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Lead Integrity

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ELECTRONIC INDUSTRIES ALLIANCE

JEDEC Solid State Technology Association

INTERNATIONAL ELECTROTECHNICAL COMMISSION

LEAD INTEGRITY TEST METHOD

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Draft PAS	**Report on voting**
47/1457/PAS	47/1490/RVD

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TEST METHOD B105-B

LEAD INTEGRITY

(From JEDEC Council Ballot JCB-98-79 formulated under the cognizance of JC-14.1 Committee on Reliability Test Methods for Packaged Devices.)

1 Purpose

This test method provides various tests for determining the integrity lead/package interface and the lead itself when the lead(s) are bent due to faulty board assembly followed by rework of the part for reassembly. For hermetic packages, it is recommended that this test be followed by hermeticity tests in accordance with Test Method A109 to determine if there are any adverse effects from the stresses applied to the seals as well as to the leads. These tests, including each of its test conditions, is considered destructive and is only recommended for qualification testing. This test is applicable to all through-hole devices and surface-mount devices requiring lead forming by the user.

1.1 Test Condition A - Tension

This test condition provides for the application of straight tensile loading.

1.2 Test Condition B - Bending Stress

This test condition provides for the application of bending stresses to determine the integrity of leads, seals and lead plating.

1.3 Test Condition C - Lead Fatigue

This test condition provides for the application of bending stresses primarily to determine the resistance of the leads to metal fatigue under repeated bending.

1.4 Test Condition D - Lead Torque

This test condition provides for the application of stresses to the leads to determine the resistance of seals and leads to twisting motions.

1.5 Test Condition E - Stud Torque

This test condition provides for the application of stresses on a threaded mounting stud caused by tightening the device during mounting.

2 Apparatus

See applicable test condition.

3 General Procedure Applicable to all Test Conditions

The device shall be subjected to the stress described in the specified test condition and the specified end point measurements and inspections shall be made except for initial conditioning unless otherwise specified. When possible, the stress shall be applied to randomly selected leads from each device. The same leads shall not be used for more than one test condition.

4 General Summary

The following details, and those required by the specific test condition, shall be specified in the applicable procurement document:

(a) Test Condition Letter

(b) Sample size (combinations of number of leads per device and number of devices) and quality level.

5 Test Condition A - Tension

5.1 Purpose

This test is designed to check the capabilities of the device, leads, welds, and seals to withstand a straight pull.

5.2 Apparatus

The tension test requires suitable clamps and fixtures for securing the device and attaching the specified weight without lead restriction. Equivalent linear pull test equipment may be used.

5.3 Procedure

A tension of 8.0 $\pm$ 0.5 oz (227 $\pm$ 14 gram) shall be applied without shock to each lead to be tested in a direction parallel to the axis of the lead or terminal and the tension shall be maintained for 30 seconds minimum. The tension shall be applied as close to the end of the lead as practicable.

5.3 Procedure (cont'd)

5.3.1 Measurements

Hermeticity test on hermetically sealed packages, visual examination and electrical measurements, that consist of parametric and functional tests, shall be taken, as specified in the applicable procurement document.

5.3.2 Failure Criteria

After the removal of the stress, examine the device using a magnification between 10X and 20X. Any evidence of breakage, loosening, or relative motion between the lead and the device body shall be considered a device failure. When hermeticity tests are conducted (in accordance with Test Method A109) as a post measurement, meniscus cracks shall not be a cause for rejection of the devices which have passed the tests. Failure of any specified post electrical measurement shall be considered a cause for failure.

5.4 Summary

The following details shall be specified in the applicable procurement documents:

(a) Weight to be attached to lead, if other than 8.0 ± 0.5 oz (227 ± 14 gram).

(b) Length of time weight is to be attached, if other than 30 seconds.

(c) Failure criteria, if other than specified.

6 Test Condition B - Bending Stress

6.1 Purpose

This test is designed to check the capability of the leads, lead finish, lead welds and seals of the devices to withstand stresses to the leads and seals which might reasonably be expected to occur from actual handling and assembly of the devices in application.

6.2 Apparatus

The bending test requires attaching devices, clamps, supports or other suitable hardware, necessary to apply the bending stress through the specified bend angle.

6 Test Condition B - Bending Stress (cont'd)

6.3 Procedure

Each lead of the sample shall be subjected to a force sufficient to bend the lead as specified in paragraphs 6.3.1 through 6.3.6, as applicable. Any number, or all of the leads of the test device, may be bent simultaneously. Rows of leads may be bent one row at a time. Each lead shall be bent through one cycle as follows:

Bend through the specified arc in one direction and return to the original position. All arcs shall be made in the same plane, without lead restriction.

6.3.1 Direction of Bends

Test leads shall be bent in the least rigid direction. If there is no least rigid direction, the leads may be bent in any direction. No lead shall be bent so as to interfere with another lead. If interference is unavoidable, the test lead shall be bent in the opposite direction to the angle specified and returned to its normal position.

6.3.2 Procedure for Initial Conditioning for Environmental Test

When normally straight leads are supplied in a formed condition (including the staggered lead dual-in-line configuration), the lead forming operation shall be considered acceptable initial conditioning in place of that specified, providing the lead forming has been performed after lead plating and the forming is at least as severe in permanent lead deformation as the specified bending.

6.3.3 Procedure for Flat-Packs and Axial Lead Metal-Can Devices (e.g., Flexible and Semi-Flexible Leads)

6.3.3.1 Flexible Leads

A lead shall be considered flexible if its section modulus (in the least rigid direction) is less than or equal to that of a rectangular lead with a cross section of 0.006 x 0.020 inch (0.15 x 0.51 mm). Round leads $\leq$ 0.020 inch (0.51 mm) in diameter shall be considered flexible. Flexible leads shall be bent through an arc of at least 45^{o}, measured at a distance 0.12 $\pm$ 0.03 inch (3.05 $\pm$ 0.76 mm) along the lead from the seal unless otherwise specified.

6.3.3.2 Semi-Flexible Leads

Semi-flexible leads are those leads with a section modulus (in the least rigid direction) greater than that of a rectangular lead with a cross section of 0.006 x 0.020 inch (0.15 x 0.51 mm) which are intended to be bent during insertion or other application. Round leads greater than 0.020 inch (0.51 mm) in diameter shall be considered semi-flexible. Semi-flexible leads shall be bent through an arc of a least 30^{o}, measured at the lead extremities, unless otherwise specified.

6.3 Procedure (cont'd)

6.3.4 Procedure for Dual-In-Line Package Leads

Dual-in-line package leads are leads with more than one section modulus, and with leads normally aligned in parallel at 90° angle from the bottom of the package during insertion. Dual-in-line package leads shall be bent inward through an angle sufficient to cause the lead to retain a permanent bend (i.e., after stress removal) of at least 15°, measured at the lead extremities about the first bend. For packages that have the shoulder restrained (see Configuration 3 of Figure 1), the angle of the bend shall be measured from the seating plane to the lead extremities. At the completion of the initial bend, the leads shall be returned to their approximate original position.

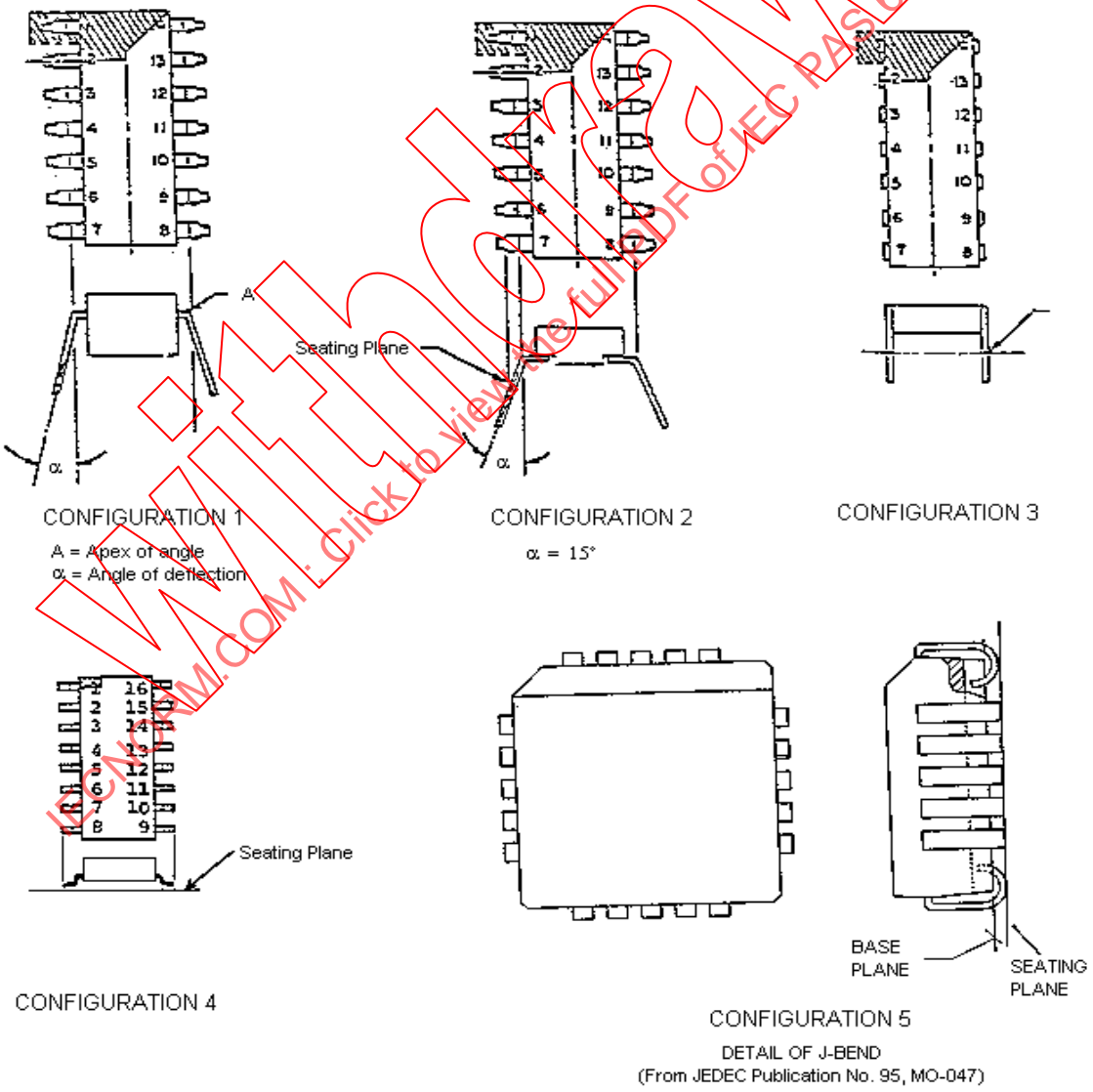


Figure 1 — Package Configurations

6.3 Procedure (cont'd)

6.3.5 Procedure for Small Outlines (SO) Packages

6.3.5.1 Small Outline (SO) Packages

Small Outline (SO) Packages, Configuration 4 of Figure 1, shall have leads bent outward at 15°, then inward 30°, then returned to the original position.

6.3.6 Procedure for "J" Leaded Chip Carrier (LCC) Packages

6.3.6.1 Leads

The leads to be tested shall be selected at random from each package in the test sample. Leads from two adjacent sides shall be sampled from each part. Prepare and test only one row of leads at a time.

6.3.6.2 Straightening "J" Leads

1) Mount the device in a fixture equivalent to Figure 2.

2) Use an ASA #2 tweezer (or equivalent) to straighten the lead.

3) Carefully straighten the "J" bend portion of the LCC package leads to position approximately perpendicular to the widest dimension.

4) Great care must be taken to prevent damage to the lead, such as nicks, kinks, or deep scratches.

6.3.6.3 Lead Inspection

Inspect each lead before and after straightening using a low power optical microscope between 10X and 20X magnification. Do not test any leads damaged by the straightening operation.

6.3.6.4 Mounting LCC Package

Mount the LCC package in a lead bend test fixture using necessary spacers, with the leads to be tested pointing straight down, i.e., at a 90° angle or normal to the bottom of the package.

6.3.6 Procedure for "J" Leaded Chip Carrier (LCC) Packages (cont'd)

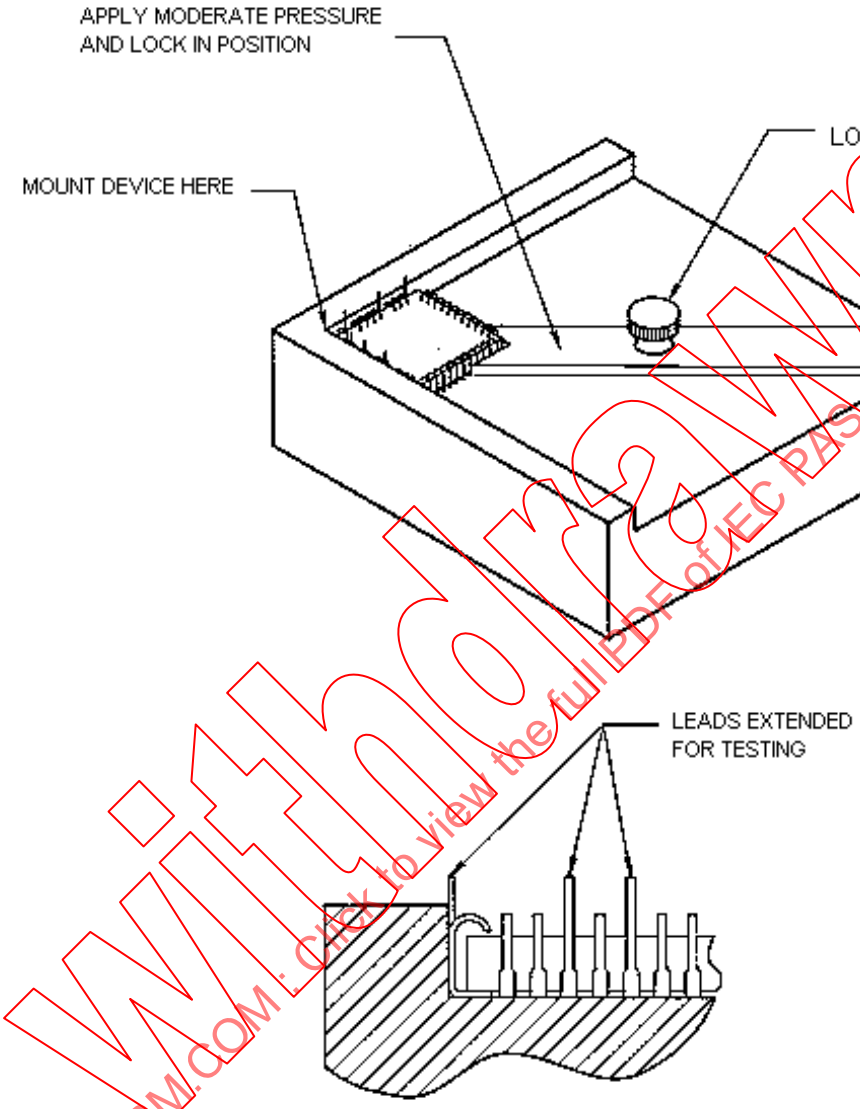


Figure 2 — Holding Fixture for Straightening "J" Leads

6.3.6.5 Test

Test in accordance with 6.3.4 except that the direction of bend shall be outward from the package.

6.3.6 Procedure for "J" Leaded Chip Carrier (LCC) Packages (cont'd)

6.3.6.6 Rotating Package Body

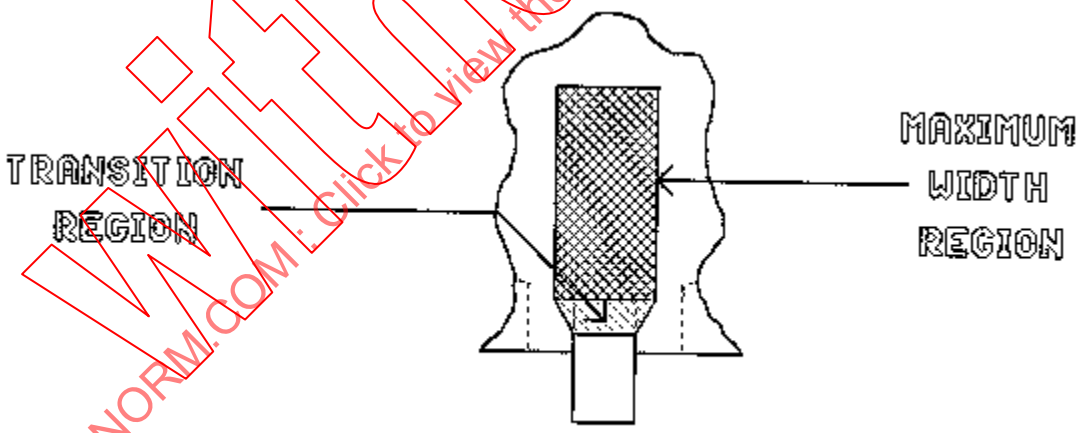
Select another untested lead and attach a 16 ± 0.5 oz (454 ± 14 gram) weight below the standoff (neck down) portion of the straightened lead. Care should be taken as to not twist or otherwise bend the lead under test or adjacent leads. Rotate the package body through a 30^{o} arc and return to its original position. This completes one cycle and should take 2 - 5 seconds. The rotation of the part must be done such as to avoid swinging or twisting motions of the weight.

6.3.7 Measurements

Hermeticity tests on hermetically sealed packages, visual examination and electrical measurements shall be taken as specified in the applicable procurement document.

6.3.8 Failure Criteria

After removal of the stress, examine the device using magnification between 10X and 20X. Any evidence of breakage, loosening or relative motion between the terminal lead and the device body shall be considered a device failure. Devices that failed at post test measurement, when specified, shall also be considered to have failed.



6.3.8.1 LCC Package Bend

For the LCC package bend, failure criteria over the entire lead is applicable to paragraph 6.3.6.5 and restricted to maximum width region for the conditions described in paragraph 6.3.6.6.

6 Test Condition B - Bending Stress (cont'd)

6.4 Summary

The following details shall be specified in the applicable procurement document:

(a) Bending arc, if other than specified.

(b) Failure criteria, if other than specified.

7 Test Condition C - Lead Fatigue

7.1 Purpose

This test is designed to check the resistance of the leads to metal fatigue.

7.2 Apparatus

The lead fatigue stress requires attaching devices, clamps, supports or other suitable hardware necessary to apply a repeated bending stress through the specified bend angle.

7.3 Procedure

The appropriate procedures of 7.3.2 or 7.3.3 for the device under test shall be used. Three bending cycles shall be performed, unless otherwise specified, (see paragraph 7.4 b).

7.3.1 Direction of Bends

The test leads shall be bent in the least rigid direction. If there is no least rigid direction, they may be bent in any direction. No leads shall be bent so as to interfere with another lead. If interference is unavoidable, the test lead shall be bent in the opposite direction to the angle specified and returned to its normal position.

7.3 Procedure (cont'd)

7.3.2 Procedure for Flexible and Semi-Flexible Leads (e.g., Flat Packs and Axial-Lead Metal-Can Devices)

A weight of 8.0 ± 0.5 oz (227 ± 14 gram), unless otherwise specified, shall be applied to each lead to be tested for three 90 ± 5° arcs of the case. For leads with a section modulus is less than or equal to that of a rectangular lead with a cross section of 0.006 x 0.020 inch (0.15 x 0.51 mm), or round lead with a cross section of 0.020 inch (0.051 mm) in diameter, the weight shall be 3.0 ± .3 oz (85 ± 9 gram). An arc is defined as the movement of the case without torsion, to a position perpendicular to the pull axis and return to normal. All arcs on a single lead shall be made in the same direction and in the same plane without lead restriction. A bending cycle shall be completed in 2 - 5 seconds. For devices with rectangular or ribbon leads, the plane of the arcs shall be perpendicular to the flat plane of the lead. The test shall not be applied to end leads of packages where its application will apply primarily torsion forces at the lead seal.

7.3.3 Procedure for Dual-In-Line Packages

Dual-in-line packages shall be subjected to three cycles in accordance with 6.3.4.

7.3.4 Procedure for Small Outline (SO) Packages

Small Outline (SO) packages shall be subjected to three cycles in accordance with 6.3.5.

7.3.5 Procedure for Leaded Chip Carrier (LCC) Packages

Prepare leads in accordance with 6.3.6.1 - 6.3.6.4.

Test in accordance with 6.3.6.5 except that the number of cycles shall be 3.

Test in accordance with 6.3.6.6 except that the number of cycles shall be 3.

7.3.6 Measurements

Hermeticity test on hermetically sealed packages, visual examination and electrical measurements shall be taken as specified in the applicable procurement document.

7.3 Procedure (cont'd)

7.3.7 Failure Criteria

After removal of the stress, examine the device using magnification between 10X and 20X. Any evidence of lead fracture shall be considered a device failure.

For the LCC package only, lead bend per 6.3.6.5, failure criteria are to be applied only to the transition region from maximum width to minimum width.

For LCC package bend only, failure criteria over the entire lead are applicable to 6.3.6.5 and restricted to maximum width region described in 6.3.6.6.

7.4 Summary

The following details shall be specified in the applicable procurement document:

(a) Force to be applied to the lead, if other than stated above.

(b) Number of cycles, if other than stated above.

(c) Bend angle, if other than stated above.

(d) Failure criteria, if other than stated above.

8 Test Condition D - Lead Torque

8.1 Purpose

This test is designed to check device leads and seals for their resistance to twisting motions.

8.2 Apparatus

The torque test requires suitable clamps and fixtures, and a torsion wrench or other suitable method of applying the specified torque without lead restriction.

8.3 Procedure

The appropriate procedure of 8.3.1 or 8.3.2 for the device under test shall be used.