Vibration result – Thermal Performance

**Thermal Resistance Variation Before/After Vibration @1mm**

- 1#-1mm: before (2.5) - After (2.65)
- 2#-1mm: before (2.75) - After (2.85)

**Thermal Resistance Variation Before/After Vibration @0.1mm**

- 3#-0.1mm: before (0.5) - After (0.5)
- 4#-0.1mm: before (0.5) - After (0.5)
- 5#-0.1mm: before (0.5) - After (0.5)
- 6#-0.1mm: before (0.5) - After (0.5)
- 7#-0.1mm: before (0.5) - After (0.5)
- 8#-0.1mm: before (0.5) - After (0.5)

* Test Method: ASTM-E1461

**Result:** HLT3000 thermal performance keep stable after vibration test under varies of thickness
Vibration result – Oil Bleeding

<table>
<thead>
<tr>
<th>Project No.</th>
<th>Test Item</th>
<th>Standard/Program/Method</th>
<th>Test Time (h)</th>
<th>Test Result Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>X-axis vibration</td>
<td>GB 18488.1 5.6.4 (technical conditions)</td>
<td>8</td>
<td>No oil bleeding</td>
</tr>
<tr>
<td>2</td>
<td>Y-axis vibration</td>
<td>GB 18488.1 5.6.4 (technical conditions)</td>
<td>8</td>
<td>No oil bleeding</td>
</tr>
<tr>
<td>3</td>
<td>Z-axis vibration</td>
<td>GB 18488.1 5.6.4 (technical conditions)</td>
<td>8</td>
<td>No oil bleeding</td>
</tr>
<tr>
<td>4</td>
<td>X-axis random vibration</td>
<td>GB 28046.3-2011 4.1.2.4 Test IV—Car Elastic Body (Vehicle)</td>
<td>8</td>
<td>No oil bleeding</td>
</tr>
<tr>
<td>5</td>
<td>Y-axis random vibration</td>
<td>GB 28046.3-2011 4.1.2.4 Test IV—Car Elastic Body (Vehicle)</td>
<td>8</td>
<td>No oil bleeding</td>
</tr>
<tr>
<td>6</td>
<td>Z-axis random vibration</td>
<td>GB 28046.3-2011 4.1.2.4 Test IV—Car Elastic Body (Vehicle)</td>
<td>8</td>
<td>No oil bleeding</td>
</tr>
</tbody>
</table>

Result: HLT3000 has no oil bleeding after vibration test
Dielectric strength post Temperature Cycle

TC chamber

Test condition:
Thermal cycle:
  Standard: JESD22-A104C
  Testing Condition: -55°C to 125°C (TCB), 1000 cycles
Dielectric strength:
  Electrode size: φ25mm X 25mm
  Rate of AC voltage raise: 0.1kV/s
  Ambient temperature: 21 °C
  Ambient relative humidity: 65%

Dielectric strength tester HJC-10KV

<table>
<thead>
<tr>
<th>Sample</th>
<th>Initial thickness (mm)</th>
<th>Dielectric strength (kV/mm) before thermal cycle</th>
<th>Dielectric strength (kV/mm) after 1000 cycles thermal cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLT3000</td>
<td>1# 1.03</td>
<td>8.8</td>
<td>9.1</td>
</tr>
<tr>
<td></td>
<td>2# 1.02</td>
<td>9.0</td>
<td>8.9</td>
</tr>
<tr>
<td></td>
<td>3# 1.06</td>
<td>8.7</td>
<td>9.0</td>
</tr>
</tbody>
</table>

Result: HLT3000 has no dielectric strength change after temperature cycle test
Moisture absorption test

- Testing Condition: 85°C, 85%RH, **96 hours**
- Put test sample in D85 chamber and compare the weight before/after test to evaluate if moisture absorbed in sample

<table>
<thead>
<tr>
<th>Initial thickness (mm)</th>
<th>Initial weight</th>
<th>Weight after 96 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>HLT3000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1#</td>
<td>3.342</td>
<td>3.335</td>
</tr>
<tr>
<td>2#</td>
<td>3.410</td>
<td>3.399</td>
</tr>
<tr>
<td>3#</td>
<td>3.373</td>
<td>3.372</td>
</tr>
</tbody>
</table>

Result: HLT3000 has no moisture absorption post D85 test
Appendix
Vibration test procedure

Cu plate
Shim
HLT3000
1mm
0.1mm

Sample preparation

Netzsch Laser Flash™
Thermal resistance test

X, Y, Z vibration

Netzsch Laser Flash™
Thermal resistance test

Netzsch Laser Flash™
Thermal resistance test
Vibration test procedure

Sample preparation

Thermal resistance test

Netzsch Laser Flash™

X, Y, Z vibration

Netzsch Laser Flash™

Thermal resistance test

Cu plate

Shim

1mm

0.1mm

HLT3000
THANK YOU

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