

INTERNATIONAL
STANDARD

IEC
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INTERNATIONALE

62005-9-2

First edition
Première édition
2007-05

**Reliability of fibre optic interconnecting devices
and passive optical components –**

**Part 9-2:
Reliability qualification for single fibre
optic connector sets –
Single mode**

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**Fiabilité des dispositifs d'interconnexion et des
composants optiques passifs à fibres optiques –**

**Partie 9-2:
Qualification relative à la fiabilité
pour les ensembles de connecteurs
à une seule fibre optique –
Unimodal**



Reference number
Numéro de référence
IEC/CEI 62005-9-2:2007



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Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

PRICE CODE
CODE PRIX

P

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**RELIABILITY OF FIBRE OPTIC INTERCONNECTING DEVICES
AND PASSIVE OPTICAL COMPONENTS –****Part 9-2: Reliability qualification for single fibre optic connector sets –
Single mode**

FOREWORD

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International Standard IEC 62005-9-2 has been prepared by subcommittee 86B: Fibre optic interconnecting devices and passive components, of IEC technical committee 86: Fibre optics.

This standard cancels and replaces IEC/PAS 62005-9-2, published in 2003. This first edition constitutes a technical revision.

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

FDIS	Report on voting
86B/2495/FDIS	86B/2536/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 of the IEC 62005 series, published under the general title *Reliability of fibre optic interconnecting devices and passive optical components*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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

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INTRODUCTION

Both performance qualification standards and reliability qualification standards (RQS) define a set of prescribed conditions and contain a series or a set of tests and measurements (which may or may not be grouped into a specific schedule) with clearly defined conditions, severities and pass/fail criteria. The tests are intended to be run on a 'once-off' basis to prove the product's ability to satisfy the performance or reliability requirements of a specific application, market sector or user group.

The remaining parts of this series contain those sets of reliability criteria that have been standardized for international use. A product that has been shown to meet all the requirements of a reliability standard may be declared as complying with that reliability standard.

It is recognised that component reliability qualification could be accomplished in alternative ways. The procedures in this standard are a baseline, but other qualification methods could prove to be more cost-effective. Alternative methods may be included in future revisions of this standard if they are demonstrated to be effectively equivalent to the baseline procedures.

Compliance with an RQS demonstrates that a product has met its optical and mechanical performance over the duration of the applied test programs. Consistency of manufacture should be maintained using a recognized Quality Assurance program.

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RELIABILITY OF FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE OPTICAL COMPONENTS –

Part 9-2: Reliability qualification for single fibre optic connector sets – Single mode

1 Scope

This part of IEC 62005 applies to fibre optic connector sets and contains the minimum test and measurement requirements and severities which a fibre optic connector set shall satisfy in order to be qualified as meeting the requirements for reliability qualification of singlemode fibre optic connectors with single fibre cylindrical ferrule PC polished as defined in the IEC 61754 series and used in controlled and uncontrolled environments (categories C and U) as defined in IEC 61753-1.

2 Normative references

The following referenced documents are indispensable for the application 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 60793-1, *Optical fibres – Measurement methods and test procedures –*

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IEC 61300 (all parts), *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures*

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IEC 61300-2-1, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-1: Tests – Vibration (sinusoidal)*

IEC 61300-2-2, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-2: Tests – Mating durability*

IEC 61300-2-4, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-4: Tests – Fibre/cable retention*

IEC 61300-2-6, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-6 Tests – Tensile strength of coupling mechanism*

IEC 61300-2-18, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-18: Tests – Dry heat – High temperature endurance*

IEC 61300-2-19, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-19: Tests – Damp heat (steady state)*

IEC 61300-2-22, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-22: Tests – Change of temperature*

IEC 61300-3-3, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-3: Examinations and measurements – Active monitoring of changes in attenuation and return loss*

IEC 61300-3-4, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-4: Examinations and measurements – Attenuation*

IEC 61300-3-6, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-6: Examinations and measurements – Return loss*

IEC 61300-3-15, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-15: Measurements – Dome eccentricity of a convex polished ferrule endface*

IEC 61300-3-16, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-16: Examinations and measurements – Endface radius of spherically polished ferrules*

IEC 61300-3-23, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-23: Examinations and measurements – Fibre position relative to ferrule endface*

IEC 61300-3-34, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures Part 3-34: Examinations and measurements – Attenuation of random mated connectors*

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IEC 61753-1, *Fibre optic interconnecting devices and passive components performance standard – Part 1: General and guidance for performance standards*

IEC 61754 (all parts), *Fibre optic connector interfaces*

IEC 61755-1, *Fibre optic connector optical interfaces – Part 1: Optical interfaces for single mode non-dispersion shifted fibres – General and guidance*

IEC 61755-3-1, *Fibre optic connector optical interfaces – Part 3-1: Optical interface, 2,5 mm and 1,25 mm diameter cylindrical full zirconia PC ferrule, single mode fibre*

IEC 61755-3-5, *Fibre optic connector optical interfaces – Part 3-5: Optical interface – 2,5 mm and 1,25 mm diameter cylindrical PC composite ferrule using Cu-Ni-alloy as fibre surrounding material, single mode fibre*

IEC 61931, *Fibre optic – Terminology*

IEC 62005-1, *Reliability of fibre optic interconnecting devices and passive components – Part 1: Introductory guide and definitions*

IEC 62005-4, *Reliability of fibre optic interconnecting devices and passive optical components – Part 4: Product screening*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the terms and definitions contained in IEC 61931 and IEC 62005-1 apply.

3.2 Abbreviations

LTPD: Lot tolerance percent defective

PC: Non-angled polished physical contact connector

RQS: Reliability qualification standard

4 General requirements

4.1 Overview

In the preparation of this standard, the following items were considered and instructions pertaining to them included:

- product definition;
- service environments;
- tests;
- details;
- requirements;
- sample size;
- groupings/sequences;
- pass/fail criteria;
- reference product definition.

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4.2 Test sample definition

The single fibre optic connector set product to which this standard relates is defined as a complete set of connector components required to provide demountable coupling between one pair of optical fibres. The length of cable (or fibre) on each side of the connector set shall be at least 1,5 m minimum. It is recommended to test non-angled polished fibre connectors (PC type) to allow return loss measurement requirement of 35 dB. This criteria is important to monitor fibre movement.

The samples shall be terminated onto single mode fibres as per IEC 60793-1 Type B1.1 in either coated fibres (primary and secondary) or reinforced cable format.

4.3 Service environments

The performance requirements for fibre optic connector sets are defined in IEC 61753-1. The relevant service environments for this standard are as indicated in Table 1.

Table 1 – Categories of service environments for fibre optic connectors

Category	Environment
C	Controlled
U	Uncontrolled
C = A controlled environment typically within an office or building	

Reliability qualification testing for categories E and O are the subject of further study.

4.4 Tests

All test methods are in accordance with the IEC 61300 series.

The tests selected/combined with the severities/durations, groupings/sequencing, method used and pass/fail criteria are indicative of a defined product location within a service environment.

4.5 Details

The details to be considered, severities, and durations, are given for all tests and measurements called up in this standard. These are related to the requirements specified for a product location within a service environment that the reliability qualification standard is intended to equate to. No ambiguity or options are allowed.

4.6 Requirements

The reliability qualification requirements that satisfy a product's compliance to this standard are specified for each test and/or measurement in Table 3 (for environmental category C) and Table 4 (for environmental category U). No ambiguities are allowed.

4.7 Groupings/sequences

Grouping and sequences must be done as shown in Figure 1 (for environmental category C) and Figure 2 (for environmental category U).

NOTE Parallel testing allows completion of reliability qualification in a shorter period of time. Sequential testing may induce cumulative stress effects causing a specific failure mechanism during the next testing steps.

4.8 Sample size

For sequential testing, the default number of samples is 11. For parallel testing, the minimum number of samples is 11.

All samples shall be taken from production and shall be representative of normal production output. Normal screens (see IEC 62005-4), if any, shall be performed before beginning of testing. Additional screening is not allowed.

4.9 Pass/fail criteria

The pass/fail criteria is stated for each test in Table 3 and Table 4. The reliability qualification of the product passes if there are no failures in 11 samples. If a failure does occur, the test shall be repeated in accordance with Table 2.

Table 2 – Allowable number defective and corresponding minimum sample size for 20 % LTPD

Allowable number defective	Minimum sample size
0	11
1	18
2	25
3	32
4	38

5	45
6	51
7	57
8	63
9	69
10	75

4.10 Reference product definition

Where a reference product is called for in any of the test and measurement methods used within this standard, the reference product shall be clearly defined. Reliability qualification by similarity should be based on the technical justification that considers the design, processes, applications, characterization, and degradation mechanism of these similar products.

4.11 Reliability standard test report

Conformance to this standard shall be supported by a test report.

Fully documented test reports and supporting evidence shall be prepared and be available for inspections as evidence that the tests have been carried out in accordance with the requirements and compliant with them.

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The test report shall clearly demonstrate that the tests were carried out in accordance with the requirements of this standard and shall provide full details of the tests together with a pass/fail declaration.

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Any product failing a particular test or sequence of tests shall be reported in the test report. The cause of the failure shall be given and any corrective action taken shall be described. If no significant design or process changes are made to the product, the test or test sequence where the failure occurred shall be rerun with the results of both the tests reported.

Any significant design or process changes shall be identified in the reliability standard test report. In this case, the full set of reliability tests must be rerun and the results reported.

5 Reliability qualification tests for fibre optic connectors

This section contains test lists and test conditions suitable to assess the reliability qualification of fibre optic connector sets. These reflect the common practice in the industry.

NOTE References to IEC documents included in the following tables are subject to updating, to include new documents as they are published.

Table 3 describes the tests and requirements for fibre optic connector sets used in a controlled environment (Category C). Table 4 describes tests and requirements for applications in an uncontrolled environment (Category U).

The optical performance is monitored during and just after each test. Conformance to this standard requires that optical and mechanical performance both meet specifications during and after each test.

Tests 0 and 14 are for failure analysis aims and are not presented as pass/fail criteria.

Reliability re-qualification shall be performed if significant changes are made in the product for any reason. Significant changes should include any design and manufacturing changes that could impact the reliability of the product.