Automotive Electronics Council
Component Technical Committee

ATTACHMENT 10

AEC - Q100-010 REV-A

SOLDER BALL SHEAR TEST

Automotive Electronics Council
Component Technical Committee

Acknowledgment

Any document involving a complex technology brings together experience and skills from many sources. The Automotive Electronics Counsel would especially like to recognize the following significant contributors to the development of this document:

Majdi Mortazavi	DaimlerChrysler
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Change Notification

The following summary details the changes incorporated into AEC-Q100-010 Rev-A:

- **All Sections: Minor revisions made to all sections to correct formatting errors.**

- **Figures 1, 2, 3 and Table 2: Revised Figure 1 to add height parameter. Added new captions to Figures 2 & 3 and Table 2.**

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METHOD - 010

SOLDER BALL SHEAR TEST

Text enhancements and differences made since the last revision of this document are shown as underlined areas.

1. SCOPE

This test method is applicable to all solder ball surface mounted packages (e.g., PBGA, Chip Scale, Micro Lead Frame) except Flip Chip.

2. PURPOSE

The purpose of this test method is to define the procedure for measuring the shear strength of the interface between the barrier metal and solder ball. This method also establishes the minimum shear strength requirements for this interface.

3. PROCEDURE

3.1 Solder Ball Shear Test Procedure

Solder ball shear shall be used to quantify the integrity of the solder connection to the barrier metallization on the device. Prior to shear testing, the test samples shall be thermally preconditioned. The balls for shear testing shall be chosen randomly throughout the test unit.

3.1.1 Detailed Ball Shear Test Procedure

The following procedure shall be used for this test:

a. Place the test samples on a clean circuit board or ceramic coupon positioned with the solder ball side up. Thermally precondition the devices with a minimum of two reflows using convection or IR reflow with a peak reflow temperature of 220 +5 /-0°C and a reflow profile as defined in J-STD-020 (moisture exposure is not required).

b. Allow samples to cool to room temperature (22 ± 3°C).

c. Mount the samples on a shear tester, with the shear arm positioned at a height of approximately 1/3 of the ball height and not touching the surface of the substrate, see Figure 1, shear the balls using a constant shear rate of 0.28 to 0.50 mm/sec. Record the shear strength.

d. Using a microscope with a minimum 40X magnification, examine and record the ball separation mode, see Table 1.

DaimlerChrysler	Date	Delphi Delco Electronics Systems	Date	Visteon Corporation	Date
Majdi Mortazavi	7/18/03	Detlef Griessman	7/18/03	Robert V Knoell	7/18/03
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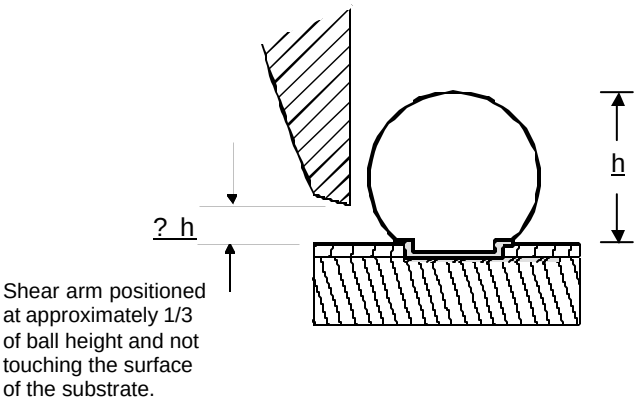

Figure 1: Arm position during Solder Ball Shear

4. FAILURE CRITERIA

The following failure criteria are not valid for devices that have undergone stress testing (beyond thermal preconditioning) or been desoldered from an assembly.

4.1 Solder Ball Shear Acceptance Criteria

Solder ball shear strength shall be 3200 gram/mm^2 (see Figures 2 & 3 and Table 2) ***in conjunction with acceptable separation modes***. Separation modes are defined in Table 1. Separation modes 1 and 4 are acceptable. Separation modes 2 shall not exceed 5% of the shear interface. Separation modes 3 and 5 are not acceptable. Evidence that the shear arm has contacted the substrate during the shearing process invalidates the ball shear value for that ball.

Table 1: Definition of Solder Ball Separation Modes

Separation Mode Designation	Separation Mode Definition
1	Separation occurs through the bulk solder. Characterized by solder remaining on entire solder pad.
2	Separation occurs as a fracture through the metal-to-metal brittle intermetallic layer (typically through the nickel-tin or gold-tin intermetallic). The pad typically appears flat in these areas.
3	Separation occurs between the barrier metal layers under the bump (typically as a loss of adhesion between the copper and nickel). The pad typically appears flat in these areas.
4	Separation occurs in the PBGA substrate material beneath the solder pad causing the pad to rip out or peel from the substrate. The solder ball remains attached to the pad.
5	Separation with the bulk of the solder separating from the solder pad, but with the plating remaining on the solder pad. This condition is typically due to improper wetting.

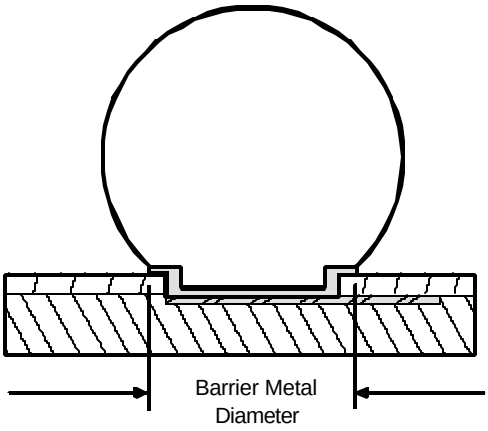

Figure 2a: Example #1

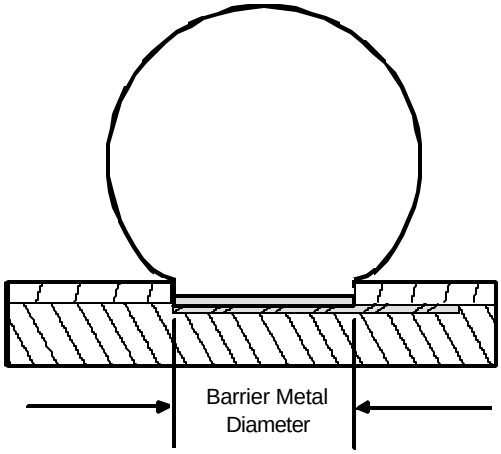

Figure 2b: Example #2

Figure 2: Solder Ball Barrier Metal Diameter Measurement

Table 2: Minimum Shear Strength

Barrier Metal Diameter (mm)	Minimum Ball Shear Strength
0.23	133
0.28	197
0.33	274
0.38	363
0.43	465
0.48	579
0.53	706
0.58	845
0.63	998
0.68	1162
0.73	1339
0.78	1529

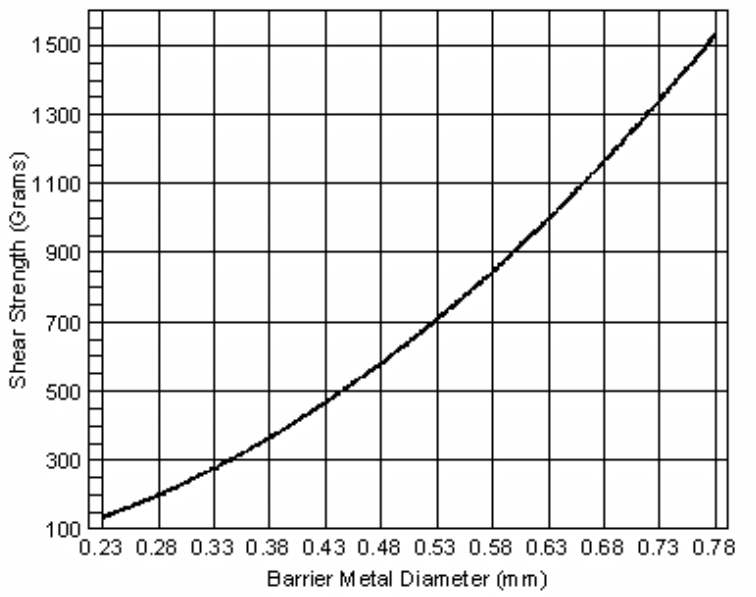

Figure 3: Minimum Shear Strength

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Revision History

Rev #	Date of change	Brief summary listing affected sections
-	Aug. 25, 2000	Initial Release
A	July 18, 2003	Corrected formatting errors. Revised Figure 1. Added new captions to Figures 2 & 3 and Table 2.