Thin Film Technology
MLCC Capacitor
CST Bending Test
Test apparatus of bending test: LLOYD LF+
Test Method

- **Supporting Condition of Substrate**
- **Testing Condition**

Discrepancy between center of supports and center of substrate

Discrepancy between center of testing substrate A and pressurizing rod

Thickness of PCB
0402/0201: 0.8mm
0603 above: 1.6mm

Discrepancy between center of supports and center of substrate
Bending Test: Follow international standard JIS C 5101

<table>
<thead>
<tr>
<th>No</th>
<th>Test Item</th>
<th>Test Condition</th>
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<tbody>
<tr>
<td>1.</td>
<td>Bending Test (Deflection) JIS C 5101-10 4.9</td>
<td>The middle part of the substrate shall be pressurized by means of the pressurizing rod at a rate of about 1mm per second until the deflection becomes 1mm/ CST series: 5mm &amp; 3mm and then the pressure shall be maintained for 5±1sec. The deflection test to 7mm (per 0.5mm) or have remarkable damage. (Thickness &gt;1.0mm; Thickness ≤1.0mm)</td>
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Pictured Below: Actual cap. Measurement on bending apparatus
• MLCC ceramic body is a rigid material.
• It will be under compressive and tensional stress when the carried board is warped
• Warpage crack happens if the suffered stress is greater than the ceramic body strength

Therefore, the warpage crack will occur only after the soldering process
Typical failure modes in the board bending test

- Small and thin chip capacitors (0603, 0805 & 1206)
  ![Diagram of small and thin chip capacitors]

- Small and medium thick chip capacitors (0603, 0805 & 1206)
  ![Diagram of small and medium thick chip capacitors]

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  ![Diagram of large and thick chip capacitors]
The Fish-Bone of Bending Issue

Component

- Size
- Thickness
- Dielectric

Bending

Solder amount
- PCB press direction
- PCB separation method
- Jig sharp

SMT process

PCB design
- Solder pads dimensions
- Component position
- Component direction
- Neighbor pads connection
- Soldering method
Stress vs Position on PCB during bending

Chip mounting close to board separation point

Pre-routed corners to relieve stress

Magnitude of stress: 1>2 ≈ 3 > 4 > 5
• The crack occurred is caused by component near and vertical to shear line
SMT device against leaded component

Incorrect

Correct

The solder resist must prevent shorting between SMT and leaded components after soldering process by wave or reflow soldering.
Correlation of Strain and Bending Level

1. Bending Level: Max Strain
2. Equation: \( y(x) = 877.764 \times x - 432.013 \), \( x \) = bending level (mm), \( y \) = Strain: PCB 0.8 mm
3. MLCC Bending Level: Max Strain
4. Item 2 Equation: 0.9 mm PCB 1.6 mm PCB

The correlation equation between board level strain and bending level will change if PCB thickness and material is different. To be defined by experiment.
Case Study: 1

- 0805, X7R, 220nF, 50V
- Thickness: 1.25mm

Case Study: 2

- 0603, X7R
- Thickness: 0.8mm

Case Study: 1

- Neighbor pads connection + excessive solder amount
- 0603, X7R
- Thickness: 0.8mm
We appreciate your time!