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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Surface mounting technology – Part 4: Classification, packaging, labelling and handling of moisture sensitive devices

Technique du montage en surface (SMT) – Partie 4: Classification, emballage, étiquetage et manipulation des dispositifs sensibles à l'humidité

IEC 61760-4:2015-05(en-fr)

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FOREWORD

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

FDIS	Report on voting
91/1244FDIS	91/1259/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 61760, published under the general title *Surface mounting technology*, can be found on the IEC website.

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

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- withdrawn,
- replaced by a revised edition, or
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INTRODUCTION

Due to the higher temperature profiles of reflow soldering processes using tin-silver-copper alloys or other lead-free solder alloys with higher melting temperatures than Sn-Pb eutectic solder, the sensitivity of components against soldering heat, when being exposed to moisture before soldering, becomes an increasingly important factor.

The currently existing standards describing the moisture sensitivity classification of devices are applicable for plastic encapsulated semiconductors and similar solid state packages (e.g. IEC 60749-20), but not for other types of components.

This part of IEC 61760 also extends the classification and packaging methods as described in J-STD-020 and J-STD-033. It is intended to be used for such type of components, where J-STD-020 and J-STD-033 are not required or not appropriate.

SURFACE MOUNTING TECHNOLOGY –

Part 4: Classification, packaging, labelling and handling of moisture sensitive devices

1 Scope

This part of IEC 61760 specifies the classification of moisture sensitive devices into moisture sensitivity levels related to soldering heat, and provisions for packaging, labelling and handling.

This part of IEC 61760 extends the classification and packaging methods to such components, where currently existing standards are not required or not appropriate. For such cases this standard introduces additional moisture sensitivity levels and an alternative method for packaging.

This standard applies to devices intended for reflow soldering, like surface mount devices, including specific through-hole devices (where the device supplier has specifically documented support for reflow soldering), but not to

- semiconductor devices,
- devices for flow (wave) soldering.

NOTE Background of this standard and its relation to currently existing standards, e.g. IEC 60749-20 or J-STD-020 and J-STD-033, are described in the INTRODUCTION.

2 Normative references

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

IEC 60068-1, *Environmental testing – Part 1: General and guidance*

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 61340-5-1, *Electrostatics – Part 5-1: Protection of electronic devices from electrostatic phenomena – General requirements*

IEC 61760-2, *Surface mounting technology – Part 2: Transportation and storage conditions of surface mounting devices (SMD) – Application guide*

IPC/JEDEC J-STD-020D.1, *March 2008, Moisture/Reflow Sensitivity Classification for Non-hermetic Solid State Surface Mount Devices*

3 Terms and definitions

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

3.1
moisture sensitive device
MSD
device, where during soldering the evaporation of absorbed moisture is likely to deteriorate its electrical or mechanical performance compared to what is given in the relevant specification

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

3.2
moisture sensitivity level
MSL
rating indicating a device's susceptibility to damage due to absorbed moisture when subjected to reflow soldering

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

3.3
moisture barrier bag
MBB
bag designed to restrict the transmission of water vapour and used to pack moisture sensitive devices

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

3.4
manufacturer's exposure time
MET
maximum time after baking that the component manufacturer requires to process components prior to sealing of the bag

Note 1 to entry: The manufacturer's exposure time also includes the maximum time allowed at the distributor in order to keep the bag open to split up its content into smaller shipments.

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

3.5
floor life
allowable time for a device or semi-finished assembly to be exposed to normal room environment humidity and temperature after removal from a moisture barrier bag or storage chamber and before a solder reflow process

3.6
shelf life
recommendation of time that products can be stored in the original packaging, during which the defined quality of the goods remains acceptable under specified conditions of transportation, storage and handling

3.7
active desiccant
absorbent material used to maintain a low relative humidity

3.8
unit of desiccant
amount of active desiccant that will absorb a minimum of 2,85 g of water vapour at 25 °C and a relative humidity of 20 % within 24 h

3.9
moisture indicating desiccant
desiccant whose colour (hue) changes perceptibly, when a certain relative humidity is exceeded

Note 1 to entry: Typically a colour change due to a moisture indicating desiccant is from blue to pink, when the change from dry state to wet state is detected.

3.10
humidity indicator card
HIC
card on which a moisture sensitive chemical is printed such that it changes colour from dry to wet when the indicated relative humidity is exceeded

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

3.11
water vapour transmission rate
WVTR
measure of the permeability of a plastic film material to moisture, used to specify a moisture barrier bag for dry packing

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

4 General information

4.1 Moisture sensitive devices

Certain materials, plastic polymers and fillers are hygroscopic and can absorb moisture dependent on time and the storage environment. Absorbed moisture will vaporize during rapid heating in the solder reflow process, generating

- pressure in the material,
- deformation,
- swelling,
- delamination,
- cracking,
- degradation of inner connection.

The penetration of moisture into the absorbing material is generally caused through exposure to the ambient air. Moisture absorption or moisture penetrating into cavities can lead to moisture concentrations in the device which are high enough to cause cracking and/or delamination to the device during the soldering process (e.g. “popcorn phenomenon”), which may adversely affect reliability.

NOTE “Popcorn phenomenon”: internal stress causes the package to bulge and then crack with an audible “pop”.

Moisture can also influence the bonding strength of adhesives, sealings, encapsulants, plastics with galvanic coating, etc.

Moisture exposure also can induce the transport of ionic contaminations into the device, thereby increasing the potential for circuit failure due to corrosion.

Hence it is necessary to dry moisture-sensitive devices, to seal them in a moisture barrier bag and only to remove them immediately prior to soldering onto the PCB. The permissible time from the opening of the moisture barrier bag until the final soldering process that a device can remain unprotected in an environment with a level of humidity approximating to real-world conditions (e.g. 30 °C/60 % RH) is a measure of the sensitivity of the device to ambient humidity. This amount of time is called floor life.

4.2 Moisture sensitivity level (MSL)

The moisture sensitivity level (MSL) is determined at the classification temperature, which is set above practical soldering temperatures. The actual soldering temperature measured at the top surface of the component therefore shall be less than the classification temperature.

Packaging, storage, floor life and pre-treatment of moisture sensitive devices before being subjected to reflow soldering processes are identified by the MSL (see Clause 5 and Table 1).

The method for classification of devices into MSL is described in Clause 6.

4.3 Relation to other environmental test methods (humidity tests)

In humidity tests, e.g. as in IEC 60068-2-78, devices are tested as they are (unmounted) or in mounted condition, e.g. soldered to a test board. These tests detect the influence of adsorbed or absorbed moisture to the performance of the device, e.g. electrical characteristics, corrosion effects, but cannot detect the influence of absorbed moisture to the sensitivity against heat stresses of the soldering processes.

The target of the test method described in this standard is to test the resistance of devices against the soldering heat in combination with the humidity load as preconditioning process.

Other effects of humidity, like detoriation of electrical characteristics or isolation properties, are not covered by this standard and need to be tested separately.

5 Assessment of moisture sensitivity

5.1 Identification of non moisture sensitive devices

Non moisture sensitive devices shall be identified by analysis of design and materials of devices depending on whether they can absorb humidity, or humidity can penetrate into cavities. If the materials apparently do not absorb humidity, the devices may be declared by the manufacturer as non moisture sensitive.

Such non moisture sensitive devices shall be designated as level “N”. There are no requirements for non moisture sensitive devices.

5.2 Classification

The procedure to classify moisture sensitive devices into MSL is described in Clause 6. The devices are classified at the appropriate classification temperature selected from Table 3 and Table 4.

The recommended procedure is to start testing at the lowest moisture sensitivity level, which the evaluation package is reasonably expected to pass (based on knowledge of other similar evaluation packages).

If supplier and user agree, components can be classified at temperatures other than those in Table 4.

If the conditions in Table 1 and/or Table 2 are not suitable for a specific product, other conditions can be applied according to the agreement between users and suppliers.

Table 1 – Moisture sensitivity levels

LEVEL	Floor life time	Floor life condition (reference condition)	Shelf life	Protective packaging	Desic-cant	Humidity indicator
1	[a]	≤30 °C/85 % RH	12 months or as specified by the supplier	No requirement		
2	1 year [a]	≤30 °C/60 % RH		MBB type 1[b], <60 % RH in MBB no pre-drying	No	Optional [c]
C2a	4 weeks	≤30 °C/60 % RH		MBB type 1[b], <30 % RH in MBB no pre-drying	Yes	Yes [c]
2a				MBB type 2 [b], <10 % RH in MBB pre-drying		
C3	168 h	≤30 °C/60 % RH		MBB type 1[b], <30 % RH in MBB no pre-drying	Yes	Yes [c]
3				MBB type 2 [b], <10 % RH in MBB pre-drying		
4	72 h	≤30 °C/60 % RH		MBB type 2 [b], <10 % RH in MBB pre-drying	Yes	Yes [c]
5	48 h	≤30 °C/60 % RH		MBB type 2 [b], <10 % RH in MBB pre-drying	Yes	Yes [c]

The floor life can be longer if the environmental conditions are less severe than the reference condition, or shorter, if more severe.

Extended shelf life can be agreed upon, but needs recalculation of the amount of desiccant.

[a] The sum of keeping time at floor and storage time should not exceed the maximum storage period as specified by the supplier.

[b] The required shelf life and humidity in packed condition shall be assured by the amount of the desiccant, calculated by the use of WVTR (water vapour transmission rate) of the applied MBB. For the description of MBB type, see Table 5.

[c] Humidity indicator can be HIC or moisture indicating desiccant.

6 Test procedure

6.1 General

6.1.1 Structurally similar components

Classification may be performed for a group of structurally similar components. Information about structural similarity shall be given in the relevant specification.

6.1.2 Verification and validation tests

The relevant specification shall describe the minimum number of specimens to be tested. The minimum number should be at least 11 pieces.

NOTE A sample of 11 pieces tested with an acceptance number zero represents a Lot Tolerance Percent Defective (LTPD) of 20 % with a confidence level (C.L.) of 90 %. See ISO 2859-1 for further information.

6.1.3 Selection of applicable soak conditions and temperature profile

The soak conditions related to the MSL shall be selected from Table 2, the applicable temperature profile for classification (Figure 1) from Table 3 and Table 4.

6.2 Drying

Unless otherwise specified in the relevant specification, the specimen shall be baked at 125 °C ± 5 °C for at least 24 h.

However, alternative baking conditions can be applied, when confirmed by the mass gain or loss analysis as described in Annex B.

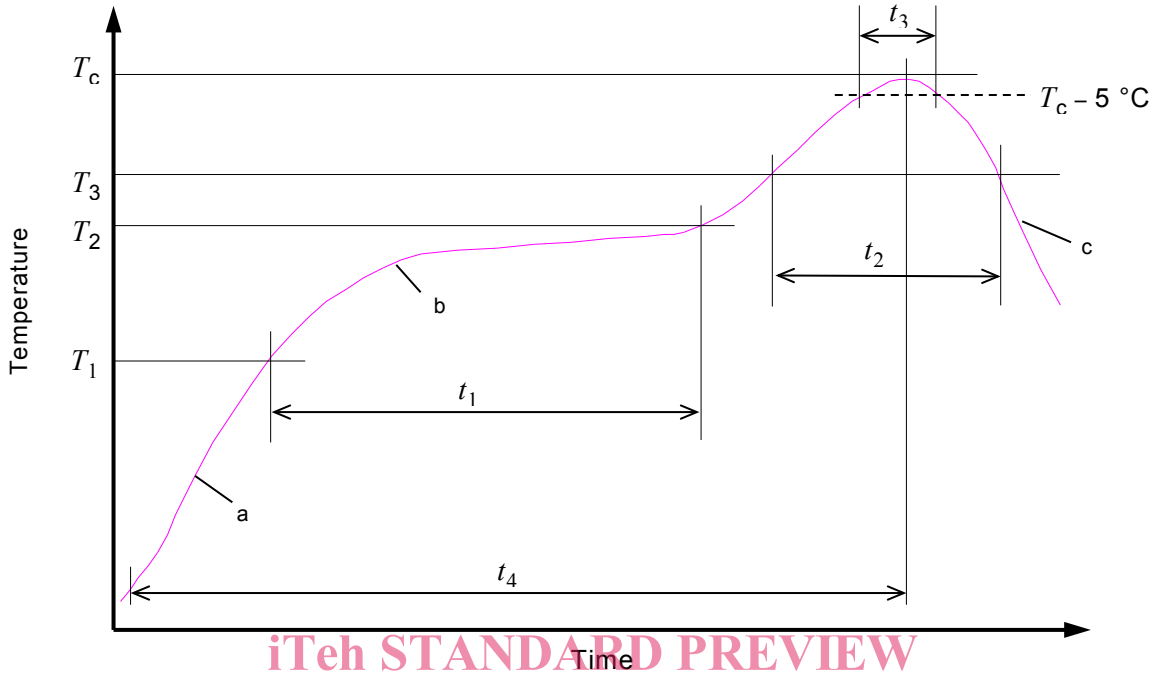
6.3 Moisture soak

Table 2 – Moisture soak conditions

LEVEL	Soak time h	Soak condition [a]	Alternative
1	(168 +5/-0)	(85 ± 2) °C, (85 ± 5) % RH	(336 +5/-0) h; (85 ± 2) °C, (60 ± 5) % RH
2	(168 +5/-0)	(85 ± 2) °C, (60 ± 5) % RH	–
C2a	(168 +5/-0) followed by (672 +5/-0)	(85 ± 2) °C, (30 ± 5) % RH, followed by (30 ± 2) °C, (60 ± 5) % RH	–
2a	(696 + 5/-0)	(30 ± 2) °C, (60 ± 5) % RH	
C3	(168 +5/-0) followed by (168 +5/-0)	(85 ± 2) °C, (30 ± 5) % RH, followed by (30 ± 2) °C, (60 ± 5) % RH	
3	(192 +5/-0)	(30 ± 2) °C, (60 ± 5) % RH	
4	(96 +2/-0)	(30 ± 2) °C, (60 ± 5) % RH	
5	(72 +2/-0)		
In levels C2a and C3, the first stage of soak condition corresponds to shelf life (≤30 °C, ≤30 % RH, 1 year) in the MBB type 1. The second stage of soak condition corresponds to floor life (see IEC 60749-20).			
[a] Soak conditions according to IPC/JEDEC J-STD-020D.1. Alternatively accelerated equivalent soak conditions from Table 5-1 in J-STD-020D.1:2008 may be applied in case the activation energy is confirmed by the manufacturer.			

6.4 Temperature load

6.4.1 Classification temperature profile



Key

T_1 Minimum preheating temperature

T_2 Maximum preheating temperature

T_3 Liquidus temperature

T_c Classification temperature

t_1 Preheating duration

t_2 Time at liquidus

t_3 Time within (T_c – 5 °C)

t_4 Time to T_c

a The temperature gradient of the increasing slope shall not exceed 3 K/s.

b Preheat area.

c The temperature gradient of the decreasing slope shall not exceed 6 K/s.

Figure 1 – Classification temperature profile