

# INTERNATIONAL STANDARD

---

**Test method for erosion of wave soldering equipment using molten lead-free solder alloy –  
Part 3: Selection guidance of erosion test methods**





**THIS PUBLICATION IS COPYRIGHT PROTECTED**  
**Copyright © 2017 IEC, Geneva, Switzerland**

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office  
3, rue de Varembe  
CH-1211 Geneva 20  
Switzerland

Tel.: +41 22 919 02 11  
Fax: +41 22 919 03 00  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://www.iec.ch)

**About the IEC**

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

**About IEC publications**

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

**IEC Catalogue - [webstore.iec.ch/catalogue](http://webstore.iec.ch/catalogue)**

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

**IEC publications search - [www.iec.ch/searchpub](http://www.iec.ch/searchpub)**

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

**IEC Just Published - [webstore.iec.ch/justpublished](http://webstore.iec.ch/justpublished)**

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

**Electropedia - [www.electropedia.org](http://www.electropedia.org)**

The world's leading online dictionary of electronic and electrical terms containing 20 000 terms and definitions in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

**IEC Glossary - [www.iec.ch/glossary](http://www.iec.ch/glossary)**

65 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

**IEC Customer Service Centre - [webstore.iec.ch/csc](http://webstore.iec.ch/csc)**

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: [csc@iec.ch](mailto:csc@iec.ch).

# INTERNATIONAL STANDARD

---

**Test method for erosion of wave soldering equipment using molten lead-free solder alloy –  
Part 3: Selection guidance of erosion test methods**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

---

ICS 31.190; 31.240

ISBN 978-2-8322-3769-4

**Warning! Make sure that you obtained this publication from an authorized distributor.**

## CONTENTS

FOREWORD.....	4
1 Scope.....	6
2 Normative references .....	6
3 Terms and definitions .....	6
4 General remarks.....	7
5 Selection of the appropriate erosion test method .....	8
5.1 Correlation between test methods and stresses induced in the field.....	8
5.2 Recommended test method by materials.....	9
6 Common items for each test method.....	10
6.1 Specimen preparation .....	10
6.2 Solder alloy.....	10
6.3 Accelerated stress conditions.....	10
6.3.1 Test temperature .....	10
6.3.2 Rotation speed .....	10
6.3.3 Bending stress to the specimen .....	11
6.4 Dross.....	11
6.4.1 Dross generation and removal interval.....	11
6.4.2 Dross removal method.....	11
6.4.3 Molten solder volume after dross removal.....	11
6.5 Erosion depth measurement method .....	11
6.5.1 Post test treatment .....	11
6.5.2 Local erosion depth .....	12
6.5.3 General (uniform) erosion depth .....	13
6.5.4 Evaluation .....	14
7 Overview of the test methods .....	14
7.1 Test methods .....	14
7.2 Metal material without surface processing.....	14
7.2.1 General .....	14
7.2.2 Rotation test at 250 °C .....	15
7.3 Metal material with surface processing.....	16
7.3.1 Test method .....	16
7.3.2 Rotation test at 450 °C .....	16
7.3.3 Rotation test at 450 °C with 2 mm bending .....	17
Annex A (informative) Selection of test temperature, test duration and bending stress.....	18
A.1 Specimen without surface processing .....	18
A.2 Specimen with surface processing .....	20
Annex B (informative) Maximum depth and other measurements .....	23
B.1 General.....	23
B.2 Maximum depth measurement .....	23
Annex C (informative) Erosion mechanism.....	26
C.1 Specimen without surface processing .....	26
C.2 Specimen with surface processing .....	26
C.3 Further guidance.....	27
Annex D (informative) Thermal acceleration for erosion .....	28
D.1 Specimen without surface processing .....	28
D.2 Specimen with surface processing .....	28

D.3 Further guidance document .....	30
Bibliography.....	31
Figure 1 – Schematic example of wave soldering equipment.....	8
Figure 2 – Example of dross removal tool .....	11
Figure 3 – Schematic general definition of erosion depth .....	12
Figure 4 – Schematic definition of erosion depth by focal depth method.....	12
Figure 5 – Examples of local erosion .....	13
Figure 6 – Example of evaluation region .....	13
Figure 7 – Examples with non-erosion area .....	14
Figure 8 – Examples without a non-erosion area and an example of a cross section.....	14
Figure 9 – Configuration example of test equipment.....	15
Figure 10 – Configuration example of test equipment for rotation test at 450 °C with 2 mm bending.....	17
Figure A.1 – Specimen configuration for preliminary test.....	18
Figure A.2 – Erosion depth against molten solder temperature .....	19
Figure A.3 – Erosion depth against rotation speed .....	19
Figure A.4 – Erosion depth against immersion time.....	20
Figure C.1 – Erosion mechanism for material with nitriding .....	27
Figure D.1 – Tin (Sn) diffusion layer growth in the plasma nitriding layer for various stainless steel.....	29
Table 1 – Location of erosion in the field and examples of problems.....	8
Table 2 – Correlation between test methods and stresses induced in the field .....	9
Table 3 – Applicable test method dependence on the materials .....	9
Table 4 – Test conditions for rotation test at 350 °C.....	16
Table 5 – Test conditions for rotation test at 350 °C.....	16
Table A.1 – Erosion test results for the materials of gas nitriding and nitrocarburizing .....	21
Table A.2 – Erosion test results for the materials of coating type surface processing .....	22
Table B.1 – Measurement methods, features and accuracy.....	24
Table B.2 – Example of measurement equipment.....	25
Table D.1 – Plasma nitriding layer peeling off period (incubation period in Figure D.1) .....	29
Table D.2 – Initial growth rate for tin (Sn) diffusion layer.....	30

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**TEST METHOD FOR EROSION OF WAVE SOLDERING EQUIPMENT USING MOLTEN LEAD-FREE SOLDER ALLOY –**

**Part 3: Selection guidance of erosion test methods**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, accept IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 62739-3 has been prepared by IEC technical committee 91: Electronics assembly technology.

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

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

CDV	Report on voting
91/1368/CDV	91/1400/RVC

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 the parts in the IEC 62739 series, under the general title *Test method for erosion of wave soldering equipment using molten lead-free solder alloy*, 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.

Currently in preview, click buy full vers.

# TEST METHOD FOR EROSION OF WAVE SOLDERING EQUIPMENT USING MOLTEN LEAD-FREE SOLDER ALLOY –

## Part 3: Selection guidance of erosion test methods

### 1 Scope

This part of IEC 62739 describes the selection methodology of an appropriate evaluating test method for the erosion of the metal materials without or with surface processing intended to be used for lead-free wave soldering equipment as a solder bath and other components which are in contact with the molten solder.

### 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 60068-2-20:2008, *Environmental testing – Part 2-20: Tests – Test T: Test methods for solderability and resistance to soldering heat of devices with leads*

IEC 61190-1-3, *Attachment materials for electronic assembly – Part 1-3: Requirements for electronic grade solder alloys and fluxed and non fluxed solid solder for electronic soldering applications*

IEC 62739-1:2013, *Test method for erosion of wave soldering equipment using molten lead-free solder alloy – Part 1: Erosion test method for metal materials without surface processing*

IEC 62739-2, *Test method for erosion of wave soldering equipment using molten lead-free solder alloy – Part 2: Erosion test method for metal materials with surface processing*

### 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>

#### 1 erosion

phenomenon where a base material is dissolved and made thinner by coming into contact with molten solder

[SOURCE: IEC 62739-1:2013, 3.1]