IEC 60749-30

Edition 1.1　2011-08

INTERNATIONAL STANDARD

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Semiconductor devices – Mechanical and climatic test methods –
Part 30: Preconditioning of non-hermetic surface mount devices prior to reliability testing

Dispositifs à semiconducteurs – Méthodes d'essais mécaniques et climatiques –
Partie 30: Préconditionnement des composants pour montage en surface non hermétiques avant les essais de fiabilité

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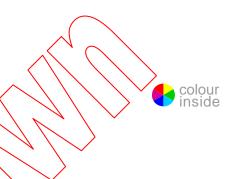Email: csc@iec.ch
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Part 30: Preconditioning of non-hermetic surface mount devices prior to reliability testing**

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et climatiques –
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SEMICONDUCTOR DEVICES –
MECHANICAL AND CLIMATIC TEST METHODS –

Part 30: Preconditioning of non-hermetic surface mount devices prior to reliability testing

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This consolidated version of IEC 60749-30 consists of the first edition (2005) [documents 47/1790/FDIS and 47/1798/RVD] and its amendment 1 (2011) [documents 47/2019/CDV and 47/2075/RVC]. It bears the edition number 1.1.

The technical content is therefore identical to the base edition and its amendment and has been prepared for user convenience. A vertical line in the margin shows where the base publication has been modified by amendment 1. Additions and deletions are displayed in red, with deletions being struck through.

International Standard IEC 60749-30 has been prepared by IEC technical committee 47: Semiconductor devices.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

IEC 60749 consists of the following parts, under the general title *Semiconductor devices – Mechanical and climatic test methods:*

Part 1:   General

Part 2:   Low air pressure

Part 3:   External visual inspection

Part 4:   Damp heat, steady state, highly accelerated stress test (HAST)

Part 5:   Steady-state temperature humidity bias life test

Part 6:   Storage at high temperature

Part 7:   Internal moisture content measurement and the analysis of other residual gases

Part 8:   Sealing

Part 9:   Permanence of marking

Part 10:   Mechanical shock

Part 11:   Rapid change of temperature – Two-fluid-bath method

Part 12:   Vibration, variable frequency

Part 13:   Salt atmosphere

Part 14:   Robustness of terminations (lead integrity)

Part 15:   Resistance to soldering temperature for through-hole mounted devices

Part 16:   Particle impact noise detection (PIND)

Part 17:   Neutron irradiation

Part 18:   Ionizing radiation (total dose)

Part 19:   Die shear strength

Part 20:   Resistance of plastic-encapsulated SMDs to the combined effect of moisture and soldering heat

Part 21:   Solderability

Part 22:   Bond strength

Part 23:   High temperature operating life

Part 24:   Accelerated moisture resistance – Unbiased HAST

Part 25:   Temperature cycling

Part 26:   Electrostatic discharge (ESD) sensitivity testing – Human body model (HBM)

Part 27:   Electrostatic discharge (ESD) sensitivity testing – Machine model (MM)

Part 28:   Electrostatic discharge (ESD) sensitivity testing – Charged device model (CDM)[1]

Part 29:   Latch-up test

Part 30:   Preconditioning of non-hermetic surface mount devices prior to reliability testing[1]

Part 31:   Flammability of plastic-encapsulated devices (internally induced)

Part 32:   Flammability of plastic-encapsulated devices (externally induced)

Part 33:   Accelerated moisture resistance – Unbiased autoclave

Part 34:   Power cycling

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[1] To be published

Part 35:   Acoustic microscopy for non-hermetic, encapsulated electronic components[2]

Part 36:   Acceleration, steady state.

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[2] In preparation

SEMICONDUCTOR DEVICES –
MECHANICAL AND CLIMATIC TEST METHODS –

Part 30: Preconditioning of non-hermetic surface mount devices prior to reliability testing

1 Scope

This part of IEC 60749 establishes a standard procedure for determining the preconditioning of non-hermetic surface mount devices (SMDs) prior to reliability testing.

The test method defines the preconditioning flow for non-hermetic solid-state SMDs representative of a typical industry multiple solder reflow operation.

These SMDs should be subjected to the appropriate preconditioning sequence described in this standard prior to being submitted to specific in-house reliability testing (qualification and/or reliability monitoring) in order to evaluate long term reliability (impacted by soldering stress).

NOTE   Correlation of moisture-induced stress sensitivity conditions (or moisture sensitivity levels (MSL)) in accordance with IEC 60749-20 and this specification and actual reflow conditions used are dependent upon identical temperature measurement by both the semiconductor manufacturer and the board assembler. Therefore, it is recommended that the temperature at the top of the package on the hottest moisture sensitive SMD during assembly be monitored to ensure that it does not exceed the temperature at which the components are evaluated.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60749-4, *Semiconductor devices – Mechanical and climatic test methods – Part 4: Damp heat, steady state, highly accelerated stress test (HAST)*

IEC 60749-5, *Semiconductor devices – Mechanical and climatic test methods – Part 5: Steady-state temperature humidity bias life test*

IEC 60749-11, *Semiconductor devices – Mechanical and climatic test methods – Part 11: Rapid change of temperature – Two-fluid-bath method*

IEC 60749-20:2008~~2~~, *Semiconductor devices – Mechanical and climatic test methods – Part 20: Resistance of plastic-encapsulated SMDs to the combined effects of moisture and soldering heat*

IEC 60749-24, *Semiconductor devices – Mechanical and climatic test methods – Part 24: Accelerated moisture resistance – Unbiased HAST*

IEC 60749-25:2003, *Semiconductor devices – Mechanical and climatic test methods – Part 25: Temperature cycling*

IEC 60749-33, *Semiconductor devices – Mechanical and climatic test methods – Part 33: Accelerated moisture resistance – Unbiased autoclave.*

3 General description

Package cracking and electrical failure in plastic encapsulated SMDs can result when soldering heat raises the vapour pressure of moisture which has been absorbed into SMDs during storage. In this test method, such problems are assessed and SMDs are evaluated for heat resistance after being soaked in an environment which simulates moisture being absorbed while under storage in a warehouse or dry pack.

4 Test apparatus and materials

This test method requires, as a minimum, access to the following equipment.

4.1 Moisture chamber

Moisture chamber(s) capable of operating at 85 °C/85 % RH (relative humidity), 85 °C/60 % RH, 85 °C/30 % RH, 30 °C/70 % RH and 30 °C/60 % RH. Within the chamber working area, temperature tolerance shall be ±2 °C and the RH tolerance shall be ±3 % RH.

4.2 Solder equipment

Solder equipment shall consist of the following.

a) 100 % convection reflow system capable of maintaining the reflow profiles required by this specification. This is the preferred equipment for solder reflow.

b) VPR (vapour phase reflow) chamber capable of operating from 215-219 °C and/or (235 ± 5) °C with appropriate fluids. The chamber shall be capable of heating the packages without collapsing the vapour blanket and re-condensing the vapour to minimize loss of the vapour phase soldering liquid. The vapour phase soldering fluid shall vaporize at the appropriate temperature specified above.

c) Infrared (IR)/convection solder reflow equipment capable of maintaining the reflow profiles required by this specification. It is recommended that this equipment use the IR to heat the air and not directly impinge upon the components under test.

d) Wave-solder equipment capable of maintaining the conditions of item ~~d)3) of Clause 5~~ 5.4.4 of IEC 60749-20:2008.

NOTE The moisture sensitivity condition (classification) test results are dependent upon the package body temperature, rather than board or lead temperature. Convection and VPR are known to be more controllable and repeatable than IR. When there are correlation problems between VPR, IR/convection, and convection, the convection results should be considered as the standard.

4.3 Optical microscope

Optical microscope (40X for external visual examination).

4.4 Electrical test equipment

Electrical test equipment capable of performing room temperature d.c. test and functional tests.

4.5   Drying (bake) oven

Oven for drying (bake) capable of operating at 125 $^{+5}_{0}$ °C.

4.6   Temperature cycle chamber (optional)

A temperature cycle chamber capable of operating as a minimum over a range of −40 $^{0}_{-10}$ °C to

+60 $^{+10}_{0}$ °C in accordance with IEC 60749-25. Acceptable alternative test conditions and

temperature tolerances are found in Table 1 of IEC 60749-25. This equipment is only required
if 5.3, the shippability option, is used.

5   Procedure

5.1   General

It is recommended that a prior evaluation should be run according to the moisture sensitivity
levels (MSL) detailed in IEC 60749-20, using the appropriate method and similar devices, to
determine which preconditioning sequence is suitable, i.e. likely to pass. Other moisture
evaluation data may be consulted. However, the soak sequence in 5.5 needs to be consistent
with the floor life information in Tables 4a and 4b 1 and 2.

5.2   Initial measurements

5.2.1   Electrical test

Perform an electrical d.c. test and functional test to verify that the devices meet the room
temperature data sheet specification. Replace any devices that fail to meet this requirement.

5.2.2   Visual inspection

Perform an external visual examination under 40× optical magnification to ensure that no
devices with external cracks or other damage are used in this test method. If mechanical
rejects are found, corrective action shall be implemented in the manufacturing process and a
new sample drawn from a product which has been processed with the corrective action.

5.3   Temperature cycling (optional)

Perform 5 cycles of temperature cycle from −40 °C (or lower) to +60 °C (or higher) to simulate
shipping conditions. This step is optional unless required by the relevant specification.

5.4   Drying (bake out)

Bake the devices for at least 24 h minimum at (125 ± 5) °C. This step is intended to remove
moisture from the package so that it will be "dry".

NOTE 1   This time may be modified if desorption data on the particular device being preconditioned shows that
more or less time is required to obtain a "dry" package.

NOTE 2   If the preconditioning sequence is being performed by the semiconductor manufacturer, steps 5.2.1,
5.2.2 and 5.4 are optional since they are at the supplier's own risk. If the preconditioning sequence is being
performed by the user, step 5.8 is optional.

5.5 Soak conditions for dry-packed SMDs

The following soak conditions shall apply to the levels shown in Table 1, Table 2, Table 4a and Table 4b. The soak should be initiated within 2 h of bake.

5.5.1 Method A for dry-packed SMDs in accordance with IEC 60749-20

This test shall be carried out in accordance with item c)1)i) of Clause 5, Method A, of IEC 60749-20 (see Table 1) 5.3.3.2, Method A, of IEC 60749-20:2008 and Table 1 of this standard.

Table 1 – Moisture soak conditions for dry-packed SMDs (method A)

Condition		Moisture soak conditions	Permissible storage conditions in the dry pack and the dry cabinet	Condition of floor life
First-stage conditioning	A1	(85 ± 2) °C, (30 ± 5) % RH, $168\,^{24}_{-0}$ h	<30 °C, 30 % RH, 1 year	–
Second-stage conditioning	A2	(30 ± 2) °C, (70 ± 5) % RH, $168\,^{24}_{-0}$ h	–	<30 °C, 70 % RH, 168 h

NOTE 1 The first stage of conditioning represents storage conditions in the dry pack and the dry cabinet, as well as increasing relative humidity in the dry pack, by repacking the SMDs at the distributor's facility and the user's inspection facility. When condition A1 is applied, the SMDs should be packed into a moisture-proof bag with packing materials and desiccants within a few weeks of drying. They may then be subjected to multiple temporary openings of the moisture-proof bag (for several hours at a time). Repack and inspection of SMDs are possible while the humidity indicator in the dry pack indicates less than 30 % RH, since SMDs will recover the initial condition of absorbed moisture within a few days of repacking. In this case, the moisture content measurement of SMDs (see Clause B.2 of IEC 60749-20) is not needed as a moisture control of the dry pack. A check of the moisture indicator is sufficient for moisture control.

NOTE 2 When moisture soak of the first-stage conditioning does not result in saturation, the soak time is extended to 336 h, because SMDs in a dry pack or dry cabinet will become saturated with moisture during long-term storage. When moisture soak of the first stage of conditioning reaches saturation, the soak time is shortened.

5.5.2 Method B for dry-packed SMDs in accordance with IEC 60749-20

This shall be carried out in accordance with item c)1)ii) of Clause 5, Method B, of IEC 60749-20 (see Table 2) 5.3.3.3, Method B, of IEC 60749-20:2008 and Table 2 of this standard.

a) Subject condition B1 (MSL level 2) devices to 168 h of 85 °C/60 % RH.

b) Subject conditions B2–B6 devices to "Z" h (see Table 2) of 30 °C/60 % RH.