Report Title:	FUSE AND RELAY BOX ASSY IEC
Report Number:	RL150081
Revision:	O
Date Issued	08 Jun 2015
Execution:	Jesus Preto
Phone:	11 3404-6270
Requestor:	Natanael Santos
Phone:	11 3404-6225
Address:	nmsantos@te.com
Disposition of Samples:	Retain in Lab
List of Part Numbers:	2819051-1

Scope/Abstract and Conclusions

Purpose

PV phase according to attached DVP&R.

Summary

Samples met requirements.

1. RESULTS

Test Sequence/ Environment	Requirements	Results
Group 0 - Cross Section Inspection	A summary of each component's condition shall be documented and reported to the GM ENV SME or CVE. GM Engineering will evaluate the reports and decide as to the necessity of corrective action.	Samples met requirements.
Group 0 - Visual Inspection and Dissection	There shall be no corrosion, discoloration, cracks, etc., which could affect the functionality of the part.	Samples met requirements.
Group 0 - Thermal Cycle Profile Development	N/A	Definition of cycle Temperature x current - This definition occurred in accordance between General Motors and TE. Accomplished on DV phase.
Group 0 - Vibration Transmissibility Demonstration	Item 6.8 GMW 3172 (Rev. Nov/2012).	Samples met requirements. Please see Magneti Marelli's test report Nr. DFI013/14. Accomplished on DV phase.

<table>
<tr><th>Test Sequence/ Environment</th><th>Requirements</th><th>Results</th></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Group 1 - 5-Point Functional/Parametric Check (Voltage Drop)</td><td>Functional Status Classification shall be A.</td><td>Initial measurements. Samples numbers PV 6 to PV 11.

<table>
<tr><th rowspan="2">Position</th><th colspan="3">Voltage Drop [mV]</th></tr>
<tr><th>Min.</th><th>Aver.</th><th>Max.</th></tr>
<tr><td>F1</td><td>6,854</td><td>7,015</td><td>7,155</td></tr>
<tr><td>F7</td><td>4,326</td><td>4,480</td><td>4,689</td></tr>
<tr><td>F10</td><td>6,453</td><td>6,687</td><td>6,895</td></tr>
<tr><td>F11</td><td>59,486</td><td>62,197</td><td>64,298</td></tr>
<tr><td>F12</td><td>13,242</td><td>13,920</td><td>14,321</td></tr>
<tr><td>F13</td><td>8,052</td><td>8,178</td><td>8,274</td></tr>
<tr><td>F14</td><td>11,539</td><td>11,764</td><td>12,008</td></tr>
<tr><td>F15</td><td>14,779</td><td>15,301</td><td>15,951</td></tr>
<tr><td>F16</td><td>7,980</td><td>8,124</td><td>8,290</td></tr>
<tr><td>F17</td><td>4,191</td><td>4,220</td><td>4,256</td></tr>
<tr><td>F19</td><td>4,105</td><td>4,271</td><td>4,356</td></tr>
<tr><td>F20</td><td>7,970</td><td>8,070</td><td>8,154</td></tr>
<tr><td>F22</td><td>4,285</td><td>4,399</td><td>4,483</td></tr>
<tr><td>F25</td><td>11,161</td><td>11,501</td><td>11,734</td></tr>
<tr><td>F26</td><td>7,747</td><td>7,967</td><td>8,136</td></tr>
<tr><td>F28</td><td>14,539</td><td>14,919</td><td>15,137</td></tr>
<tr><td>F30</td><td>23,898</td><td>27,808</td><td>30,451</td></tr>
<tr><td>F31</td><td>11,214</td><td>11,460</td><td>11,756</td></tr>
<tr><td>F33</td><td>15,522</td><td>15,966</td><td>16,350</td></tr>
<tr><td>F34</td><td>14,779</td><td>15,301</td><td>15,951</td></tr>
<tr><td>F35</td><td>7,123</td><td>7,615</td><td>8,040</td></tr>
<tr><td>F37</td><td>16,028</td><td>16,410</td><td>16,923</td></tr>
<tr><td>F39</td><td>15,173</td><td>15,509</td><td>15,852</td></tr>
<tr><td>F40</td><td>16,007</td><td>16,455</td><td>16,822</td></tr>
<tr><td>F52</td><td>4,660</td><td>5,125</td><td>5,916</td></tr>
<tr><td>F54</td><td>14,251</td><td>14,565</td><td>15,212</td></tr>
</table>

Samples met requirements.</td></tr>
<tr><td>Group 1 - High Temperature Degradation</td><td>Functional Status Classification shall be A.</td><td>Samples met requirements.</td></tr>
</table>

<table>
<tr><th>Test Sequence/ Environment</th><th>Requirements</th><th>Results</th></tr>
<tr><td>Group 1 - Mechanical Shock - Pothole 25G</td><td>Functional Status Classification shall be A. Additionally, during the Visual Inspection and Dissection – DRBTR, there shall be no evidence of structural damage to the component.</td><td>Samples met requirements.
Please see Smarttech’s test report Nr. 015099.</td></tr>
<tr><td>Group 1 - Vibration with Thermal Cycling (For Car sprung Masses)</td><td>Functional Status Classification shall be A. Additionally, during the Visual Inspection and Dissection – DRBTR, there shall be no evidence of structural damage to the component.</td><td>Samples met requirements.
Please see Smarttech’s test report Nr. 015099.</td></tr>
<tr><td>Group 1 - 5-Point Functional/Parametric Check (Voltage Drop)</td><td>Functional Status Classification shall be A.</td><td>Final measurements. Samples numbers PV 6 to PV 11.
<table>
<tr><th rowspan="2">Position</th><th colspan="3">Voltage Drop (mV)</th></tr>
<tr><th>Min.</th><th>Aver.</th><th>Max.</th></tr>
<tr><td>F1</td><td>7,101</td><td>8,177</td><td>9,124</td></tr>
<tr><td>F7</td><td>5,069</td><td>5,769</td><td>6,810</td></tr>
<tr><td>F10</td><td>7,782</td><td>8,465</td><td>9,039</td></tr>
<tr><td>F11</td><td>59,788</td><td>62,757</td><td>64,593</td></tr>
<tr><td>F12</td><td>16,496</td><td>17,362</td><td>18,321</td></tr>
<tr><td>F13</td><td>8,835</td><td>9,451</td><td>10,201</td></tr>
<tr><td>F14</td><td>12,030</td><td>12,888</td><td>15,287</td></tr>
<tr><td>F15</td><td>18,769</td><td>23,542</td><td>29,610</td></tr>
<tr><td>F16</td><td>8,404</td><td>9,392</td><td>10,408</td></tr>
<tr><td>F17</td><td>4,957</td><td>5,334</td><td>5,940</td></tr>
<tr><td>F19</td><td>4,840</td><td>5,358</td><td>6,265</td></tr>
<tr><td>F20</td><td>8,440</td><td>8,757</td><td>9,065</td></tr>
<tr><td>F22</td><td>4,734</td><td>5,701</td><td>8,810</td></tr>
<tr><td>F25</td><td>11,748</td><td>12,574</td><td>14,310</td></tr>
<tr><td>F26</td><td>8,229</td><td>8,796</td><td>9,442</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Test Sequence/ Environment</th><th>Requirements</th><th>Results</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><td>F28</td><td>15,203</td><td>15,974</td><td>16,861</td></tr>
<tr><td>F30</td><td>26,763</td><td>31,377</td><td>34,752</td></tr>
<tr><td>F31</td><td>11,980</td><td>13,316</td><td>15,028</td></tr>
<tr><td>F33</td><td>17,528</td><td>18,328</td><td>19,241</td></tr>
<tr><td>F34</td><td>18,769</td><td>23,542</td><td>29,610</td></tr>
<tr><td>F35</td><td>9,132</td><td>10,987</td><td>13,013</td></tr>
<tr><td>F37</td><td>17,615</td><td>18,651</td><td>20,705</td></tr>
<tr><td>F39</td><td>16,682</td><td>18,181</td><td>21,425</td></tr>
<tr><td>F40</td><td>17,044</td><td>19,378</td><td>23,322</td></tr>
<tr><td>F52</td><td>6,817</td><td>8,176</td><td>10,924</td></tr>
<tr><td>F54</td><td>22,159</td><td>24,833</td><td>29,810</td></tr>
</table>
Samples met requirements.
</td></tr>
<tr><td>Group 1 - Visual Inspection and Dissection</td><td>There shall be no corrosion, discoloration, cracks, etc., which could affect the functionality of the part.</td><td>Samples met requirements.</td></tr>
<tr><td>Group 6 - Connector Test - GMW-3191 (For connector 2w</td><td>Terminal Push-out Force. Normal condition > 90 N.</td><td>
<table>
<tr><th rowspan="2">Sample</th><th colspan="2">Terminal Extraction Force [N]</th></tr>
<tr><th>Way 1</th><th>Way 2</th></tr>
<tr><td>PV C6</td><td>152,0</td><td>156,5</td></tr>
<tr><td>PV C7</td><td>187,5</td><td>202,5</td></tr>
<tr><td>PV C8</td><td>194,0</td><td>194,5</td></tr>
<tr><td>PV C9</td><td>168,5</td><td>162,0</td></tr>
<tr><td>PV C10</td><td>219,5</td><td>200,0</td></tr>
<tr><td>Min.</td><td>152,0</td><td>156,5</td></tr>
<tr><td>Aver.</td><td>184,3</td><td>183,1</td></tr>
<tr><td>Max.</td><td>219,5</td><td>202,5</td></tr>
</table>
Samples met requirements.
</td></tr>
</table>

<table>
<tr><th>Test Sequence/ Environment</th><th>Requirements</th><th>Results</th></tr>
<tr><td></td><td>Terminal Push-out Force.
After exposure to temperature and humidity > 110N.</td><td>
<table>
<tr><th rowspan="2">Sample</th><th colspan="2">Terminal Extraction Force [N]</th></tr>
<tr><th>Way 1</th><th>Way 2</th></tr>
<tr><td>PV C1</td><td>161,0</td><td>161,5</td></tr>
<tr><td>PV C2</td><td>187,0</td><td>196,5</td></tr>
<tr><td>PV C3</td><td>195,5</td><td>194,5</td></tr>
<tr><td>PV C4</td><td>166,0</td><td>157,0</td></tr>
<tr><td>PV C5</td><td>175,0</td><td>166,5</td></tr>
<tr><td>Min.</td><td>161,0</td><td>157,0</td></tr>
<tr><td>Aver.</td><td>176,9</td><td>175,2</td></tr>
<tr><td>Max.</td><td>195,5</td><td>196,5</td></tr>
</table>
Samples met requirements.
</td></tr>
<tr><td></td><td>Connector-to-Connector Engagement Force < 75N.</td><td>
<table>
<tr><th>Sample</th><th>Connector-to-Connector Engagement Force [N]</th></tr>
<tr><td>PV C1</td><td>73,0</td></tr>
<tr><td>PV C2</td><td>48,0</td></tr>
<tr><td>PV C3</td><td>54,5</td></tr>
<tr><td>PV C4</td><td>45,5</td></tr>
<tr><td>PV C5</td><td>55,0</td></tr>
<tr><td>PV C6</td><td>72,0</td></tr>
<tr><td>PV C7</td><td>45,5</td></tr>
<tr><td>PV C8</td><td>48,5</td></tr>
<tr><td>PV C9</td><td>40,5</td></tr>
<tr><td>PV C10</td><td>41,5</td></tr>
<tr><td>Min</td><td>40,5</td></tr>
<tr><td>Aver.</td><td>52,4</td></tr>
<tr><td>Max.</td><td>73,0</td></tr>
</table>
Samples met requirements.
</td></tr>
</table>

<table>
<tr><th>Test Sequence/ Environment</th><th>Requirements</th><th>Results</th></tr>
<tr><td></td><td>Locked Connector Disengagement Force > 120N.</td><td>
<table>
<tr><th>Sample</th><th>Locked Connector Disengagement [N]</th></tr>
<tr><td>PV C31</td><td>184,5</td></tr>
<tr><td>PV C32</td><td>195,5</td></tr>
<tr><td>PV C33</td><td>215,0</td></tr>
<tr><td>PV C34</td><td>183,5</td></tr>
<tr><td>PV C35</td><td>189,0</td></tr>
<tr><td>PV C36</td><td>201,0</td></tr>
<tr><td>PV C37</td><td>185,0</td></tr>
<tr><td>PV C38</td><td>176,5</td></tr>
<tr><td>PV C39</td><td>206,5</td></tr>
<tr><td>PV C40</td><td>190,0</td></tr>
<tr><td>Min.</td><td>176,5</td></tr>
<tr><td>Aver.</td><td>192,7</td></tr>
<tr><td>Max.</td><td>215,0</td></tr>
</table>
Samples met requirements.
</td></tr>
<tr><td></td><td>Unlocked Connector Disengagement Force < 100N.</td><td>
<table>
<tr><th>Sample</th><th>Unlocked Connector Disengagement Force [N]</th></tr>
<tr><td>PV C1</td><td>42,5</td></tr>
<tr><td>PV C2</td><td>37,0</td></tr>
<tr><td>PV C3</td><td>35,0</td></tr>
<tr><td>PV C4</td><td>38,0</td></tr>
<tr><td>PV C5</td><td>43,0</td></tr>
<tr><td>PV C6</td><td>36,0</td></tr>
<tr><td>PV C7</td><td>39,5</td></tr>
<tr><td>PV C8</td><td>42,5</td></tr>
<tr><td>PV C9</td><td>46,0</td></tr>
<tr><td>PV C10</td><td>34,5</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Test Sequence/ Environment</th><th>Requirements</th><th>Results</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><td>Min</td><td>34,5</td></tr>
<tr><td>Aver.</td><td>39,4</td></tr>
<tr><td>Max.</td><td>46,0</td></tr>
</table>
Samples met requirements.
</td></tr>
<tr><td>Group 6 - Visual Inspection and Dissection</td><td>There shall be no corrosion, discoloration, cracks, etc., which could affect the functionality of the part.</td><td>Samples met requirements.</td></tr>
<tr><td>Group 8 - Fretting Corrosion</td><td>The resistance measured shall always meet the value as required by GMW3191 Dry Circuit Resistance acceptance criteria.</td><td>Please see Magneti Marelli’s test report Nr. DFI003/15.
Initial
<table>
<tr><th rowspan="2">Sample</th><th colspan="2">Voltage drop [mv]</th></tr>
<tr><th colspan="2">Way</th></tr>
<tr><th></th><th>A</th><th>B</th></tr>
<tr><td>PV1</td><td>10,783</td><td>11,356</td></tr>
<tr><td>PV2</td><td>10,648</td><td>10,458</td></tr>
<tr><td>PV3</td><td>10,711</td><td>10,434</td></tr>
<tr><td>PV4</td><td>10,539</td><td>10,594</td></tr>
<tr><td>PV5</td><td>10,470</td><td>10,508</td></tr>
</table>
After 1st vibration (4h)
<table>
<tr><th rowspan="2">Sample</th><th colspan="2">Voltage drop [mv]</th></tr>
<tr><th colspan="2">Way</th></tr>
<tr><th></th><th>A</th><th>B</th></tr>
<tr><td>PV1</td><td>10,810</td><td>11,241</td></tr>
<tr><td>PV2</td><td>10,652</td><td>10,332</td></tr>
<tr><td>PV3</td><td>10,695</td><td>10,564</td></tr>
<tr><td>PV4</td><td>10,548</td><td>10,623</td></tr>
<tr><td>PV5</td><td>10,374</td><td>10,499</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Test Sequence/ Environment</th><th>Requirements</th><th>Results</th></tr>
<tr><td></td><td></td><td>
After Humidity exposure
<table>
<tr><th rowspan="2">Sample</th><th colspan="2">Voltage drop [mv]
Way</th></tr>
<tr><th>A</th><th>B</th></tr>
<tr><td>PV1</td><td>10,851</td><td>11,126</td></tr>
<tr><td>PV2</td><td>10,684</td><td>10,541</td></tr>
<tr><td>PV3</td><td>10,701</td><td>10,489</td></tr>
<tr><td>PV4</td><td>10,459</td><td>10,758</td></tr>
<tr><td>PV5</td><td>10,412</td><td>10,387</td></tr>
</table>
Final measurement after 2nd vibration (4h)
<table>
<tr><th rowspan="2">Sample</th><th colspan="2">Voltage drop [mv]
Way</th></tr>
<tr><th>A</th><th>B</th></tr>
<tr><td>PV1</td><td>10,873</td><td>11,427</td></tr>
<tr><td>PV2</td><td>10,793</td><td>10,411</td></tr>
<tr><td>PV3</td><td>10,751</td><td>10,470</td></tr>
<tr><td>PV4</td><td>10,478</td><td>10,772</td></tr>
<tr><td>PV5</td><td>10,286</td><td>10,455</td></tr>
</table>
Samples met requirements.
</td></tr>
<tr><td>Group 10 - Shipping vibration</td><td>Functional Status Classification shall be C. Additionally, during the Visual Inspection and Dissection – DRBTR, there shall be no external visible damage to any of the components. And there shall be no internal damage to the 6 selected components that were functionally tested.</td><td>Samples met requirements. Please see Smarttech’s test report Nr. 014900-1.</td></tr>
</table>

Test Sequence/ Environment	Requirements	Results
Group 10 - Visual Inspection and Dissection	There shall be no corrosion, discoloration, cracks, etc., which could affect the functionality of the part.	Samples met requirements.

2. SAMPLE & WIRE DESCRIPTION

The Certification of Conformance (C of C), submitted with the test request, lacked the necessary information to verify the samples tested. Therefore the Test Lab cannot verify that the samples have been produced, inspected, and accepted as conforming to product drawing requirements, and made using the same core manufacturing processes and technologies as production or parts.

2.1. Group / Samples

Group	Part Number	Rev.	Date Code	Sample Description	Quantity Tested
0	2819051-1	1	N/A*	FUSE AND RELAY BOX ASSY IEC Samples numbers 1 to 3.	3
1	2819051-1	1	N/A*	FUSE AND RELAY BOX ASSY IEC Samples numbers PV 6 to PV 11.	6
6	2819051-1	1	N/A*	FUSE AND RELAY BOX ASSY IEC Samples numbers PV 12 to PV 21.	10
6	2819052-1	1	N/A*	2 WAYS CONNECTOR Nr. PV C1 to PV C10 and C31 to C40.	20
8	2819051-1	1	N/A*	FUSE AND RELAY BOX ASSY IEC Samples numbers PV 1 to PV 5.	5
10	2819051-1	1	N/A*	FUSE AND RELAY BOX ASSY IEC Samples numbers PV 22 to PV 61.	40

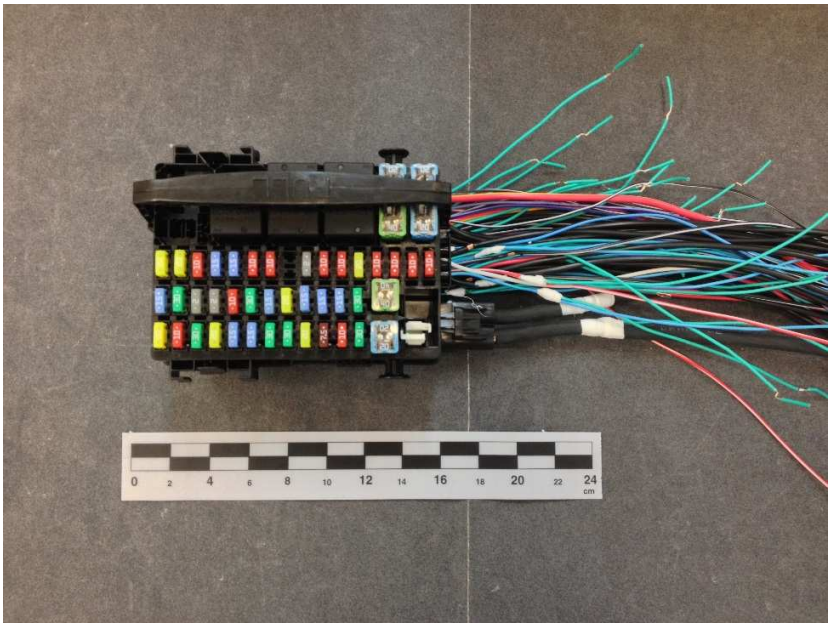
* Information either unavailable or not provided by requestor.

2.2. Wire Information

Group Number	Wire Gage	Overall Diameter	Strand Diameter	Number of Strands
All Groups	0,35 mm²	1,3	0,18	12
	0,5 mm²	1,5	0,18	16
	0,75 mm²	1,8	0,18	24
	1 mm²	2	0,18	32
	1,5 mm²	2,3	0,23	30
	2,5 mm²	2,8	0,23	50
	4 mm²	3,5	0,28	60

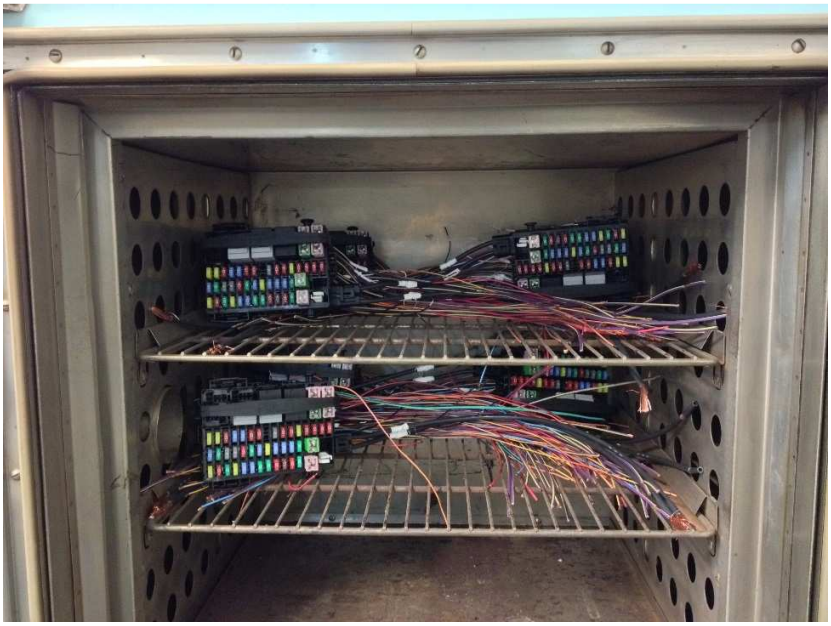
3. SAMPLE PREPARATION

3.1. Sample identification



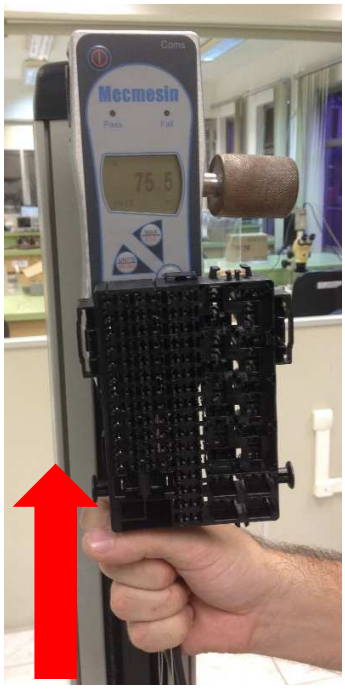
IEC FUSE AND RELAY BOX ASSY

3.2 High Temperature degradation

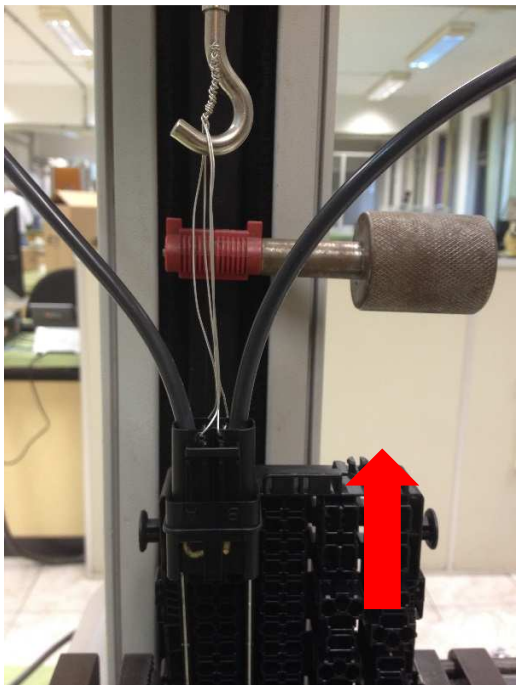


Samples inside the chamber for high temperature degradation exposure

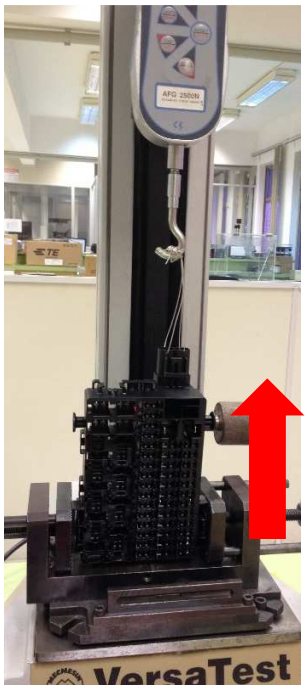
3.3 Connector Test - GMW-3191 (For connector 2w)



Connector-to-Connector Engagement Force



Unlocked Connector Disengagement Force



Locked Connector disengagement force

3.4 Fretting Corrosion

Samples under fretting corrosion test

3.5 Shipping vibration

Samples inside box under shipping vibration test

3.6 Mechanical Shock - Pothole 25G and Vibration with Thermal Cycling

Samples mounted in the fixture for mechanical shock and vibration tests.

4 TEST PROCEDURE

4.1 Cross Section Inspection
According to GMW 3172 (Rev. Nov/2012) item 6.6.

4.2 Visual Inspection and Dissection
According to GMW 3172 (Rev. Nov/2012) item 6.5.

4.3 1-Point Functional/Parametric Check (Voltage Drop)
According to GMW 3172 (Rev. Nov/2012) item 6.1, measurements accomplished at room temperature using 1A. Circuits selected by TE engineering. The same circuits mentioned in the item Results.

4.4 High Temperature Degradation
According to GMW 3172 (Rev. Nov/2012) item 9.4.1; 500 hours at 85ºC.

4.5 Connector Test - GMW-3191 (For connector 2w)
- Terminal Push-out Force -Item 4.5.2.5 GMW 3191.
- Connector-to-Connector Engagement Force – Item 4.2.8.2 GMW 3191.
- Locked Connector Disengagement Force – Item 4.2.18.5 GMW 3191.
- Unlocked Connector Disengagement Force – Item 4.2.19.5 GMW 3191.

4.6 Mechanical Shock - Pothole 25G
According to GMW 3172 (Rev. Nov/2012) item 9.3.2. Test accomplished in Smarttech's laboratory. Please see Smarttech's test report Nr. 015099.

4.7 Fretting Corrosion
According to GMW 3172 (Rev. Nov/2012) item 9.3.11. Test accomplished in Magneti Marelli's laboratory. Please see Magneti Marelli's test report Nr. DFI003/15.

4.8 Vibration with Thermal Cycling (For Car sprung Masses)
According to GMW 3172 (Rev. Nov/2012) item 9.3.1.2. Test accomplished in Smarttech's laboratory. Please see Smarttech's test report Nr. 015099.

4.9 Shipping Vibration
According to GMW 3172 (Rev. Nov/2012) item 9.3.1.2. Test accomplished in Smarttech's laboratory. Please see Smarttech's test report Nr. 014900-1.

5 TEST EQUIPMENT

All equipment containing a calibration number is calibrated and traceable through TE to the National Institute of Standards and Technology (NIST).

Instrument Description	Manufacturer	Model Number	Calibration Number	Purpose
Dynamometer	Mecmesin	AFG 2500N	92-339017-090	- Connector Test - GMW-3191 (For connector 2w) - Crush for Housing (Elbow Load).
Oven	Fanem	320E	92-339031-1231	- High Temperature Degradation. - Over load – fuse protect circuits.
DC Power Supply	GW Laboratory	GPR-1810	93-339033-726	- 5-Point Functional/ Parametric Check (Voltage Drop) - Fretting Corrosion
Digital Multimeter	Hewlett Packard	34401A	93-339033-024	- 5-Point Functional/ Parametric Check (Voltage Drop) - Fretting Corrosion
Humidity chamber	ACS	DCTC 1300	92-339032-009	Connector Test - GMW-3191 (For connector 2w)

6 APPROVALS

Approvals are secured electronically through the corporate document repository routing and approval system.

Testing & Report By: Jesus Preto, Laboratory Engineer

Reviewed & Approved By: Paulo Almeida, Laboratory Coordinator