

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Test method for mechanical properties of flexible opto-electric circuit boards
under thermal stress**

**Méthode d'essai des propriétés mécaniques des circuits optoélectriques
souples sous contrainte thermique**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2023 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 Secretariat
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
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 corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

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 It also gives information on projects, replaced and withdrawn publications.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 once a month by email.

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: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Discover our powerful search engine and read freely all the publications preview. With a subscription you will always have access to up-to-date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 300 terminological entries in English and French, with equivalent terms in 19 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

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.

Recherche de publications IEC -

webstore.iec.ch/advsearchform

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 une fois par mois par email.

Service Clients - webstore.iec.ch/csc

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

IEC Products & Services Portal - products.iec.ch

Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

Electropedia - www.electropedia.org

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 300 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 19 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Test method for mechanical properties of flexible opto-electric circuit boards
under thermal stress**

**Méthode d'essai des propriétés mécaniques des circuits optoélectriques
souples sous contrainte thermique**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 31.180

ISBN 978-2-8322-7750-8

**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.....	4
1 Scope.....	6
2 Normative references	6
3 Terms and definitions	6
4 Test method	7
4.1 General.....	7
4.2 Test sample	7
4.3 Test process	8
4.3.1 General description of the test.....	8
4.3.2 Preconditioning.....	9
4.3.3 Test.....	9
4.3.4 Recovery	9
4.3.5 Final measurements	10
5 Report.....	10
Annex A (informative) Example of optical bending loss test results with general glass optic fibres.....	11
Annex B (informative) Example of preparation method of O-E circuit test samples (optic fibre type).....	12
B.1 General.....	12
B.2 Manufacturing processes of the FOECBs with optic fibres (POF, GOF).....	12
B.3 Manufacturing processes of the FOECBs with optical polymer waveguides	13
B.4 Characteristics of the optic fibres.....	14
Annex C (informative) Example of reflow assembly simulation test results	15
C.1 General.....	15
C.2 Results of reflow assembly simulation test for a LED chip mounted FOECB with GOF	15
C.3 Results of reflow assembly simulation test for a transparent FOECB with GOF for display applications	16
C.4 Results of reflow assembly simulation test for a polyimide (PI) based FOECB with GOF	16
C.5 Results of reflow assembly simulation test for a polymer-based FOECB	17
Annex D (informative) Example of thermal shock endurance test results.....	18
D.1 General.....	18
D.2 Results of thermal shock endurance test for an FOECB with GOF	18
Annex E (informative) Example of humidity storage test results	19
E.1 General.....	19
E.2 Results of humidity storage test for an FOECB with GOF	19
E.3 Results of humidity storage test for an FOECB with POF	19
Bibliography.....	21
Figure 1 – Schematic diagram of FOECB (top view).....	7
Figure 2 – Schematic diagrams of the FOECB test samples of fibre type	8
Figure 3 – Schematic diagram of the FOECB test samples of fibre type	8
Figure A.1 – Bending loss test setup.....	11
Figure A.2 – Optical loss versus bending diameter.....	11
Figure B.1 – Arrayed structure of the FOECB test samples formed on one sheet	12

Figure B.2 – Fabrication of the optic circuits with optic fibres	13
Figure B.3 – Fabrication of the optic circuits with optic polymer waveguide via the photo-etching method	13
Figure C.1 – LED chip mounted FOECB.....	15
Figure C.2 – Appearance of a LED chip mounted FOECB after the reflow assembly simulation test	15
Figure C.3 – Appearance of a transparent FOECB with GOFs after the reflow assembly simulation test	16
Figure C.4 – Appearance of a PI based FOECB with GOF after the reflow assembly simulation test	16
Figure C.5 – Appearance of a polymer-based FOECB after the reflow assembly simulation test	17
Figure D.1 – Appearance of an FOECB with GOF after the thermal shock test.....	18
Figure E.1 – Appearance of an FOECB with GOF after the humidity storage test.....	19
Figure E.2 – Appearance of an FOECB with POF after the humidity storage test	20
Table 1 – Thermal endurance test class for FOECB.....	9

INTERNATIONAL ELECTROTECHNICAL COMMISSION

TEST METHOD FOR MECHANICAL PROPERTIES OF FLEXIBLE OPTO-ELECTRIC CIRCUIT BOARDS UNDER THERMAL STRESS

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 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) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at <https://patents.iec.ch>. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 63251 has been prepared by IEC technical committee 91: Electronics assembly technology. It is an International Standard.

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

Draft	Report on voting
91/1898/FDIS	91/1914/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. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

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 in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

TEST METHOD FOR MECHANICAL PROPERTIES OF FLEXIBLE OPTO-ELECTRIC CIRCUIT BOARDS UNDER THERMAL STRESS

1 Scope

This International Standard defines the thermal endurance test methods for reliability assessment of flexible opto-electric circuit boards. The purpose of this document is to accommodate the uniform thermal characteristics required by the flexible opto-electric circuit in high temperature environments such as automobiles. In particular, this document specifies a test method to inspect the occurrence of colour exchange, deformation and delamination of flexible opto-electric circuit boards under thermal stress.

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

IEC 60068-2-14, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60068-2-78, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

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

optic circuit

circuit that is composed of optical waveguides and can transmit optical signals

3.2

glass optic fibre

GOF

optic fibre made of glass material

3.3

polymer optic fibre

POF

optic fibre made of polymer material

3.4

opto-electric circuit

O-E circuit

circuit that contains both optic circuit and electric circuit