest and largest wires size.

Number of Test samples: 10 pairs
3 pairs with largest wire size
4 pairs with smallest wire size
3 pairs mixed with smallest, largest and not used cavities.

Mount the test samples on the support and rotate it at (5 ± 1)</td>
</tr>
</table>

revolutions per minute, and subject them to the high pressure water jet for 30s in each of the positions 1 to 4 as in Figure 20. The distance between the nozzle aperture and the reference points on the test sample shall be (125 ± 25) mm, see in Figure 20.

Figure 19: Nozzle and jet dimensions

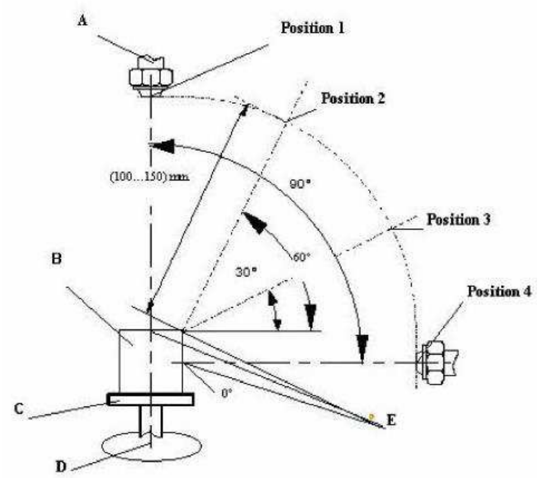


1 Scatter area
2 Measuring area
3 Nozzle
4 Jet
α, a, b See Table 21.

Table 21: Dimensions

α	a	b
°	mm	mm
30 ± 5	100	8 ± 2
30 ± 5	150	10 ± 2

Figure 20: Test Arrangement



A Nozzle
B Test sample
C Support
D Rotating axis
E Reference points (0º, 30º, 60º and 90º)
Thoroughly dry the exterior of the parts in ambient air

4.32 **Fluid Resistance.**	At the conclusion of this test: Each mated terminal pair in every test sample shall meet the Acceptance Criteria of the Isolation Resistance test, paragraph 4.20, the locked connector – disengage force, paragraph 4.14 and the terminal from connector extraction force, paragraph 4.9. There shall be no visible degradation, swelling, cracking, or loss of mechanical function evident on	Prepare complete test samples fitted with all terminals and the smallest wire size. For mat type cable seals, insert and remove the terminal from its cavity twice. Test samples: Mated connector pairs. Number of Test samples: 2 pairs Using the smallest conductor size and insulation type for the terminals to be used in the intended application, machine crimp test samples until one meets the crimp height, crimp width, and tensile strength requirements of the applicable crimp specification or as required by the manufacturer of the terminal

<table>
<tr>
<td></td>
<td>any test sample, examined with ta suitable magnification (10 ... 40) x.</td>
<td>system being used for the test. Using that crimp setting, machine crimp enough test samples of male and female terminals to assemble a minimum of 20 pairs (at least 20 male and 20 female) of connector assemblies. Crimp both the conductor and insulation grips. Assemble insulation displacement style terminals per their manufacturer's recommended assembly criteria. For Header type connectors, prepare test samples only for the mating connector.
Assemble a minimum of 20 pairs of fully populated connectors (at least 20 male and 20 female connector halves) using the terminals prepared in Step 1 above. Assembly must include all applicable wedges (TPAs, PLRs, etc.), seals, etc. Number each mated connector pair.
Completely mate and unmate each connector pair a total of 10× per paragraph. Verify conformance of each mated test sample connector assembly to visual examination and to the Isolation Resistance test, paragraph 4.1.7. This establishes a reference for the concluding Isolation Resistance test. Completely submerse at least 2 test samples in each fluid listed in Table 22 for 60 min., exception for Battery acid (immerse it 3 times within 1 min). Fluids are to be stabilized at the temperatures indicated. 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.
Caution: Follow all Federal, state, and local safety regulations, standards, and procedures when performing this test.
Note: Depending on the specific application, additional fluids may be required. At the conclusion of the submersion period, remove the test sample from the fluid.
Caution: Do NOT shake off any excess fluid. Use care not to splash any fluid on unintended surfaces. Leave the test samples "wet" and store them in a suitable container or area 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.
At the conclusion of the storage period, test samples may be dried sufficiently to allow inspection and to avoid contamination of test apparatus.
Table 22: Fluids
<table>
<tr><th>Fluid</th><th></th><th>Temperature
ºC</th></tr>
<tr><td>Brake Fluid</td><td>L 000 0102</td><td>+50</td></tr>
<tr><td>Oil</td><td>B 042 0900</td><td>+85</td></tr>
<tr><td>Gasoline</td><td>GME L0003</td><td>+25</td></tr>
<tr><td>Engine Coolant</td><td>B 040 1065</td><td>+100</td></tr>
<tr><td>Automatic Transmission Fluid</td><td>B 040 1073</td><td>+85</td></tr>
<tr><td>Commercial Windshield Washer Solvent</td><td>2</td><td>+25</td></tr>
<tr><td>Power Steering Fluid</td><td>B 040 2012</td><td>+50</td></tr>
<tr><td>Diesel Fluid</td><td>EN 590</td><td>+25</td></tr>
<tr><td>E85 Ethanol Fuel</td><td>85 % Ethanol + 15 %
GME L0003</td><td>+25</td></tr>
<tr><td>Battery Acid</td><td>25 vol % H2S04 dens. 1.28</td><td>+23</td></tr>
</table>
</td>
</tr>
<tr>
<td>4.34
Terminal Bend Resistance.</td>
<td>The TUT must not tear when subjected to the applied force for 15 sec. If the TUT was bent from its original position during the test, it must not tear or crack when straightened to its original position.</td>
<td>1 From Figure 21, determine which design style most closely resembles the terminal under test (TUT).
2 Prepare terminal samples per section 3.2, Terminal Sample Preparation, using the smallest gage size conductor with the thinnest insulation applicable to the design of the terminal to be tested. For Style "A" terminals, prepare a total of at least 15 samples. For Style "B" terminals, prepare a minimum of 30 terminals, in order to test both bend locations.
3 Repeat Step 2 except use the largest conductor gage size with the thickest insulation applicable to the design.
4 Number each terminal. (Note 4)Use at least 5 new samples for each test sequence (Steps 6 - 9).</td>
</tr>
</table>

5 Mount the TUT in a fixture taking care that location "1" is positioned as shown in Figure 22.
6 Apply force to the sample as shown in Figure 22 for 15 seconds, then release. The required forces by material thickness are listed in Table 23.
7 Inspect the area around the bend using at least 10X magnification. Note in the test report any signs of metal cracking or tearing. Straighten the terminal to its original position and re-inspect the terminal for cracks.
8 Select a new batch of at least 5 samples and mount them in the test fixture with the terminal rotated 180o from the position shown in Figure 22. Repeat Steps 5-7.
9 Select a new batch of at least 5 samples and mount them in the test fixture with the terminal rotated 90o from the position shown in Figure 22. Repeat Steps 5-7. Since terminals are typically symmetrical in this "side to side’’ direction, it is not necessary to test both directions. If the TUT is not symmetrical in this direction, it may be necessary to test both ways. Consult the Authorized Person for guidance in this regard.
10 For terminal style "B" designs (Figure 21), repeat Steps 5 - 9 with each TUT mounted such that location "2" is firmly retained at the edge of the fixture.

Figure 21: Terminal Design Style

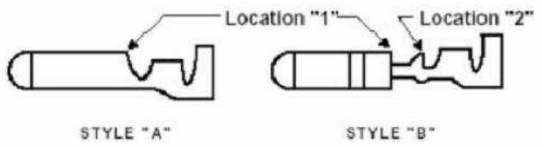


Figure 22: Terminal Bend Test

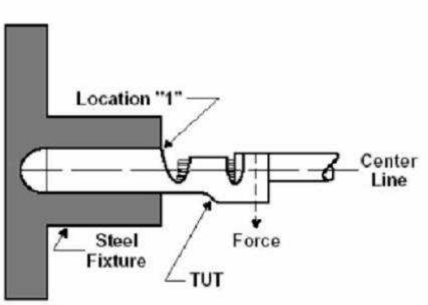


Table 23: Material Thickness Vs. Applied Bending Force

Terminal Material Thickness (mm)	Applied Force
≤ 0.20	4.0
≤ 0.30	10.0
≤ 0.40	15.0
> 0.40	20.0

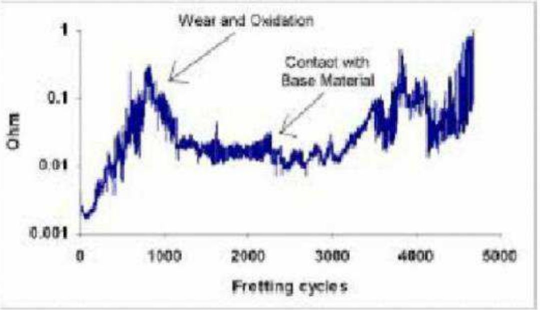
4.35 Pressure /Vacuum Leak.

1 When samples are subjected to positive pressure, there must be no loss in the applied pressure and no bubbles visible exiting any test sample.
2 After samples are subjected to negative pressure (vacuum), all must meet the Acceptance Criteria of the Isolation Resistance test, Section 4.20.4.
3 At the conclusion of the test, all samples must meet the Acceptance Criteria of the Visual Inspection test, Section 4.1.8. When disconnecting the samples, use care not to allow any

Note: When using samples that have been subjected to any prior testing that includes the Temperature/ Humidity Cycling test, Section 4.24 or High Temperature Exposure test, section 4.22, proceed directly to Step 18. This assumes that the samples have already been prepared with vacuum tubes per steps 1 through 17.
1 Refer to section 3.2 and prepare leads using the smallest conductor size and insulation type appropriate to the terminal and connector under test. Crimp enough samples of male and Female Terminals to assemble a minimum of 10 pairs of connector assemblies, less one cavity for each connector pair. Crimp both the conductor and insulation grips.
2 For convenience, and to minimize loose conductor ends, conductor lengths may be terminated on both ends and looped between samples.
3 Using the terminals prepared in Step 1, assemble a minimum of

	residual solution to enter the interior of any connector half. Careful examination is required to detect any trace of fluid Leakage that escaped detection by the Isolation Resistance test. There should be no trace of fluid ingress in the connector at the conclusion of this test.	10 pairs of fully populated connectors, leaving one conveniently located cavity open in each connector pair. Determination of which connector half has the vacant cavity will have been determined in Step 1. Assembly must include all applicable Wedges (TPAs, PLRs, seals, etc). Number each mated connector pair. **4** For multiple conductor (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. (Not required if previously done on this sample set.) **5** Into the one open cavity in each connector pair, insert a tube of sufficient diameter and wall strength to ensure that there is not a possible leak path between the outer tube surface and the conductor seal. Be sure the tube is inserted far enough to engage the full sealing capability of the conductor seal. After completing Steps 6 and 7 below, connect the free end of the tube to a regulated pressure source. Alternative methods of adding a pressure/ vacuum port are acceptable as long as the integrity of the part is not compromised. **6** Complete the Connector and/or Terminal Cycling procedure per section 4.13 if not already performed on the sample set **7** Verify conformance of each mated sample connector assembly to the Isolation Resistance test, Section 4.20.5. This establishes a reference for the concluding Isolation Resistance test. **8** Prepare enough salt water solution to completely submerse all samples to a depth of 30- 40 cm below the surface. Use tap water and 15-16 grams of table salt per liter. 10 ml of liquid dish washing soap per liter of water may be added. Mix well before adding to test apparatus. It is recommended that an appropriate ultraviolet dye be added to assist in visual inspection for any ingress of solution into the test samples. **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 seal(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. **10** Completely submerse all samples into a container of the Room Temperature salt water solution prepared in Step 8 above. Use care to avoid submersing any wire ends or the open end of the tube. **11** Slowly increase the air pressure of the regulated pressure source supplying the tube in each sample until the gage 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 48 KPa (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 perform the Isolation

		Resistance test of Section 4.20. **16** Disconnect each mated sample pair and perform the Visual Inspection test of Section 3.2. When disconnecting the samples, use care not to allow any residual solution to enter the interior of any connector half. Careful examination is required to detect any trace of fluid leakage that escaped detection by the Isolation Resistance test. **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 Temperature Class selected from Table 1 for the CUT. 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, then repeat steps 9 - 15, except limit pressure in Step 11, and vacuum in Step 13, to 28 KPa (4 psig). **19** Verify conformance of all test samples to the Acceptance Criteria of Section 4.35.4. **20** SPECIAL TEST for connectors with multi-cavity (mat) type conductor seals. This test is not applicable to single cavity connector designs. This is an additional test and requires use of new samples. Its purpose is to check for seal distortion from extremes of conductor size that may produce a leak. **a** Repeat Step 1, except prepare one male and one Female Terminal (smallest conductor size) for each connection pair to be tested. **b** Repeat Step 1 except use the largest conductor size and insulation type for the terminals to be used in the intended application. Prepare only enough terminal samples to fully populate all connector pairs, less one cavity for each connector half and less the one cavity left open for the pressure/vacuum tube. **c** Prepare a minimum of 10 connector pairs so that all but one randomly selected cavity in each connector half is populated with a terminal crimped to the largest conductor size, prepared in Step b above. Leave one cavity in each connector pair open for the pressure/ vacuum tube, as directed in Step 1. Then fill the remaining cavity in each connector half with the appropriate terminal crimped to the smallest conductor size, prepared in Step a above. Unless the size of the connector makes it impossible, do not place the smallest conductor in a cavity adjacent to the pressure/vacuum tube. Number each connector pair. **d** Repeat Steps 4 through 19 using the samples prepared in Step c above.
4.36 **Forced Fretting** **Test.**	**1** The test requestor may determine the Dry Circuit resistance Acceptance Criteria as well as any additional Acceptance Criteria such as visual examination of the interface.	**1** At least 8 samples of male and Female Terminal should be tested. Set up the terminal holding device so that there is at least 1.0mm of over-travel from the end of the Male Terminal lead-in past the contact point of the Female Terminal. Terminals must be positioned so that testing begins at the nominal contact point of the interface. **2** Record initial Dry Circuit Resistance of each sample. Contact resistance data must be taken throughout the procedure. **3** Set the equipment to the following: Stroke — 50 µm Frequency — 1 Hz. Higher frequencies are permissible depending on equipment capability. Cycles — 100K or sufficient to reach a defined failure (total cycles depends on the system being evaluated) Alternative settings and equipment may be determined by the test requestor. Frequency and stroke can have major effects on the outcome of the test. **4** Turn on the equipment and complete the test cycle. **5** Plot the resistance vs. fretting cycles for each sample.

		(ref. Figure 24) **6** Following the test cycle, measure the Dry Circuit resistance of each interface. **7** Visual examination of the interface may be requested. If so, photograph and document the wear characteristics of the interface including SEM analysis if applicable. **Figure 24: Example Forced Fretting Resistance Curve of a Tin Contact** 

3.5. Applied Part No List

TE Part no	Description
1743695-2	HOOD S/W SLD 2P PLUG ASSY