

# INTERNATIONAL STANDARD

## NORME INTERNATIONALE

**Fibre optic active components and devices – Reliability standards –  
Part 3: Laser modules used for telecommunication**

**Composants et dispositifs actifs en fibres optiques – Normes de fiabilité –  
Partie 3: Modules laser utilisés pour les télécommunications**

IEC 62572-3:2014

<https://standards.iteh.ai/standards/iec/8f910bf2-43de-4f99-bb2c-9254021e0349/iec-62572-3-2014>



## THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2014 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 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 more than 30 000 terms and definitions in English and French, with equivalent terms in 14 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

#### IEC Glossary - [std.iec.ch/glossary](http://std.iec.ch/glossary)

More than 55 000 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).

### 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](http://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](http://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](http://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](http://www.electropedia.org)

Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient plus de 30 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 14 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

#### Glossaire IEC - [std.iec.ch/glossary](http://std.iec.ch/glossary)

Plus de 55 000 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](http://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](mailto:csc@iec.ch).

# INTERNATIONAL STANDARD

## NORME INTERNATIONALE

**Fibre optic active components and devices – Reliability standards –  
Part 3: Laser modules used for telecommunication**

**Composants et dispositifs actifs en fibres optiques – Normes de fiabilité –  
Partie 3: Modules laser utilisés pour les télécommunications**

IEC 62572-3:2014

<https://standards.iteh.ai/standards/iec/8/910bf2-43de-4f99-bb2c-9254021e0349/iec-62572-3-2014>

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

PRICE CODE  
CODE PRIX

R

ICS 31.260, 33.180

ISBN 978-2-8322-1635-4

**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.....	3
INTRODUCTION.....	5
1 Scope.....	6
2 Normative references .....	6
3 Terms, definitions, symbols and abbreviations.....	7
3.1 Terms and definitions.....	7
3.2 Symbols and abbreviations .....	8
4 Laser reliability and quality assurance procedure .....	8
4.1 Demonstration of product quality.....	8
4.2 Testing responsibilities .....	9
4.2.1 General .....	9
4.2.2 Recommendation applicable to laser customer/system supplier.....	9
4.2.3 Recommendation applicable to system operator.....	9
4.3 Quality improvement programmes (QIPs).....	9
5 Tests.....	9
5.1 General.....	9
5.2 Structural similarity .....	10
5.3 Burn-in and screening (when applicable in the specification).....	10
6 Activities.....	13
6.1 Analysis of reliability results.....	13
6.2 Technical visits to LMMs.....	14
6.3 Design/process changes.....	14
6.4 Deliveries.....	14
6.5 Supplier documentation.....	14
Annex A (informative) Guidance on testing in Table 1 and Table 2.....	15
A.1 Laser module life tests containing thermoelectric coolers (for example, Peltier, test 1.1, Table 1).....	15
A.2 Laser module life tests – Uncooled modules (test 1.2, Table 1).....	15
A.3 Laser diode life tests on submounts (test 1.3, Table 1) .....	16
A.4 Monitor photodiode life tests (test 1.4, Table 1) .....	16
A.5 Temperature cycling and thermal shock (test 3, Table 1 and Test 2, Table 2) .....	17
A.6 Sealing/hermeticity (test 4, Table 1 and test 3, Table 2).....	17
A.7 Shock and vibration (test 5, Table 1 and test 4, Table 2).....	17
A.8 High-temperature storage (test 6, Table 1 and test 5, Table 2).....	17
A.9 Electrostatic discharge sensitivity (ESD) (test 7, Table 1 and test 6, Table 2) .....	18
A.10 Residual gas analysis (RGA) (test 8, Table 1 and test 7, Table 2).....	18
Table 1 – Initial qualification ( <i>1 of 3</i> ) .....	10
Table 2 – Maintenance of qualification ( <i>1 of 2</i> ).....	12
Table 3 – Performance for laser module reliability parameters .....	14
Table A.1 – Recommended life test conditions for laser modules containing Peltier coolers.....	15
Table A.2 – Recommended life test conditions for uncooled laser modules .....	16
Table A.3 – Recommended laser diode life test conditions.....	16
Table A.4 – Recommended photodiode life test conditions.....	17

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**FIBRE OPTIC ACTIVE COMPONENTS AND DEVICES –  
RELIABILITY STANDARDS –****Part 3: Laser modules used for telecommunication**

## 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 62572-3 has been prepared by subcommittee 86C: Fibre optic systems and active devices of IEC technical committee 86: Fibre optics.

This second edition cancels and replaces the first edition published in 2011. This second edition constitutes a technical revision in which multiple errors in references have been corrected.

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

FDIS	Report on voting
86C/1234/FDIS	86C/1259/RVD

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 62572 series, published under the general title *Fibre optic active components and devices – Reliability standards*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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

iTech Standards  
(<https://standards.itih.ai>)  
Document Preview

IEC 62572-3:2014

<https://standards.itih.ai/standards/iec/8910bf2-43de-4f99-bb2c-9254021e0349/iec-62572-3-2014>

WITHDRAWN

## INTRODUCTION

The laser modules covered by this International Standard are purchased by system suppliers (SS) to be inserted in equipment, which in turn are supplied/sold to a system operator (SO) or a network operator (see definitions in Clause 3).

For the system operator to act as an informed buyer, he/she should have knowledge of the potential risks posed by the use of critical components..

Optoelectronic component technology is continuing to develop. Consequently, during product development phases, many failure mechanisms in laser modules have been identified. These failure mechanisms, if undetected, could result in very short laser lifetime in system use.

Withdrawing

iTech Standards  
(<https://standards.itih.ai>)  
Document Preview

IEC 62572-3:2014  
<https://standards.itih.ai/standards/iec/8/910bf2-43de-4f99-bb2c-9254021e0349/iec-62572-3-2014>



# FIBRE OPTIC ACTIVE COMPONENTS AND DEVICES – RELIABILITY STANDARDS –

## Part 3: Laser modules used for telecommunication

### 1 Scope

This part of IEC 62572 deals with reliability assessment of laser modules used for telecommunication.

The aim of this standard is

- to establish a standard method of assessing the reliability of laser modules in order to minimize risks and to promote product development and reliability;
- to establish means by which the distribution of failures with time can be determined. This should enable the determination of equipment failure rates for specified end of life criteria.

In addition, guidance is given in IEC TR 62572-2.

### 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*

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

IEC 60747-1, *Semiconductor devices – Part 1: General*

IEC 60749-6, *Semiconductor devices – Mechanical and climatic test methods – Part 6: Storage at high temperature*

IEC 60749-8, *Semiconductor devices – Mechanical and climatic test methods – Part 8: Sealing*

IEC 60749-10, *Semiconductor devices – Mechanical and climatic test methods – Part 10: Mechanical shock*

IEC 60749-11, *Semiconductor devices – Mechanical and climatic test methods – Part 11: Rapid change of temperature – Two-fluid-bath method*

IEC 60749-12, *Semiconductor devices – Mechanical and climatic test methods – Part 12: Vibration, variable frequency*

IEC 60749-25, *Semiconductor devices – Mechanical and climatic test methods – Part 25: Temperature cycling*

IEC 60749-26, *Semiconductor devices – Mechanical and climatic test methods – Part 26: Electrostatic discharge (ESD) sensitivity testing – Human body model (HBM)*



IEC TR 62572-2, *Fibre optic active components and devices – Reliability standards – Part 2: Laser module degradation*

MIL-STD-883, *Test method standard – Microcircuits*

### 3 Terms, definitions, symbols and abbreviations

#### 3.1 Terms and definitions

For the purposes of this document the following definitions apply.

##### 3.1.1

##### **laser module**

packaged assembly containing a laser diode with/without photodiode

Note 1 to entry: The module may also include a cooler and temperature sensor to enable laser temperature to be controlled and monitored. The optical output is normally via an optical fibre pigtail.

##### 3.1.2

##### **submount**

substrate upon which a laser diode or photodiode may be mounted for assembly into the laser module

Note 1 to entry: Components on submounts are also subject to qualification testing.

##### 3.1.3

##### **laser module manufacturer**

LMM

manufacturer of laser modules who provides devices meeting the requirements of the relevant detail specification (DS) and the customer's reliability requirements

##### 3.1.4

##### **network operator**

NO

organization which operates a telecommunications network

##### 3.1.5

##### **system supplier**

SS

manufacturer of telecommunications/data transmission equipment containing optoelectronic semiconductor lasers, i.e. laser module customer

##### 3.1.6

##### **system operator**

SO

network operator of telecommunications/data transmission equipment containing optoelectronic semiconductor lasers in the transmission path

Note 1 to entry: The system may also be part of other more extensive systems, for example telecommunications, rail, road vehicles, aerospace or weapons.

##### 3.1.7

##### **capability qualifying components**

CQC

components selected to represent critical stages of the process and limiting or boundary characteristics of mechanical and electro-optic design

Note 1 to entry: Such components should aid the identification of end product failure mechanisms to enable the determination of activation energies.

### 3.2 Symbols and abbreviations

$T_A$	minimum storage temperature
$T_B$	maximum storage temperature
$T_C$	module case temperature
$T_S$	submount temperature
$T_{S \text{ nom}}$	recommended submount temperature
$T_{\text{op min}}$	module minimum operating temperature
$T_{\text{op max}}$	module maximum operating temperature
$T_{\text{stg min}}$	module minimum storage temperature
$T_{\text{stg max}}$	module maximum storage temperature
Qc	test for gross leak detection
Qk	test for fine leak detection
$p$	periodicity (in months)
$n$	sample size
CA	capability approval
CQC	capability qualifying components
DS	detail specification
LMM	laser module manufacturer
ML	median life
NO	network operator
QA	quality approval
QIP	quality improvement programmes
RGA	residual gas analysis
SO	system operator
SS	system suppliers

## 4 Laser reliability and quality assurance procedure

### 4.1 Demonstration of product quality

This standard (where required by the specification) gives the minimum mandatory requirements and is part of a total laser reliability and quality assurance procedure adopted by the laser module manufacturer.

It also provides guidance on the activities of system suppliers and system operators and provides feedback on field performance to laser module manufacturers and system suppliers.

The laser module manufacturer shall be capable of demonstrating, by means of qualification approval of devices, technology approval or capability approval of the manufacturing process.

- a documented and audited manufacturing process including the qualification of purchased components in accordance with an internationally recognized quality management system;
- a performance qualification programme, including for example, accelerated life testing, burn-in and screening of components and modules;
- a qualification maintenance programme to ensure continuity of reliability performance;
- a procedure to provide feedback on reliability issues to development and production.

## 4.2 Testing responsibilities

### 4.2.1 General

The testing detailed in Tables 1 and 2 is to be performed by the laser module manufacturer and component suppliers (where applicable). Additional testing may be specified in the specification.

### 4.2.2 Recommendation applicable to laser customer/system supplier

The system supplier is recommended to have a programme to analyse and verify the results including failure analysis. This programme includes an independent life test of fully packaged laser modules (see Table 2, test 1 and/or test 2 and 3 and/or test 5 (sample size >10 per test)).

### 4.2.3 Recommendation applicable to system operator

The system operator is recommended to have a programme to monitor and report field failure rates in sufficient detail to enable the system supplier and laser module manufacturer to initiate any necessary corrective actions at an early stage in the lifetime of a product.

Suppliers may have different approaches (i.e. to reliability concepts) during the development of product maturity and resource limitations may dictate testing strategies.

Alternative tests and activities to those specified are permitted, provided the LMM/SS/SO can show intent to remove end-product failures and the associated failure mechanisms. However, this will require significant data to substantiate compliance.

## 4.3 Quality improvement programmes (QIPs)

Quality improvement programmes (QIPs) shall be initiated with component suppliers and customers (SOs, SSs and LMMs) to address non-compliances (including quality and reliability problems identified during subsequent service life of the laser). The correction of non-compliances and subsequent QIPs are a required strategy to minimize reliability risks. The operation of QIPs should be stated in the quality approval (QA) generic and capability approval documents.

## 5 Tests

### 5.1 General

The tests described in Tables 1 and 2 are designed to accelerate the main failure mechanisms known to be reliability hazards in laser modules (see IEC TR 62572-2). Where appropriate, the CQC shall demonstrate an ability to reduce end product failure mechanisms. Final product validation is required to demonstrate that CQCs are operating at the boundaries of the process or technology. These tests will reduce the risk of unreliable components entering system use and will enable estimates to be made of the distribution of laser lifetimes and hence the laser failure rates.

The sample size and level of testing may vary depending on the business volume between the laser customer/system supplier (SS) and laser module manufacturer (LMM). This information will be given in the capability approval (CA) document and the specification where appropriate.

It is essential that the lasers evaluated are entirely representative of standard production devices and have passed all the production and/or specified (where applicable in the specification) burn-in and screening procedures.

*Table 1 – Initial qualification*

These tests will normally be performed by the laser manufacturer as part of an initial qualification programme.

*Table 2 – Maintenance of qualification*

These tests cover periodic monitoring performed on production devices to ensure that the quality and reliability performance established during initial qualification is maintained or improved.

**5.2 Structural similarity**

Where a range of laser modules is produced by a laser manufacturer, there may be some significant structural similarity between different type codes. A combination of results from different test programmes, where appropriate, is therefore permitted.

Consideration should be given to the fact that minor differences in technology or processing can have a major impact on reliability, whilst not being apparent during quality assessment.

Evidence shall be presented which demonstrates that all results are directly relevant.

**5.3 Burn-in and screening (when applicable in the specification)**

NOTE See IEC TR 62572-2.

The screening test should be designed by the laser module manufacturer specifically for his particular technology. Any approach based on similarity to that which is performed by other manufacturers is good for comparison purposes, but can be ineffective in achieving the actual screening goal. This is particularly true for fibre optic components whose technology is not yet mature and varies significantly from supplier to supplier.

Where a manufacturer can demonstrate component and process stability, screening procedures may be revised.

**Table 1 – Initial qualification (1 of 3)**

Test no.	Test	IEC references	Conditions	n
1	Initial endurance test			
1.1	a) Module with thermoelectric cooler		$\Phi_e$ specified, constant power Temperature: $T_c = T_{op\ max}$ $T_s = T_{s\ nom}$ Duration: 5 000 h <sup>a</sup>	25
1.2	b) Module without thermoelectric cooler		$\Phi_e$ specified, constant power Temperature: $T_c = T_{op\ max}$ Duration: 5 000 h <sup>a</sup>	25
1.3	Laser diode (submount)		Temperature: at least two test temperatures: $\Phi_e$ specified, constant power $T_{s1} = T_{s\ max}$ $T_{s2} = <T_{s1} - 10\ ^\circ C$ if applicable Duration: >5 000 h	See <sup>d</sup> See <sup>d</sup>