

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Environmental testing –

Part 2-69: Tests – Test Te/Tc: Solderability testing of electronic components and printed boards by the wetting balance (force measurement) method

Essais d'environnement –

Partie 2-69: Essais – Essai Te/Tc: Essai de brasabilité des composants électroniques et cartes imprimées par la méthode de la balance de mouillage (mesure de la force)





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.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

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

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
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

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

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

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

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 - std.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

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

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Catalogue IEC - webstore.iec.ch/catalogue

Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

Recherche de publications IEC - www.iec.ch/searchpub

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient 20 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalelement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

65 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: csc@iec.ch.



IEC 60068-2-69

Edition 3.0 2017-03

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Environmental testing –

Part 2-69: Tests – Test Te/Tc: Solderability testing of electronic components and printed boards by the wetting balance (force measurement) method

Essais d'environnement –

Partie 2-69: Essais – Essai Te/Tc: Essai de brasabilité des composants électroniques et cartes imprimées par la méthode de la balance de mouillage (mesure de la force)

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 19.040; 31.190

ISBN 978-2-8322-3994-0

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

Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.

CONTENTS

FOREWORD.....	5
1 Scope	7
2 Normative references	7
3 Terms and definitions	7
4 General description of the method	8
4.1 General.....	8
4.2 Components	8
4.3 Printed boards	8
4.4 Measurement.....	8
5 Description of the test apparatus	8
6 Preparation of specimens	10
6.1 Cleaning	10
6.2 Preconditioning	10
7 Materials	11
7.1 Solder	11
7.1.1 General	11
7.1.2 Solder alloy containing lead	11
7.1.3 Lead-free solder alloy	11
7.1.4 Solder contamination control	11
7.1.5 Solder mass for solder globule wetting balance method.....	12
7.2 Flux	13
7.2.1 Rosin based flux	13
7.2.2 Flux maintenance	13
7.2.3 Test flux selection criteria	13
8 Procedure.....	13
8.1 Test temperature	13
8.1.1 Solder alloy containing lead	13
8.1.2 Lead-free solder alloy	13
8.2 Test procedure.....	13
8.2.1 Applicable test procedure	13
8.2.2 Solder bath wetting balance procedure	14
8.2.3 Solder globule wetting balance procedure.....	17
8.2.4 Procedure for testing printed board specimens	20
9 Presentation of results.....	21
9.1 Form of force versus time trace.....	21
9.2 Test requirements	22
10 Information to be given in the relevant specification.....	23
Annex A (normative) Equipment specification	24
A.1 Characteristics of the apparatus.....	24
A.2 Solder bath	24
A.3 Globule support blocks	25
Annex B (informative) Use of the wetting balance for SMD solderability testing.....	26
B.1 Definition of the measure of solderability	26
B.2 Gauge R&R – Test protocol for wetting balance gauge repeatability and reproducibility using copper foil coupons.....	26

B.2.1	Test coupon	26
B.2.2	Test parameters	27
B.2.3	Known good coupon	27
B.3	Solder globule mass and pin size	28
B.4	Specimen orientation and immersion depth	28
B.4.1	General	28
B.4.2	Resistors and capacitors	29
B.4.3	Small-leaded components	29
B.4.4	Multi-leaded devices	29
B.5	Test flux	30
B.6	Test temperature	30
B.6.1	Solder alloy containing lead	30
B.6.2	Solder alloy without lead	31
B.7	Characteristics of the test apparatus	31
B.7.1	Recording device	31
B.7.2	Balance system	32
B.7.3	Lifting mechanism and controls	32
B.7.4	Parameters to be measured from the force-time trace	37
B.7.5	Reference wetting force	37
B.7.6	Equipment location	38
B.7.7	Globule pins	38
B.7.8	Globule modules	38
B.8	Test flux – IPC-J-STD-002/J-STD-003 activated solderability test flux rationale committee letter	38
B.8.1	General	38
B.8.2	Proactive solderability testing approach to the implementation of non-tin finishes	39
B.8.3	Reduced solderability test variability	39
B.8.4	Standardization of solderability test flux composition on a global scale	39
Annex C (normative)	Test methods for SMD components sizes 0603M (0201) or smaller	40
C.1	General	40
C.2	General description of the test method	40
C.3	Preconditioning	40
C.3.1	Preparation of the specimens	40
C.3.2	Ageing	40
C.4	Materials	40
C.4.1	Solder	40
C.4.2	Flux	41
C.5	Method 1	41
C.5.1	Description of the test apparatus	41
C.5.2	Procedures	41
C.5.3	Presentation of results	44
C.5.4	Information to be given in the relevant specification	45
C.6	Method 2	46
C.6.1	Test apparatus	46
C.6.2	Observation equipment	46
C.6.3	Test method 2	46
C.6.4	Presentation of results	47

Annex D (informative) Evaluation criteria – Guidance	48
D.1 General considerations	48
D.2 Evaluation criteria for components	48
D.3 Evaluation criteria for printed boards.....	49
Annex E (informative) Method of calculating the maximum theoretical force and integrated value of the area of the wetting curve for leaded non-SMD	50
E.1 Method of calculating the maximum theoretical force	50
E.2 Method of calculating the integrated value of the area of the wetting curve	50
Bibliography.....	52
 Figure 1 – Arrangement for the test apparatus (solder bath wetting balance method).....	9
Figure 2 – Arrangement for the test apparatus (solder globule wetting balance method)	9
Figure 3 – Immersion conditions for solder bath method	16
Figure 4 – Immersion conditions for solder globule method	19
Figure 5 – Suggested wetting balance test specimens and soldering immersion	20
Figure 6 – Printed board immersion	21
Figure 7 – Typical wetting balance trace	22
Figure B.1 – Understanding wetting curves	35
Figure B.2 – Typical wetting curve	35
Figure B.3 – Representative force-time curves.....	36
Figure C.1 – Cross-section of aluminium body	41
Figure C.2 – Dipping position and relative position.....	42
Figure C.3 – Time and test sequence.....	44
Figure C.4 – Typical wetting balance trace.....	45
Figure D.1 – Set A wetting curve.....	49
Figure D.2 – Set B wetting curve.....	49
 Table 1 – Preconditioning	10
Table 2 – Maximum limits of solder bath contaminants.....	12
Table 3 – Globule and pellet sizes	12
Table 4 – Rosin based flux compositions	13
Table 5 – Recommended solder bath wetting balance test conditions	15
Table 6 – Time sequence of the test (solder bath).....	17
Table 7 – Recommended solder globule wetting balance test conditions	18
Table 8 – Time sequence of the test (solder globule)	20
Table B.1 – Carboxylic acid based flux (water solution)	30
Table B.2 – Carboxylic acid based flux (alcohol solution)	30
Table C.1 – Time sequence of the test procedure	43
Table D.1 – Wetting balance parameter and suggested evaluation criteria.....	48
Table D.2 – Printed board test parameter and suggested criteria	49

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ENVIRONMENTAL TESTING –**Part 2-69: Tests – Test Te/Tc: Solderability testing of
electronic components and printed boards
by the wetting balance (force measurement) method****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, access to 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 60068-2-69 has been prepared by IEC technical committee 91: Electronics assembly technology.

This third edition cancels and replaces the second edition published in 2007 as well as the second edition of IEC 60068-2-54 published in 2006 and constitutes a technical revision.

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

- integration of IEC 60068-2-54;
- inclusion of tests of printed boards;
- inclusion of new component types, and updating test parameters for the whole component list;

- inclusion of a new gauge R & R test protocol to ensure that the respective wetting balance equipment is correctly calibrated.

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

FDIS	Report on voting
91/1405/FDIS	91/1426/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 60068 series, under the general title *Environmental testing*, 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.

ENVIRONMENTAL TESTING –

Part 2-69: Tests – Test Te/Tc: Solderability testing of electronic components and printed boards by the wetting balance (force measurement) method

1 Scope

This part of IEC 60068 outlines test Te/Tc, the solder bath wetting balance method and the solder globule wetting balance method to determine, quantitatively, the solderability of the terminations. Data obtained by these methods are not intended to be used as absolute quantitative data for pass-fail purposes.

The procedures describe the solder bath wetting balance method and the solder globule wetting balance method. They are applicable to components and printed boards with metallic terminations and metallized solder pads.

This document provides the measurement procedures for solder alloys both with and without lead (Pb).

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, *Environmental testing – Part 1: General and guidance*

IEC 60068-2-2, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

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 60068-2-66, *Environmental testing – Part 2: Test methods – Test Cx: Damp heat, steady state (unsaturated pressurized vapour)*

IEC 61190-1-3:2007, *Attachment materials for electronic assembly – Part 1-3: Requirements for electronic grade solder alloys and fluxed and non-fluxed solid solders for electronic soldering applications*

IEC 61190-1-3:2007/AMD1:2010

ISO 683 (all parts), *Heat-treatable steels, alloy steels and free-cutting steels*

ISO 6362 (all parts), *Wrought aluminium and aluminium alloys – Extruded rods/bars, tubes and profiles*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60068-1 and IEC 60068-2-20 apply.