# Reliability Test Report

**Part Type:** Transformer  
**M/A-Com Part Number:** MABACT0059  
**Platform:** Welded Ceramic Carrier  
**Test Laboratory:** SGS-CSTC Standards Technical Services Co. LTD., Shenzhen China.

**M/A-Com Part Numbers Qualified by Similarity:** All Welded ceramic carriers

## RELIABILITY TEST SUMMARY:

<table>
<thead>
<tr>
<th>TEST GROUP</th>
<th>DESCRIPTION</th>
<th>TEST METHOD</th>
<th>TEST PARAMETERS / COMMENTS</th>
<th>ED520 REF</th>
<th>SAMPLE SIZE</th>
<th>RESULT</th>
<th>REPORT SECTION</th>
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</thead>
<tbody>
<tr>
<td>TEST GROUP 1</td>
<td>Visual &amp; Dimensions</td>
<td>MIL-STD-883 Method 2009.9</td>
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<td>Resistance</td>
<td>MIL-STD-883 Method 2015.13</td>
<td>Perform at room temp</td>
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<td>Terminal Fatigue</td>
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<td>TEST GROUP 2</td>
<td>Steam Age (10 Units)</td>
<td>N/A</td>
<td>35°C, 95%RH, 108 Hrs</td>
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<td>Bake (10 Units)</td>
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<td>Solderability</td>
<td>MIL-STD-883 Method 2003.8</td>
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<td>Hi Temp Life</td>
<td>MIL-STD-883 Method 1008.2 COND A</td>
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<td>Thermal Shock</td>
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<td>0°C to 100°C, 100 cycles</td>
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<td>Solder Temp Shock</td>
<td>MIL-STD-750D Method 2031.2</td>
<td>260°C for 10 Seconds</td>
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<td>Salt Atmosphere</td>
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<td>Pressure Cooker</td>
<td>JESD22-A-102-C</td>
<td>121°C, 15PS, 90 Hrs</td>
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<td>Temp./Humidity</td>
<td>JESD22-A-101-III</td>
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<td>Lead Material &amp; Plating</td>
<td>Cross Section &amp; XRF</td>
<td>Substrate Part Drawing</td>
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<td>Glass Transition Temp (Tg)</td>
<td>ASTM D7028</td>
<td>Tg TEST</td>
<td>2.0.7</td>
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<td>This test is not applicable to ceramic carriers</td>
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<td>MABACT0059 Test File</td>
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<td></td>
<td>Vibration</td>
<td>MIL-STD-202 Method 201 Condition A</td>
<td>Freq: 10Hz to 55Hz Displacement 1.024mm Sweep Speed 1min/Cycle Orientation X,Y,Z axis Duration 2H/m</td>
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<td>Mechanical Shock</td>
<td>MIL-STD-202 Method 213B Condition A</td>
<td>Shock Wave Shape: Half Sine Acceleration 50g Pulse duration: 11ms Shock Times: 3 on each x, y, z</td>
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</table>
**Test Group 1**

1.1 Dimensional Analysis:

1.1.1 Test Purpose:
These measurements are to verify that the units meet the dimensional specifications outlined in the data sheet.

1.1.2 Test Method/Specification:
Refer to dimensional section of MABACT0059 data sheet

See Figure 1.1A

![Figure 1.1A - MABACT0059 specification.](image)

1.1.3 Measurement Results:
Sample(s) Description: MABACT0059

Quantity: 30 PCS

All 30 samples measured meet the data sheet dimensional specifications.

The measurement results can be seen in Figure 1.1B. Capability plots for each dimension are shown in Figure 1.1C.
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<th>SAMPLE #</th>
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<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
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Figure 1.1B – Dimensional results
Figure 1.1C – Capability Analysis
1.2 Solvent Resistance Test:


1.2.1 Test Purpose:
The purpose of this test is to verify that the markings will not become illegible on the component parts when subjected to solvents.

1.2.2 Test Method/Specification:

1.2.3 Appearance Inspection:
Appearance inspection performed before and after test.

1.2.4 Sample(s) Inspection before Test:
Sample(s) Description: MABACT0059
Quantity: 2 PCS (1#, 2#)
Appearance Inspection: No visual damage was found on samples before test. See Photo 1.2A.

1.2.5 Test Procedure:
Lab Environmental Conditions: Ambient temperature: 25±3°C, Relative humidity: 55±20%RH.

1.2.6 Test Result(s):
Standard’s failure criteria:
After subjection to the test, evidence of damage to the device and any specified markings which are missing in whole or in part, faded, smeared, blurred, or shifted (dislodged) to the extent that they cannot be readily identified from a distance of at least 15.0 cm (6 inches) with normal room lighting and without the aid of magnification or with a viewer having a magnification no greater than 3X shall constitute a failure.

Appearance Inspection: No visual damage was found on samples after test. See Photo 1.2B.

<table>
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<th>Sample Item</th>
<th>Sample No.</th>
<th>Appearance after test</th>
<th>Conclusion</th>
</tr>
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<td>MABACT0059</td>
<td>1#</td>
<td>No visible damage</td>
<td>Pass</td>
</tr>
<tr>
<td></td>
<td>2#</td>
<td>No visible damage</td>
<td>Pass</td>
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1.3 Terminal Fatigue Testing:


1.3.1 Test Purpose:
This test is designed to check the capabilities of the device solder pads to withstand a delamination (peel) stress of specified tension and time.

1.3.2 Test Method/Specification:
Refer to Mil-STD-883G Method 2004.5 condition D.
Test Condition:
- A minimum tension of 8 ounces (2.22 N) shall be applied, without shock, to each solder pad to be tested in a direction perpendicular to the solder pad surface and maintained for 30 seconds minimum.

Test Profile:

![Figure 1.3A · Solder pad adhesion](image)

1.3.3 Appearance Inspection:
Appearance inspection performed before and after test.

1.3.4 Sample(s) Inspection before Test:
Sample(s) Description: MABACT0059
Quantity: 5 PCS (3#~7#)
Appearance Inspection: No visual damage was found on samples before test. See Photo 1.3C.

1.3.5 Test Procedure:

Test Equipment:

**Name:** Testometric

**Model:** CMT6503

**Equipment No.:** 10611042

Lab Environmental Conditions: Ambient temperature: 25±3°C, Relative humidity: 55±20%RH.
1.3.6 Test Result(s):
Standard's failure criteria:
When examined, using 10X magnification, after removal of the tension stress, the appearance of any delamination involving constituent solder pad interfaces shall be considered an adhesion failure of the solder pad. Separation of the solder pad from the device is an obvious (without visual magnification) adhesion failure. Separation of the wire from the solder fillet (leaving the solder pad intact) or wire breakage is considered a test procedure failure.

<table>
<thead>
<tr>
<th>Sample Item</th>
<th>Sample No.</th>
<th>Appearance after test</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
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<td>MABA CT0059</td>
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<td>No visible damage</td>
<td>Pass</td>
</tr>
<tr>
<td></td>
<td>4#</td>
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<td>Pass</td>
</tr>
<tr>
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<td>5#</td>
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<td></td>
<td>6#</td>
<td>No visible damage</td>
<td>Pass</td>
</tr>
<tr>
<td></td>
<td>7#</td>
<td>No visible damage</td>
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</tr>
</tbody>
</table>

Photo 1.3C - Samples Before Test

Photo 1.3D - Samples After Test
Test Group 2

2.1 Steam Age Test:


2.1.1 Test Purpose:
The test aim is to verify the samples’ ability to resist the environment conditions.

2.1.2 Test Method/Specification:
Refer to client’s requirements.
  • Test Temperature: 35ºC
  • Test Humidity: 95%RH
  • Test Duration: 168hours

2.1.3 Appearance Inspection:
Appearance inspection performed before and after test.

2.1.4 Sample(s) Inspection before Test:
Sample(s) Description: MABACT0059
Quantity: 10 PCS
Appearance Inspection: No visual damage was found on samples before test.
See Photo 2.1B.

2.1.5 Test Procedure:

Test Equipment:

Name: Temp & Humidity Chamber
Model: ETH-B0-100
Equipment No.: POLY-I-242

Lab Environmental Conditions: Ambient temperature: 25±3ºc, Relative humidity: 55±20%RH

2.1.6 Test Result(s):
Appearance Check: No visual damage was found on samples after test.
See Photo 2.1C.
2.2 Bake Test:


2.2.1 Test Purpose:
The test aim is to verify the samples’ ability to resist the environment conditions.

2.2.2 Test Method/Specification:
Refer to client’s requirements.
- Test Temperature: 150ºC
- Test Duration: 100 hours

2.2.3 Appearance Inspection:
Appearance inspection performed before and after test.

2.2.4 Sample(s) Inspection before Test:
Sample(s) Description: MABACT0059
Quantity: 10 PCS
Appearance Inspection: No visual damage was found on samples before test. See Photo 2.2B.

2.2.5 Test Procedure:
Test Equipment:

Name: Thermal Shock Chamber
Model: TS300
Equipment No.: SZREL-010

Lab Environmental Conditions: Ambient temperature: 25±3ºc, Relative humidity: 55±20%RH

2.2.6 Test Result(s):
Appearance Check: No visual damage was found on samples after test. See Photo 2.2C
2.3 Solderability Test:

2.3.1 Test Purpose:
The purpose of this test is to verify the solderability of the samples subjected to the steam age and bake testing outlined in sections 2.1 & 2.2.

2.3.2 Test Method/Specification:
- Dip and Look solderability Test.
- Solder Temperature 245ºC ± 5 ºC
- Solder: SN60
- Immersion rate: 1” per second ± 0.25” per second
- Dwell Time: 5 seconds ± 0.5 second.

2.3.3 Appearance Inspection:
Appearance inspection performed before and after test.

2.3.4 Sample(s) Inspection before Test:
Sample(s) Description: MABACT0059
Quantity:
10 PCS after Steam age test.
10PCS after Bake test.

Appearance Inspection: No visual damage was found on samples before test. See Photo 2.3A.

2.3.5 Test Result(s):
Appearance Check: Samples checked using magnification of 10-15x.
All samples meet the criteria for acceptable solderability.
The solder coverage is >95%
See Photo 2.3B
Test Group 3:

3.1: High Temperature Life Stabilization Bake Test:


3.1.1 Test Purpose:
The purpose of this test is to determine the effect on microelectronic devices of storage at elevated temperatures without electrical stress applied.

3.1.2 Test Method/Specification:
Refer to Mil-STD-883G Method 1008.2 condition A.
- Test Temperature: 100ºC
- Test Duration: 500hours

3.1.3 Appearance Inspection:
Appearance inspection performed before and after test.

3.1.4 Sample(s) Inspection before Test:
Sample(s) Description: MABACT0059
Quantity: 76 PCS
Appearance Inspection: No visual damage was found on samples before test. See Photo 3.1B.

3.1.5 Test Procedure:

Test Equipment:

Name: Ramp Temperature Cycling Chamber
Model: WK-800/70/25
Equipment No.: SZREL-009

Lab Environmental Conditions: Ambient temperature: 25±3ºC, Relative humidity: 55±20%RH

3.1.6 Test Result(s):
Appearance Check: No visual damage was found on samples after test. See Photo 3.1C.
3.2: Thermal Shock Test:


3.2.1 Test Purpose:
The purpose of this test is to determine the resistance of the part to sudden exposure to extreme changes in temperature and the effect of alternate exposures to these extremes.

3.2.2 Test Method/Specification:
Refer to Mil-STD-883G Method 1011.9 condition A.

- Low Temperature: 0 ºC.
- High Temperature: 100 ºC.
- Dwell Time: 10 minutes.
- Test Cycles: 100.
- Total duration: about 34 hours.

3.2.3 Appearance Inspection:
Appearance inspection performed before and after test.

3.2.4 Sample(s) Inspection before Test:
Sample(s) Description: MABACT0059
Quantity: 76 PCS (after Hi temp Life Stabilization Bake Test).
Appearance Inspection: No visual damage was found on samples before test. See Photo 3.2C.

3.2.5 Test Procedure:

Test Equipment:

Name: Thermal Shock Chamber
Model: TS300
Equipment No.: SZREL-010

Lab Environmental Conditions: Ambient temperature: 25±3 ºC, Relative humidity: 55±20%RH

3.2.6 Test Result(s):
Appearance Check: No visual damage was found on samples after test. See Photo 3.2D.
3.3: Functional Test:

3.3.1 Initial Functional Test Results
The 76 units were functionally tested for Insertion loss before being subjected to High Temperature Life Stabilization Bake and Thermal Shock outlined in sections 3.1 & 3.2. All 76 units passed to specification. The initial test results are plotted in Figure 3.3A below.

![Figure 3.3A – Test Plots before Temperature Testing.](image)

3.3.2 Functional Test Results After Temperature testing
The 76 units were functionally re-tested after High Temperature Life Stabilization Bake and Thermal Shock. All 76 units continue to pass specification. The test results after Temperature testing are plotted in Figure 3.3B below.

![Figure 3.3B – Test Plots after Temperature Testing.](image)
Test Group 4:

4.1 Convection Oven Profile, 260degC:

4.1.1 Test Purpose:
The purpose of this test is to determine the resistance of the part to high temperature experienced during Convection Oven reflow.

4.1.2 Test Method/Specification:
Refer to client’s reflow requirements.
- Test Temperature: 260ºC
- Test Duration: 30 seconds.
See Figure 4.1A

4.1.3 Appearance Inspection:
Appearance inspection performed before and after test.

4.1.4 Sample(s) Inspection before Test:
Sample(s) Description: MABACT0059
Quantity: 10 PCS
Appearance Inspection:
No visual damage was found on samples before test.
See Photo 4.1B.

4.1.5 Test Procedure:
Test Equipment:
8 Zone Convection Reflow Oven.
4.1.6 Test Result(s):
Appearance Check: No visual damage was found on samples after test. See Photo 4.1C.

4.2: Functional Test After Reflow, 260degC :

4.2.1 Functional Test Results after Convection Reflow
The 10 finished good units were functionally tested for Insertion Loss after the Convection oven reflow outlined in section 4.1.

All 10 units pass functional specification after reflow. The test results after Convection oven reflow are plotted in Figure 4.2A below.

Figure 4.2A – Test Plots after Reflow.
4.3 Convection Oven Profile, 230degC:

4.3.1 Test Purpose:
The purpose of this test is to determine the resistance of the part to high temperature experienced during Convection Oven reflow.

4.3.2 Test Method/Specification:
- Test Temperature: 230°C
- Test Duration: 30seconds.

See Figure 4.3A

Figure 4.3A-Reflow Profile

4.3.3 Appearance Inspection:
Appearance inspection performed before and after test.

4.3.4 Sample(s) Inspection before Test:
Sample(s) Description: MABACT0059
Quantity: 10 PCS
Appearance Inspection:
No visual damage was found on samples before test. See Photo 4.3B.

4.3.5 Test Procedure:
Test Equipment:
7 Zone Convection Reflow Oven.

4.3.6 Test Result(s):
Appearance Check: No visual damage was found on samples after test. See Photo 4.3C.

Photo 4.3B Samples Before Reflow  Photo 4.3C Samples after Reflow

4.4: Functional Test After Reflow, 230degC:

4.4.1 Functional Test Results after Convection Reflow
The 10 finished good units were functionally tested for Insertion Loss after the Convection oven reflow outlined in section 4.3.

All 10 units pass functional specification after reflow. The test results after Convection oven reflow are plotted in Figure 4.4A below.

Figure 4.4A – Test Plots after Reflow.
Test Group 5:

5.1 Salt Atmosphere Test:


5.1.1 Test Purpose:
This test provides a controlled corrosive environment which has been utilized to produce relative corrosion resistance information for specimens of metals and coated metals exposed in a given test chamber.

5.1.2 Test Method/Specification:
Refer to Mil-STD-883G Method 1009.8 condition A.
- Concentration of salt solution: 0.5% ~ 3.0% NaCl (m/m)
- Chamber temperature: 35ºC
- PH of salt solution at (35±2) ºC: 6.5 ~ 7.2
- Exposure period: 24h

5.1.3 Appearance Inspection:
Appearance inspection performed before and after test.

5.1.4 Sample(s) Inspection before Test:
Sample(s) Description: MABACT0059
Quantity: 5 PCS
Appearance Inspection: No visual damage was found on samples before test. See Photo 5.1A.

5.1.5 Test Procedure:
Test Equipment:
Name: Salt Spray Chamber
Model: CEEC-YW-150
Equipment No.: 070042
Lab Environmental Conditions: Ambient temperature: 25±3ºC, Relative humidity: 55±20%RH

5.1.6 Test Result(s):
Standard’s failure criteria:
  a) Corrosion defects over more than 5 percent of the area of the finish or base metal of any package element other than leads such as lid, cap, or case.
  b) Leads missing, broken, or partially separated.
  c) Specified markings, which are missing in whole or in part, faded, smeared, blurred, shifted, or dislodged to the extent that they are not legible.
Appearance Inspection: No visual damage was found on samples before test. See 5.1B

<table>
<thead>
<tr>
<th>Sample Item</th>
<th>Sample No.</th>
<th>Appearance after test</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>MABA CT0059</td>
<td>1#</td>
<td>No visible damage</td>
<td>Pass</td>
</tr>
<tr>
<td></td>
<td>2#</td>
<td>No visible damage</td>
<td>Pass</td>
</tr>
<tr>
<td></td>
<td>3#</td>
<td>No visible damage</td>
<td>Pass</td>
</tr>
<tr>
<td></td>
<td>4#</td>
<td>No visible damage</td>
<td>Pass</td>
</tr>
<tr>
<td></td>
<td>5#</td>
<td>No visible damage</td>
<td>Pass</td>
</tr>
</tbody>
</table>
Test Group 6:

6.1 Pressure Cooker Test:


6.1.1 Test Purpose:
This test is performed to evaluate the moisture resistance integrity of non-hermetic packaged solid state devices using moisture condensing or moisture saturated steam environments.

6.1.2 Test Method/Specification:
Refer to JESD22-A-102-C and client’s requirements.
- Vapor pressure: 15 PSI
- Test Temperature: 121ºC
- Test Duration: 96 hours

6.1.3 Appearance Inspection:
Appearance inspection performed before and after test.

6.1.4 Sample(s) Inspection before Test:
Sample(s) Description: MABACT0059
Quantity: 38 PCS
Appearance Inspection: No visual damage was found on samples before test. See Photo 6.1B.

6.1.5 Test Procedure:

Test Equipment:

Name: Pressure Cooker Tester
Brand: KSON
Model: PCT-S/S022

Lab Environmental Conditions: Ambient temperature: 25±3ºC, Relative humidity: 55±20%RH.

6.1.6 Test Result(s):
Appearance Check: No visual damage was found on samples after test. See Photo 6.1C.

6.2 Temp/Humidity Test:

6.2.1 Test Purpose:
This test is performed for the purpose of evaluating the reliability of non-hermetic packaged solid-state devices in humid environments.

6.2.2 Test Method/Specification:
Refer to JESD22-A-101-B and client’s requirements.
- Test Temperature: 85ºC
- Test Humidity: 85%RH
- Test Duration: **500** hours

6.2.3 Appearance Inspection:
Appearance inspection performed before and after test.

6.2.4 Sample(s) Inspection before Test:
Sample(s) Description: MABACT0059
Quantity: 38 PCS (after Pressure Cooker Test)
Appearance Inspection: No visual damage was found on samples before test. See Photo 6.2B.

6.2.5 Test Procedure:

Test Equipment:

- **Name:** Triple Temp & Humidity Chamber
- **Brand:** GIANT FORCE
- **Model:** GTH-162TR-SP/MAA0605-012

Lab Environmental Conditions: Ambient temperature: 25±3ºC, Relative humidity: 55±20%RH.

6.2.6 Test Result(s):
Appearance Check: No visual damage was found on samples after test. See Photo 6.2C.
6.3: Functional Test:

6.3.1 Initial Functional Test Results:
The 38 units were functionally tested for Insertion loss before being subjected to Pressure Cooker and Temp/Humidity testing outlined in sections 6.1 & 6.2. All 38 units passed to specification. The initial test results are plotted in Figure 6.3A below.

![Figure 6.3A – Test Plots before Pressure Cooker and Temp/Humidity testing.](image)

6.3.2 Functional Test Results After Pressure & Humidity testing:
The 38 units were functionally re-tested after Pressure Cooker and Temp/Humidity testing. All 38 units continue to pass specification. The test results after Temperature testing are plotted in Figure 6.3B below.

![Figure 6.3B – Test Plots after Pressure Cooker and Temp/Humidity testing.](image)
Test Group 7:

7.1 Lead Material & plating:

7.1.1 Test Purpose:
Measurements performed to verify that the lead plating thickness and composition meet specification.

7.1.2 Test Method/Specification:
Refer to Substrate material drawing 1000021271 for plating specification.
- Plating Thickness:
  - Ag: 10-40µm,
  - Ni: 2-6µm,
  - Au: (flash) 0.1 -.05µm
- Plating Composition:
  - Ag: 80±10%,
  - Ni: 15±2% ,
  - Au: 0.25±0.1%

7.1.3 Sample(s) Inspection before Test:
Sample(s) Description: MABACT0059
Quantity: 3 PCS
Appearance Inspection: No visual damage was found on samples before test.

7.1.4 Test Procedure: XRF and cross sectional analysis.

7.1.5. Test Results:
Lead plating on all samples meet the required thickness and composition specifications. See Photo 7.1A

<table>
<thead>
<tr>
<th>Model #</th>
<th>Substrate</th>
<th>Thickness (µm)</th>
<th>Composition (%)</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>MABACT0059</td>
<td>1000021271</td>
<td>16-30µm, 3-5µm, 0.11-0.12µm</td>
<td>Ag 85.05%, Ni 14.59%, Au 0.29%</td>
<td>Pass</td>
</tr>
</tbody>
</table>

Photo 7.1A- Cross Section of sample and thickness measurements.
Test Group 8 & 9:

8.1 Vibration:


8.1.1 Test Purpose:
This test is performed to evaluate the resistance of the part to vibration.

8.1.2 Test Method/Specification:
Refer to MIL-STD-202, Method 201, Condition A.
- Freq: 10Hz to 55Hz
- Displacement 1.524mm
- Swept Speed: 1min/cycle
- Orientation X,Y,Z axes
- Duration 2H/axis

8.1.3 Appearance Inspection:
Appearance inspection performed before and after test.

8.1.4 Sample(s) Inspection before Test:
Sample(s) Description: MABACT0059
Quantity: 50 PCS
Appearance Inspection: No visual damage was found on samples before test.
See Photo 8.1C.

8.1.5 Test Procedure:

Test Equipment:

Name: Vibration System
Model: EM-600F2K-40N120
Equipment: TTS-TQ-058

Photo: 8.1A – Units under vibration
8.1.6 Test Result(s):
Appearance Check: No visual damage was found on samples after test. See Photo 8.1D.
8.2 Mechanical Shock:

*TTS Report Reference: WDZ0383 – Section 2.*

8.2.1 Test Purpose:
This test is performed to evaluate the resistance of the part to mechanical shock.

8.2.2 Test Method/Specification:
Refer to MIL-STD-202, Method 213B, Condition A
- Shock Wave Shape: Half Sine
- Acceleration: 50g
- Pulse duration: 11ms
- Shock Times: 3 on each ±X, ±Y, ±Z,

8.2.3 Appearance Inspection:
Appearance inspection performed before and after test.

8.2.4 Sample(s) Inspection before Test:
Sample(s) Description: MABACT0059
Quantity: 50 PCS (after Vibration Test)
Appearance Inspection: No visual damage was found on samples before test.

8.2.5 Test Procedure:

Test Equipment:

**Name:** Mechanical Shock Tester

**Model:** DP-1200-60

**Equipment No:** TTS-YQ-094

*Photo: 8.2A – Units under mechanical shock*
Lab Environmental Conditions: Ambient temperature: 25±3°C, Relative humidity: 55±20%RH.

8.2.6 Test Result(s):
Appearance Check: No visual damage was found on samples after test. See Photo 8.2C.
8.3: Functional Test:

8.3.1 Initial Functional Test Results:
The 50 units were functionally tested for Insertion loss before being subjected to Vibration & Mechanical Shock testing outlined in sections 8.1 & 8.2. All 50 units passed to specification.

The initial test results are plotted in Figure 8.3A below.

8.3.2 Functional Test Results After Vibration & Mechanical Shock:
The 50 units were functionally re-tested after Vibration & Mechanical Shock testing. All 50 units continue to pass specification. The test results after Vibration & Mechanical Shock are plotted in Figure 8.3B below.