



IEC 61760-4

Edition 2.0 2026-05

# INTERNATIONAL STANDARD

REDLINE VERSION

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

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## CONTENTS

FOREWORD .....	3
INTRODUCTION .....	1
1 Scope .....	6
2 Normative references .....	6
3 Terms and definitions .....	6
4 General information .....	8
4.1 Moisture sensitive devices .....	8
4.2 Moisture sensitivity level (MSL).....	8
4.3 Relation to other environmental test methods (humidity tests).....	9
5 Assessment of moisture sensitivity .....	9
5.1 Identification of non-moisture sensitive devices .....	9
5.2 Classification .....	9
6 Test procedure .....	10
6.1 General.....	10
6.1.1 Structurally similar components .....	10
6.1.2 Verification and validation tests .....	10
6.1.3 Selection of applicable soak conditions and temperature profile .....	10
6.2 Drying .....	10
6.3 Moisture soak .....	11
6.4 Temperature load.....	11
6.4.1 Classification temperature profile.....	11
6.4.2 Classification temperature profile for special devices.....	13
6.4.3 Reflow .....	13
6.5 Recovery .....	14
6.6 Final measurements.....	14
6.6.1 Requirements .....	14
6.6.2 Visual inspection .....	14
6.6.3 Electrical measurements.....	15
6.6.4 Non-destructive inspection (if required) .....	15
6.7 Classification .....	15
6.8 Information to be given in the relevant specification .....	15
7 Requirements to packaging and labelling.....	15
7.1 Packaging process.....	15
7.1.1 Drying of MSDs and carrier materials before being sealed in MBBs .....	15
7.1.2 Evacuation and sealing.....	16
7.2 Packaging material for dry pack.....	16
7.2.1 Moisture barrier bag (MBB).....	16
7.2.2 Desiccant .....	17
7.2.3 Humidity indicator.....	19
7.3 Information to be given on labels .....	19
8 Handling of moisture sensitive devices .....	20
8.1 Storage.....	20
8.1.1 Recommended storage conditions .....	20
8.1.2 Shelf life .....	20
8.1.3 Floor life .....	21
8.2 ESD.....	21

8.3	Humidity indication.....	21
8.3.1	Humidity indicator card (HIC).....	21
8.3.2	Moisture indicating desiccant.....	22
8.4	Unpacking and re-packing.....	22
9	Drying .....	22
9.1	Drying options.....	22
9.2	Methods.....	23
9.2.1	General considerations for baking .....	23
9.2.2	Bakeout times.....	24
9.2.3	ESD protection .....	24
9.2.4	Reuse of carriers .....	24
9.2.5	Solderability limitations.....	24
Annex A (informative)	Moisture sensitivity of assemblies .....	25
Annex B (informative)	Mass/gain loss analysis.....	26
Annex C (informative)	Baking of devices .....	27
C.1	Baking time and conditions .....	27
C.2	Example of a baking process .....	27
Annex D (normative)	Moisture sensitivity labels .....	28
D.1	Object.....	28
D.2	Graphical symbols and labels .....	28
D.2.1	Graphical symbols for moisture sensitivity .....	28
D.2.2	Moisture sensitivity identification label (MSID) .....	29
D.2.3	Moisture sensitivity caution label (MSCL) .....	29
Bibliography	.....	31
Figure 1	– Classification temperature profile .....	12
Figure 2	– Examples of humidity indicator cards .....	19
Figure C.1	– Baking process.....	27
Figure D.1	– Standardized graphical symbol for Moisture sensitive devices (IEC 60417-6093:2011-10), for use on equipment.....	28
Figure D.2	– <del>Alternative moisture sensitivity symbol (also in market use)</del> Example of a moisture sensitivity symbol used on components and packaging labels (as seen in JEDEC JEP113 [15]).....	29
Figure D.3	– MSID labels (examples).....	29
Table 1	– Moisture sensitivity levels.....	10
Table 2	– Moisture soak conditions .....	11
Table 3	– Parameters of the classification temperature profile .....	13
Table 4	– Classification temperatures $T_C$ .....	13
Table 5	– MBB material properties .....	17
Table 6	– Conditions for re-bake – Example for one type of plastic encapsulated devices .....	22
Table 7	– Conditions for baking prior to dry pack – Example for one type of plastic encapsulated devices .....	23

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

FOREWORD

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IEC 61760-4 has been prepared by IEC technical committee 91: Electronics assembly technology. It is an International Standard.

This second edition cancels and replaces the first edition published in 2015 and Amendment 1:2018. This edition constitutes a technical revision.

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

- a) The content is updated to cover the classification conditions given in the new editions of J-STD-020F and IEC 60068-2-58.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
91/2101/FDIS	91/2111/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/publications](http://www.iec.ch/publications).

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 document will remain unchanged until the stability date indicated on the IEC website under [webstore.iec.ch](http://webstore.iec.ch) in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

## 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 \[1\]](#)), but not for other types of components.

This part of IEC 61760 also extends the classification and packaging methods as described in [J-STD-020F \[2\]](#) and [J-STD-033 \[3\]](#). It is intended to be used for such type of components, where [J-STD-020F \[2\]](#) and [J-STD-033 \[3\]](#) are not required or not appropriate.

It is important to note that [moisture sensitivity levels](#) existing in both [J-STD-020F \[2\]](#) and this document are equivalent.

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## 1 Scope

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

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

This document 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 document and its relation to currently existing standards, e.g. IEC 60749-20 [1] or J-STD-020F [2] and J-STD-033 [3], are described in the [Introduction](#).

## 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 60068-1:2013, *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-020E, January 2015, *Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Surface Mount Devices*~~

## 3 Terms and definitions

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

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

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

### 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 \(3.1\)](#)

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 \(3.3\)](#) 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~~

**3.8**  
**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.

**3.9**  
**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.

### 3.10

#### water vapour transmission rate

WVTR

measure of the permeability of a plastic film material to moisture, used to specify a [moisture barrier bag \(3.3\)](#) 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~~ can adversely affect reliability.

NOTE “Popcorn phenomenon” defines 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~~ circuit board. 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, for example as in [IEC 60068-2-78 \[4\]](#), devices are tested either in 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 document 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 deterioration of electrical characteristics or isolation properties, are not covered by this document and ~~need to~~ shall 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~~ can 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](#). See [Annex A](#) for the classification of semi-finished assemblies.

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 suppliers and users agree, components can be classified at temperatures other than those in [Table 4](#).

If the conditions in [Table 1](#) 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	Desiccant	Humidity indicator
1	a	≤30 °C/85 % RH	12 months or as specified by the supplier	No requirement		
2	1 year <sup>a</sup>	≤30 °C/60 % RH		MBB type 1 <sup>b</sup> , <60 % RH in MBB no pre-drying	No	Optional <sup>c</sup>
C2a	4 weeks	≤30 °C/60 % RH		MBB type 1 <sup>b</sup> , <30 % RH in MBB no pre-drying	Yes	Yes <sup>c</sup>
2a				MBB type 2 <sup>b</sup> , <10 % RH in MBB pre-drying		
C3	168 h	≤30 °C/60 % RH		MBB type 1 <sup>b</sup> , <30 % RH in MBB no pre-drying	Yes	Yes <sup>c</sup>
3				MBB type 2 <sup>b</sup> , <10 % RH in MBB pre-drying		
4	72 h	≤30 °C/60 % RH		MBB type 2 <sup>b</sup> , <10 % RH in MBB pre-drying	Yes	Yes <sup>c</sup>
5	48 h	≤30 °C/60 % RH		MBB type 2 <sup>b,c</sup> , <10 % RH in MBB pre-drying	Yes	Yes <sup>c</sup>
<p>The floor life can be longer if the environmental conditions are less severe than the reference condition, or shorter, if more severe.</p> <p>Extended shelf life can be agreed upon, but <del>needs</del> requires recalculation of the amount of desiccant.</p> <p><sup>a</sup> The sum of keeping time at floor and storage time should not exceed the maximum storage period as specified by the supplier.</p> <p><sup>b</sup> The required shelf life and humidity in packed condition shall be assured by the amount of the desiccant, calculated by the use of water vapour transmission rate (WVTR) of the applied MBB. For the description of MBB type, see Table 5.</p> <p><sup>c</sup> Humidity indicator can be HIC or moisture indicating desiccant.</p>						

## 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 [5] 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

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

However, alternative baking conditions ~~can~~ may 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**

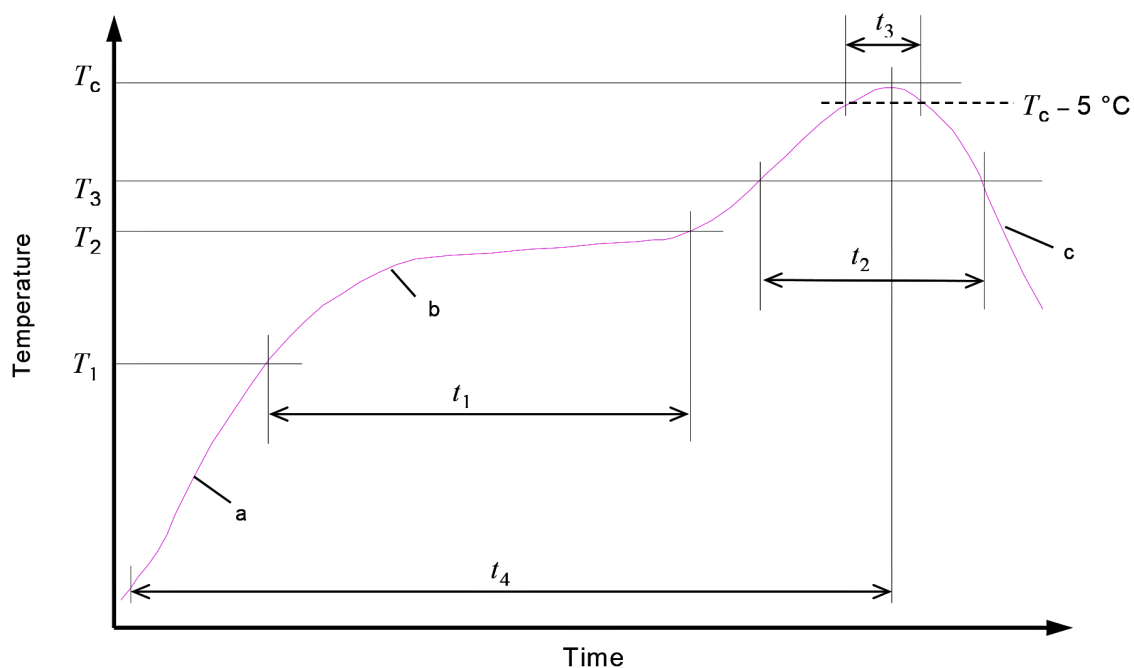
LEVEL	Soak time (h)	Soak condition <sup>a</sup>	Alternative
1	(168 +5/-0)	(85 ± 2) °C, (85 ± 5) % RH	(336 +5/-0) h; (85 ± 2) °C, (60 ± 5) % RH
2	(168 +5/-0)	(85 ± 2) °C, (60 ± 5) % RH	–
C2a	(168 +5/-0) followed by (672 +5/-0)	(85 ± 2) °C, (30 ± 5) % RH, followed by (30 ± 2) °C, (60 ± 5) % RH	–
2a	(696 + 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** ( $\leq 30$  °C,  $\leq 30$  % RH, one year) in the **MBB** type 1. The second stage of soak condition corresponds to **floor life** (as in IEC 60749-20 [1]).

<sup>a</sup> Soak conditions according to ~~IPC/JEDEC J-STD-020E~~ J-STD-020F [2]. Alternatively accelerated equivalent soak conditions from ~~Table 5-1 in J-STD-020E~~ Table 4 in J-STD-020F [2] may be applied in case the activation energy is confirmed by the manufacturer.

### 6.4 Temperature load

#### 6.4.1 Classification temperature profile



IEC

## 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 $(T_c - 5\text{ °C})$
$t_4$	Time to $T_c$
a	Temperature gradient of the increasing slope
b	Preheat area
c	Temperature gradient of the decreasing slope

The temperature gradient of the increasing slope shall not exceed 3 K/s and the temperature gradient of the decreasing slope shall not exceed 6 K/s.

**Figure 1 – Classification temperature profile**

**Table 3 – Parameters of the classification temperature profile**

Solder process	Sn-Pb (or equivalent)	SnAgCu (or equivalent)	Sn-Bi (or equivalent)
$T_1$	100 °C	150 °C	100 °C
$T_2$	150 °C	200 °C	120 °C
$t_1$	(60 to 120) s	(60 to 120) s	(30 to 90) s
$T_3$	183 °C	217 °C	139 °C
$t_2$	(60 to 150) s	(60 to 150) s	(60 to 150) s
$t_3$	20 s	30 s	20 s
$T_c$	See <a href="#">Table 4</a>		
$t_4$	≤6 min	≤8 min	≤4 min

**Table 4 – Classification temperatures  $T_c$** 

Solder process	Package thickness	Classification temperature $T_c$ for package volume		
		<350 mm <sup>3</sup>	350 mm <sup>3</sup> to 2 000 mm <sup>3</sup>	>2 000 mm <sup>3</sup>
	mm	°C	°C	°C
SnPb (or equivalent)	<2,5	235	220	220
	≥2,5	220	220	220
SnAgCu (or equivalent)	<1,6	260	260	260
	1,6 to 2,5	260	250	245
	>2,5	250	245	245
	>2,5 plus high thermal capacity <sup>a</sup>	not applicable	230 <sup>b</sup>	230 <sup>b</sup>
Sn-Bi (or equivalent) [LTS]	All package thickness and volume: 190			

<sup>a</sup> This condition may be applied for devices with high thermal mass, where peak package temperature does not reach 245 °C when soldered with a profile typical to soldering processes using SnAgCu alloy solder, or for very temperature sensitive devices. The peak package temperature is measured at the device surface or any other point specified in the relevant specification.

<sup>b</sup>  $T_c$  measured at the device terminal or solder joint shall achieve the minimum temperature and time necessary for a specific solder alloy to form a solder joint.

#### 6.4.2 Classification temperature profile for special devices

When the classification temperature profiles of [Table 3](#) and [Table 4](#) are not applicable to a device (e.g. components with high thermal mass **and/or** thermal sensitivity) the temperature profiles in [IEC 60068-2-58:2015 \[6\]](#), Table 7, can be used. Other profiles may be specified in the relevant specification according to the agreement between user and supplier. For information see [J-STD-075:2008](#) also J-STD 075A [7].

#### 6.4.3 Reflow

The sample shall be subjected to 3 cycles of the appropriate reflow conditions as defined in [Figure 1](#), [Table 3](#) and [Table 4](#), starting in a time interval **between** of 15 min to 4 h after removal from the temperature/humidity chamber. The recovery period between two successive cycles shall be the time it takes until the temperature of the specimen drops below 50 °C.