

JEDEC STANDARD

Accelerated Moisture Resistance - Unbiased Autoclave

JESD22-A102E

(Revision of JESD22-A102D, November 2010)

JULY 2015

JEDEC SOLID STATE TECHNOLOGY ASSOCIATION



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TEST METHOD A102E

ACCELERATED MOISTURE RESISTANCE - UNBIASED AUTOCLAVE

(From JEDEC Board Ballots JCB-00-55, JCB-01-62, and JCB-15-27, formulated under the cognizance of the JC-14.1 Subcommittee on Reliability Test Methods for Packaged Devices.)

1 Scope

This test method applies primarily to moisture resistance evaluations and robustness testing. Samples are subjected to a condensing, highly humid atmosphere under pressure to force moisture into the package to uncover weaknesses such as delamination and metallization corrosion. This test is used to evaluate new packages or packages that have undergone changes in materials (e.g., mold compound, die passivation) or design (e.g., die/paddle sizes). However, this test should not be applied on laminate or tape based packages, i.e., FR4 material, polyimide tape or equivalent.

Some cautions should be considered when performing this test and evaluating test results. Failure mechanisms, both internal (e.g., due to plastic package swelling from saturation) and external (e.g., dendritic growth of conducting material between leads), may be produced which are not applicable to the intended application use conditions. Most semiconductor components are not rated for field applications conditions exceeding 95% RH, including condensing moisture such as rain or fog. The combination of high humidity, high temperature ($>T_g$) and high pressure may produce unrealistic material failures because absorbed moisture typically decreases the glass transition temperature for most polymeric materials. Extrapolation of autoclave test results to arrive at an application life should be accomplished with care.

The purpose of the "Unbiased Autoclave Test" is performed to evaluate the moisture resistance integrity of non-hermetic packaged solid state devices using moisture condensing or moisture saturated steam environments. It is a highly accelerated test that employs conditions of pressure, humidity and temperature under condensing conditions to accelerate moisture penetration through the external protective material (encapsulant or seal) or along the interface between the external protective material and the metallic conductors passing through it. This test is used to identify failure mechanisms internal to the package and is destructive.

2 Apparatus

The test requires a pressure chamber capable of maintaining a specified temperature, and relative humidity.

2.1 Records

A permanent record of the temperature profile for each test cycle is recommended, so the stress conditions can be verified.

2 Apparatus (cont'd)

2.2 Devices under stress

Devices under stress shall be no closer than 3 cm from the internal chamber surface, and must not be subjected to direct radiant heat.

2.3 Ionic contamination

Ionic contamination of the test apparatus and storage chamber shall be controlled to avoid test artifacts.

2.4 Distilled or deionized water

Distilled or deionized water with a minimum resistivity of 1 M Ω -cm at room temperature shall be used.

3 Test conditions

Test conditions consist of a temperature, relative humidity, vapor pressure and duration.

Table 1 — Temperature, relative humidity and pressure^{2,3}

| Temperature ¹ [dry-bulb °C] | Relative humidity ¹ [%] | Vapor pressure [kPa (psia)] |
|---|---------------------------------------|--------------------------------|
| 121 \pm 2 | 100% | 205 (29.7) |

NOTE 1 Tolerances apply to the entire usable test area.

NOTE 2 The test conditions are to be applied continuously except during any interim readouts. For interim readouts, devices should be returned to stress within the time specified in 5.2

NOTE 3 Previous revisions of this document specified the following test conditions:

| <u>Condition</u> | <u>Duration</u> |
|------------------|---------------------|
| A | 24 hours (-0,+2) |
| B | 48 hours (-0, +2) |
| C | 96 hours (-0, +5) |
| D | 168 hours (-0, +5) |
| E | 240 hours (-0, +8) |
| F | 336 hours (-0, +8). |

The stress duration is specified by internal qualification requirements, JESD47 or the applicable procurement document. 96 hours duration is typical for this test.

CAUTION: For plastic-encapsulated microcircuits, it is known that moisture reduces the effective glass transition temperature of the molding compound. Stress temperatures above the effective glass transition temperature may lead to failure mechanisms unrelated to operational use.

4 Procedure

The test devices shall be mounted in a manner which exposes them to the specified temperature and humidity conditions. Exposure of devices to ambient environments greater than 100 °C and less than 10% R.H. shall be avoided, particularly during stress ramp-up, ramp-down and the pre-readout drying period. Ramp-up and ramp-down periods should be less than 3 hours each. Care should be taken through equipment control or cool down procedures to prevent destructive depressurization of the parts under test. Frequent cleaning of the test chamber is necessary to ensure elimination of contamination.

4.1 Test clock

The test clock starts when the temperature and relative humidity reach the set points specified in clause 4 and stops at the beginning of ramp-down.

4.2 Readout

Electrical test shall be performed not sooner than 2 hours and not later than 48 hours after the end of ramp-down with room temperature testing done first in the sequence of testing. For intermediate readouts, devices shall be returned to stress within 96 hours of the end of ramp-down. The rate of moisture loss from devices after removal from the chamber can be reduced by placing the devices in sealed moisture barrier bags, the bags should be non-vacuum sealed without a N2 purge and without desiccant. When devices are placed in sealed bags, the "test window clock" runs at 1/3 of the rate of devices exposed to the laboratory ambient. Thus the test window can be extended to as much as 144 hours, and the time to return to stress to as much as 288 hours by enclosing the devices in sealed moisture barrier bags.

NOTE 1 The electrical test parameters should be chosen to preserve any defect (i.e., by limiting the applied test current).

NOTE 2 Additional time-to-test delay or return-to-stress delay time may be allowed if justified by technical data

Condensed moisture on the exterior surface of the device package may be removed through contact with an absorbing medium or isopropyl alcohol. Because the purpose of this test is to identify failure mechanisms internal to the package, cleaning of the packaged device or leads is permitted, providing it doesn't induce anomalous failures or obscure valid failures.

4.3 Handling

Hand-coverings that eliminate any source of ancillary contamination or ESD damage shall be used to handle devices and test fixtures. Contamination control is important in the application of this test method and any highly-accelerated moisture stress test.

5 Failure criteria

A device under accelerated moisture resistance shall be defined a failure if its parametric limits are exceeded, or its functionality cannot be demonstrated under nominal and worst-case conditions as specified in the applicable procurement document or data sheet. Electrical failures due to external package damage which are an artifact of the test method shall be excluded from the failure classification.

6 Safety

Follow equipment manufacturer's recommendation and local safety regulations.

7 Summary

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

- (a) Test duration.
- (b) Measurements after test.

Annex A (informative) Differences between JESD22-A102E and its predecessors

These tables briefly describe most of the non-editorial changes made to entries that appear in this standard, JESD22-A102E, compared to its predecessors, JESD22-A102D (November 2010) and JESD22-A102C (December 2000).

A.1 Differences between JESD22-A102E and JESD22-A102D

| Clause | Description of change |
|--------|--|
| 1, 4.3 | Changed “which” to “that”. |
| 3 | Changed “psia/kPa” to “kPa (psia)”. |
| 4 | 1 st paragraph, added 3 rd sentence: “Ramp-up and ramp-down periods should be less than 3 hours each.” |

A.2 Differences between JESD22-A102D and JESD22-A102C

| Clause | Description of change |
|--------|---|
| 1, 2 | Combined to align with JEDEC Style Manual, JM7. |
| All | Renumbered accordingly. |
| 4.4 | Readout: Added two notes. |

A.3 Differences between JESD22-A102C, JESD22-A102B, JESD22-A102A, and JESD22-A102

No records are available.



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JEDEC JESD22-A102E

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Requirement, clause number _____

Test method number _____ Clause number _____

The referenced clause number has proven to be:

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