IEC 60749-3

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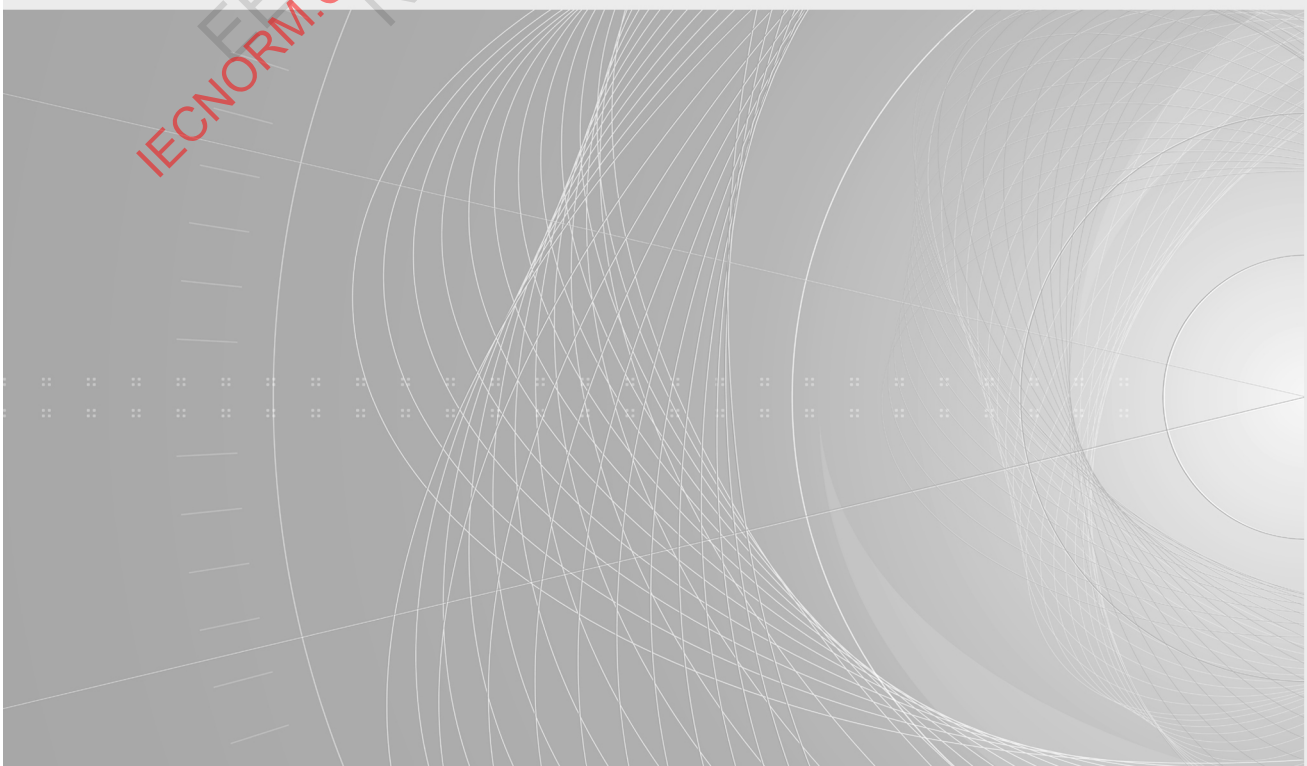
INTERNATIONAL STANDARD

Semiconductor devices – Mechanical and climatic test methods – Part 3: External visual examination



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SEMICONDUCTOR DEVICES – MECHANICAL AND CLIMATIC TEST METHODS –

Part 3: External visual examination

FOREWORD

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International Standard IEC 60749-3 has been prepared by IEC technical committee 47: Semiconductor devices.

This second edition cancels and replaces the first edition published in 2002. This edition constitutes a technical revision.

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

a) reference to the need for ESD protection;
b) inclusion of information on the phenomenon of tin whiskers;
c) inclusion of an optional report form/checklist.

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

FDIS	Report on voting
47/2345/FDIS	47/2370/RVD

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

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

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- withdrawn,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

A bilingual version of this publication may be issued at a later date.

SEMICONDUCTOR DEVICES – MECHANICAL AND CLIMATIC TEST METHODS –

Part 3: External visual examination

1 Scope

The purpose of this part of IEC 60749 is to verify that the materials, design, construction, markings, and workmanship of a semiconductor device are in accordance with the applicable procurement document. External visual inspection is a non-destructive test and applicable for all package types. The test is useful for qualification, process monitor, or lot acceptance.

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

IEC 62483, *Environmental acceptance requirements for tin whisker susceptibility of tin and tin alloy surface finishes on semiconductor devices*

3 Terms and definitions

No terms and definitions are listed in this document.

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

4 Test apparatus

Apparatus used in this test shall be capable of demonstrating device conformance to the applicable requirements, which may include optical equipment capable of magnification to resolve features between > 0,5 mm to 10 mm. A lense magnification between 3× and 10× and a relatively large and accessible field of view with an illuminated ring magnifier is typically used. Where visual observation requires clarification, a higher magnification (up to x30) can be used. Illumination should be in the range between 1,000 to 10,000 lux in an ambient overhead lighting environment of greater than 200 lux.

5 Procedure

The device shall be examined in accordance with the requirements of the relevant specification and the criteria listed in Clause 6. Where adherence of foreign material is in question, devices may be subjected to a clean filtered air stream (suction or expulsion) of

27 ms^{-1} maximum, and reinspected. At all times proper ESD handling procedures shall be followed in accordance with IEC 61340-5-1.

It is recommended that a form or checklist, such as that contained in Annex A, is used to report and classify the results of external visual inspection.

6 Failure criteria

Devices shall be considered a failure if they exhibit any of the following:

a) Device design, terminal identification, markings (content, placement, and legibility), materials, construction, and workmanship, are not in accordance with the applicable procurement document.

b) Visible evidence of corrosion, contamination (such as tin whiskers, see IEC 62483) or breakage (grossly bent or broken terminals, cracked seals – except for glass meniscus), defective (peeling, flaking, or blistering) or damaged plating or exposed base metal. (Discoloration of the finish shall not be cause for failure unless there is evidence of flaking, pitting or corrosion.)

c) Terminals that are not intact and aligned in their normal location, free of sharp or unspecified terminal bends, and (for ribbon terminals) free of twist outside the normal terminal plane.

d) Terminals that are not free of foreign material such as paint or other adherent deposits.

e) Evidence of any non-conformance with the detail drawing or applicable procurement document, absence of any required feature, or evidence of damage, corrosion or contamination that will interfere with the normal application of the device.

f) Defects or damage resulting from manufacturing, handling, testing.

g) Cracked or broken packages. Surface scratches shall not be cause for failure, except where they violate other criteria stated herein for marking, finish, etc.

h) Any chip-out dimension that exceeds 1,5 mm in any direction on the surface and has a depth that exceeds 25 % of the thickness of the affected package element (i.e. cover, base or wall).

i) Any chip-out that exposes either sealing glass (not previously exposed prior to the chip-out) or any terminal frame material that is not intended to be exposed by design.

7 Summary

The following details shall be specified in the relevant specification:

a) Requirements for markings and the terminal identification (see 6a)).

b) Detailed requirements for materials, design, construction, and workmanship (see 6a)).

c) Sample size.

Annex A
(informative)

External visual report form/checklist
(example only – not a mandatory template)

This form or an equivalent form may be used to report the results of external visual inspection:

Part number	
Description	
Lot number	
Supplier	
Applicable drawing number	
Applicable specification number	
Quantity inspected	
Quantity good	
Date	
Inspector	
Comments – failed condition	

A.1 Leads

Inspected:		**Yes**	**No**	**N/A**
Defects List	**A/U***	**Comments**		
Cracked or broken				
Missing or extra				
Incorrect placement or spacing (pitch)				
Improperly bent, reverse-bent, twisted, or misshapen				
Non-coplanar seating				
Non-parallel				
Notched or creased				
Improper dimensions (width, length, thickness)				
Improper foot angle and/or foot length				
Improper exit locations				
Metal burrs				
Missing or improperly located standoff swages				
Other				
* **A**cceptable/**U**nacceptable				

A.2 Lead finish

Inspected:		Yes	No	N/A
Defects List	**A/U***	**Comments**		
Pitted or corroded				
Missing				
Deeply scratched or abraded				
Cracked or flaked				
Extraneous material				
Icicles				
Lump (slump)				
Bridged				
Oxidized				
Tin whiskers, see IEC 62483				
Contaminated				
Other				
* **A**cceptable/**U**nacceptable				

A.3 Moulding and mould compound

Inspected:		Yes	No	N/A
Defects List	**A/U***	**Comments**		
Incomplete fill				
Surface pits, craters, or pinholes				
Ejector pin marks (indentations)				
Top/bottom reversal (reverse mold)				
Top/bottom offset (misalignment)				
Cracked				
Gaps, cracks, or spaces between body and leads				
Gaps, cracks, or spaces between body and molded-in metal heat sink				
Surface blisters				
Surface dents (depressions)				
Plastic protrusions (flash)				
Missing lead 1 identifying mark				
Dam bar protrusions				
Dam bar intrusions				
Warped				
Contaminated				
Other				
* **A**cceptable/**U**nacceptable				

A.4 Critical sealant

Inspected:		Yes	No	N/A
Defects List	**A/U***	**Comments**		
Incomplete coverage				
Air bubbles or voids				
Surface pits, craters, or pinholes				
Contaminated				
Other				
* **A**cceptable/**U**nacceptable				

A.5 Attachments

Inspected:		Yes	No	N/A
Defects List	**A/U***	**Comments**		
Excessive gaps, cracks, or spaces in glue joint and TIM (thermal interface material)				
Solder bridging, solder balls				
Missing or extra				
Misplaced or mis-positioned				
Poor or improper fit				
Cracked or broken				
Bent or warped				
Contaminated				
Other				
* **A**cceptable/**U**nacceptable				

A.6 Marking

Inspected:		Yes	No	N/A
Defects List	**A/U***	**Comments**		
Illegible characters (deformed, broken, faint), See IEC 60749-9				
Missing or extra characters				
Wrong				
Doubled				
Extraneous marks				
Other				
* **A**cceptable/**U**nacceptable				

A.7 Solder Balls

Inspected:		Yes	No	N/A
Defects List	**A/U***	**Comments**		
Low volume				
Missing or extra				
Pitted or corroded				
Smeared				
Cracked or broken				
Oxidized				
Contaminated				
Other				
* **A**cceptable/**U**nacceptable				

A.8 Substrate

Inspected:		Yes	No	N/A
Defects List	**A/U***	**Comments**		
Non-plated areas				
Cracked, chipped, broken, or otherwise damaged				
Blisters, delamination, or other soldermask defects				
Extraneous metal				
Bent or warped				
Contaminated				
Other				
* **A**cceptable/**U**nacceptable				

A.9 Exposed (Backside) Silicon

Inspected:		Yes	No	N/A
Defects List	**A/U***	**Comments**		
Physical damage (i.e., cracks, etch marks, pits, scuffs, dimples, dings, scratches, etc.)				
Foreign film or material				
Other				
* **A**cceptable/**U**nacceptable				