

INTERNATIONAL STANDARD



**Semiconductor devices – Mechanical and climatic test methods –
Part 20-1: Handling, packing, labelling and shipping of surface-mount devices
sensitive to the combined effect of moisture and soldering heat**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**SEMICONDUCTOR DEVICES –
MECHANICAL AND CLIMATIC TEST METHODS –**

**Part 20-1: Handling, packing, labelling and shipping of surface-mount
devices sensitive to the combined effect of moisture and soldering heat**

FOREWORD

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This second edition cancels and replaces the first edition published in 2009. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) updates to subclauses to better align the test method with IPC/JEDEC J-STD-033C, including new sections on aqueous cleaning and dry pack precautions;
- b) addition of two annexes on colorimetric testing of HIC (humidity indicator card) and derivation of bake tables.

The text of this standard is based on the following documents:

FDIS	Report on voting
47/2565/FDIS	47/2579/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

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

A list of all parts in the IEC 60749 series, published under the general title *Semiconductor devices – Mechanical and climatic test methods*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

The advent of surface-mount devices (SMDs) introduced a new class of quality and reliability concerns regarding package damage "cracks and delamination" from the solder reflow process. This document describes the standardized levels of floor life exposure for moisture/reflow-sensitive SMDs along with the handling, packing and shipping requirements necessary to avoid moisture/reflow-related failures. IEC 60749-20 defines the classification procedure and Annex A of this document defines the labelling requirements.

Moisture from atmospheric humidity enters permeable packaging materials by diffusion. Assembly processes used to solder SMDs to printed circuit boards (PCBs) expose the entire package body to temperatures higher than 200 °C. During solder reflow, the combination of rapid moisture expansion, materials mismatch, and material interface degradation can result in package cracking and/or delamination of critical interfaces within the package.

~~The solder reflow processes of concern are convection, convection/IR, infrared (IR), vapour phase (VPR) and hot air rework tools. The use of assembly processes that immerse the component body in molten solder are not recommended for most SMDs.~~

~~This first edition of IEC 60749-20-1 is based principally on IPC/JEDEC J-STD-033¹ and the permission to use this standard is gratefully acknowledged. It is also based on contributing documents from various national committees.~~

Typical solder reflow processes of concern for all devices are infrared (IR), convection/IR, convection, vapour phase reflow (VPR), hot air rework tools, and wave solder, including full immersion.

Non-semiconductor devices can exhibit additional process sensitivities beyond moisture sensitivity such as thermal sensitivity, flux sensitivity, or cleaning process sensitivity.

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¹—Refer to Bibliography.

SEMICONDUCTOR DEVICES – MECHANICAL AND CLIMATIC TEST METHODS –

Part 20-1: Handling, packing, labelling and shipping of surface-mount devices sensitive to the combined effect of moisture and soldering heat

1 Scope

This part of IEC 60749 applies to all ~~non-hermetic SMD packages which are subjected to reflow solder processes and~~ devices subjected to bulk solder reflow processes during PCB assembly, including plastic encapsulated packages, process sensitive devices, and other moisture-sensitive devices made with moisture-permeable materials (epoxies, silicones, etc.) that are exposed to the ambient air.

The purpose of this document is to provide SMD manufacturers and users with standardized methods for handling, packing, shipping, and use of moisture/reflow sensitive SMDs that have been classified to the levels defined in IEC 60749-20. These methods are provided to avoid damage from moisture absorption and exposure to solder reflow temperatures that can result in yield and reliability degradation. By using these procedures, safe and damage-free reflow can be achieved, with the dry packing process, providing a minimum shelf life capability in sealed dry-bags from the seal date.

Two test conditions, method A and method B, are specified in the soldering heat test of IEC 60749-20. For method A, moisture soak conditions are specified on the assumption that moisture content inside the moisture barrier bag is less than 30 % RH. For method B, moisture soaking conditions are specified on the assumption that manufacturer's exposure time (MET) does not exceed 24 h and the moisture content inside the moisture barrier bag is less than 10 % RH. In an actual handling environment, SMDs tested by method A are permitted to absorb moisture up to 30 % RH, and SMDs tested by method B are permitted to absorb moisture up to 10 % RH. This document specifies the handling conditions for SMDs subjected to the above test conditions.

NOTE Hermetic SMD packages are not moisture sensitive and do not require moisture precautionary handling.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60749-20, *Semiconductor devices – Mechanical and climatic test methods – Part 20: Resistance of plastic-encapsulated SMDs to the combined effect of moisture and soldering heat*

IEC 60749-30, *Semiconductor devices – Mechanical and climatic test methods – Part 30: Preconditioning of non-hermetic surface mount devices prior to reliability testing*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1 **active desiccant**

desiccant that is either fresh (new) or has been baked according to the manufacturer's recommendations to renew it to original specifications

3.2 **bar code label**

label that gives information in a code consisting of parallel bars and spaces, each of various specific widths

Note 1 to entry: For the purposes of this document, the bar code label is on the lowest level shipping container and includes information that describes the product, e.g. part number, quantity, lot information, supplier identification, ~~and~~ moisture-sensitivity level ~~etc.~~

3.3 **mass reflow**

reflow of a number of components with simultaneous attachment by an infrared (IR), convection/IR, convection, or vapour phase reflow (VPR) process

3.4 **carrier**

container that directly holds components such as a tray, tube, or tape and reel

3.5 **desiccant**

absorbent material used to maintain a low relative humidity

3.6 **floor life**

allowable time period for a moisture-sensitive device, after removal from a moisture barrier bag, dry storage or dry bake and before the solder reflow process

3.7 **humidity indicator card** **HIC**

~~card on which a moisture sensitive chemical is applied in such a way that it will make a significant, perceptible change in colour (hue), typically from blue (dry) to pink (wet) when the indicated relative humidity is exceeded~~

card printed with a moisture-sensitive chemical (cobalt bromide) that changes from blue to pink in the presence of water vapour

Note 1 to entry: The HIC is packed inside the moisture-barrier bag, along with a desiccant, to aid in determining the level of moisture to which the moisture-sensitive devices have been subjected.

Note 2 to entry: This note applies to the French language only.

3.8 **manufacturer's exposure time** **MET**

maximum time after bake that the component manufacturer requires to process components prior to bag seal, and that also includes the maximum time allowed at the distributor for having the bag open to split out smaller shipments

Note 1 to entry: This note applies to the French language only.

3.9
moisture barrier bag
MBB

~~bag designed to restrict the transmission of water vapour and used to pack moisture-sensitive devices~~

storage bag manufactured with a flexible laminated vapour barrier film that restricts the transmission of water vapour

Note 1 to entry: This note applies to the French language only.

3.10
rework

removal of a component for scrap, reuse, or failure analysis; replacement of an attached component; or heating and repositioning of a previously attached component

3.11
shelf-life

maximum storage period for a dry-packed moisture-sensitive device in an unopened moisture barrier bag (MBB) to avoid exceeding the specified interior bag ambient humidity

3.12
surface-mount device
SMD

plastic-encapsulated surface-mount devices made with moisture-permeable materials

Note 1 to entry: For the purposes of this document, the term "SMD" is limited as indicated in the above definition.

3.13
solder reflow

solder attachment process in which previously applied solder or solder paste is melted to attach a component to the printed circuit board

3.14
water vapour transmission rate
WVTR

measure of the permeability of plastic film or metallized plastic film material to moisture

4 General applicability and reliability considerations

4.1 Assembly processes

4.1.1 Mass reflow

This document applies to mass solder reflow assembly by convection, convection/IR, infrared (IR), and vapour phase (VPR), processes. It does not apply to mass solder reflow processes that immerse the component bodies in molten solder (e.g. wave soldering bottom mounted components). Such processes are not allowed for many SMDs and are not covered by the component qualifications standards used as a basis for this document.

4.1.2 Localized heating

This document also applies to moisture-sensitive SMDs that are removed or attached singly by local ambient heating, i.e. "hot air rework". See Annex B.

4.1.3 Socketed components

This document does not apply to SMDs that are socketed and not exposed to solder reflow temperatures. Such SMDs are not at risk and do not require moisture precautionary handling.

4.1.4 Point-to-point soldering

This document does not apply to SMDs in which only the leads are heated to reflow the solder, e.g. hand-soldering, hot bar attach of gull-wing leads, and through hole by wave soldering. The heat absorbed by the SMD body from such operations is typically much lower than that for mass surface mount reflow or hot air rework, and moisture precautionary measures are typically not needed.

4.1.5 Aqueous cleaning

For non-cavity SMDs, typical short-term aqueous cleaning processes will not impact the floor life (internal moisture content). Special consideration should be given to non-hermetic cavity packages.

4.2 Reliability

The methods set forth in this specification ensure that an adequate SMD reliability can be achieved during and after the PCB assembly operation, when the SMDs are evaluated and verified by IEC 60749-20 and/or by IEC 60749-30, together with environmental reliability testing.

This specification does not address or ensure solder joint reliability of attached components.

5 Dry packing

5.1 Requirements

Dry packing requirements for the various moisture sensitivity levels are shown in Table 1. The levels are determined in accordance with IEC 60749-20 and/or IEC 60749-30, together with reliability testing. As a minimum, all materials used in dry packing should conform to relevant national packaging material standards for ESD-sensitive items.

Table 1 – Dry packing requirements

Level	Dry before bag	MBB	Desiccant	MSID ^a label	Caution label
A1 or B1	Optional	Optional	Optional	Not required	Not required if classified at 220 °C to 225 °C
					Required ^b if classified at other than 220 °C to 225 °C
A2 or B2	Optional	Required	Required	Required	Required
B2a-B5a	Required	Required	Required	Required	Required
B6	Optional	Optional	Optional	Required	Required

^a MSID = moisture-sensitive identification label.

^b A "Caution" label is not required if level and reflow temperature are given, in human readable form, on the barcode label attached to the lowest level shipping container.

5.2 Drying of SMDs and carrier materials before being sealed in MBBs

5.2.1 Drying requirements – level A2

Packing of the SMDs classified as Level A2 into MBBs shall be carried out within one week under the environmental condition below 30 °C/60 % RH after moulding, burn-in, or bake.

MET is not specified for Level A2 SMDs.

MBBs may be opened for a short period of time (less than 1 h) and re-closed provided that the HIC indicates a humidity of less than 30 % RH and provided that the desiccant is replaced with fresh desiccant. When the MBB is next opened, as long as the HIC indicates below 30 % RH, the duration time of the previous MBB's opening may be disregarded. Thus, if the HIC indicates below 30 % RH when MBB is opened, the floor life is not dependent on the duration time of the MBB's opening, and is 168 h at 30 °C/70 % RH.

5.2.2 Drying requirements – levels B2a to B5a

SMDs classified from Levels B2a through to B5a shall be dried (see Clause 6) prior to being sealed in MBBs. The period between drying and sealing shall not exceed the MET less the time allowed for distributors to open the bags and repack parts. If the supplier's actual MET is more than the default 24 h, then the actual time shall be used. If the distributor practice is to repack the MBBs with active desiccant, then this time does not need to be subtracted from the MET.

5.2.3 Drying requirements – carrier materials

The materials from which carriers (such as trays, tubes, reels, ~~etc.~~) are made can affect the moisture level when placed in the MBB. Therefore, the effect of these materials shall be compensated for by baking or, if required, adding additional desiccant in the MBB to ensure the shelf life of the SMDs (see 6.3).

5.2.4 Drying requirements – other

Suppliers may use the drying effect of normal in-line processes such as post-mould cure, marking cure, and burn-in to reduce the bake time. An equivalency evaluation is recommended to ensure that high-temperature processing maintains moisture weight gain to an acceptable level. The total weight gain for the SMD at the time it is sealed in the MBB shall not exceed the moisture gain of that SMD starting dry and then being exposed to 30 °C/60 % RH for MET h (less the time for distributors).

5.2.5 Excess time between bake and bag

If the allowable time between bake and bag is exceeded, the SMDs shall be redried in accordance with Clause 6.

5.3 Dry pack

5.3.1 Description

A dry pack consists of desiccant material and a humidity indicator card (HIC) sealed with the SMDs and their carriers inside a moisture barrier bag (MBB). A representative dry pack configuration is shown in Figure 1.