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Reliability of devices used in fibre optic systems – General and guidance

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FOREWORD

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IEC 62721, which is a technical report, has been prepared by IEC technical committee 86: Fibre optics.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
86/406/DTR	86/412/RVC

Full information on the voting for the approval of this technical report 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.

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- withdrawn,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.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

TC86 (Fibre optics) is a group that reviews and implements the standardization of optical fibres and optical cables, optical interconnecting devices, passive and active optical components and modules, and optical sub-systems. As these optical components and modules are used for telecommunications as well as data communications systems, the reliability required for these are extremely high. Since the 1980s, when fibre optic communication systems were first deployed for commercial use, the reliability of optical fibres, optical components and modules has been examined and checked. As a result, reliability theories are nearly completely established for optical fibre, optical connectors, optical passive components and optical active components.

How to check reliability differs depending on the type of optical device. For example, for optical fibres, it is measured by the probability of fibre breaks under the condition of constant stress. Optical passive components are generally tested using accelerated deterioration tests under high temperature and high humidity conditions. For the reliability of laser diodes (LD) (a typical optical active device), the primary failure mode is a decrease of optical output power and an increase of threshold electric current caused by the increase of the leakage of electrical current in the active layers of the LD chip. The lifetime has an inverse correlation with the drive current.

In addition, the industry has established and uses standard reliability evaluation tests developed for the purpose of commercialisation in addition to the approach of estimating the lifetime by failure mode analysis mentioned above.

Information on failure mode and lifetime estimates are discussed and summarised in many documents prepared by the Subcommittees (SC) and Working Groups (WG) of TC86. Test items and conditions for reliability qualification tests are described in documents prepared and set forth by each SC.

RELIABILITY OF DEVICES USED IN FIBRE OPTIC SYSTEMS – GENERAL AND GUIDANCE

1 Scope and objective

This technical report provides information on the IEC documents concerning reliability for optical fibres, optical connectors, optical passive components, optical active components, optical amplifiers, and optical dynamic modules used for optical fibre communications.

Documents on reliability include summaries of reliability theory and quality management methods, technical information on failure mode analysis and failure mechanisms, lifetime and fit-rate estimates using acceleration tests, test items, conditions, and pass/fail criteria in reliability qualification tests, and tests and measurement methods for optical fibres, optical components, and optical modules.

Each SC in TC86 has already created documents on reliability. This technical report provides this information in a user-friendly manner.

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 (all parts), *Environmental testing*

IEC 60749 (all parts), *Semiconductor devices – Mechanical and climatic test methods*

IEC 60793-1 (all parts), *Optical fibres – Part 1: Measurement methods and test procedures*

IEC 60793-1-30, *Optical fibres – Part 1-30: Measurement methods and test procedures – Fibre proof test*

IEC 60794-1-2, *Optical fibre cables – Part 1-2: Generic specification – Basic optical cable test procedures*

IEC 61290 (all parts), *Optical amplifiers – Test methods*

IEC 61291-5-2, *Optical amplifiers – Part 5-2: Qualification specifications – Reliability qualification for optical fibre amplifiers*

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

IEC 62005 (all parts), *Reliability of fibre optic interconnecting devices and passive components*

IEC 62007-2, *Semiconductor optoelectronic devices for fibre optic system applications – Part 2: Measuring methods*

IEC 62150 (all parts), *Fibre optic active components and devices – Test and measurement procedures*

IEC 62343-2, *Dynamic modules – Part 2: Reliability qualification*

IEC 62343-5-1, *Dynamic modules – Test methods – Part 5-1: Dynamic gain tilt equalizer – Response time measurement*

IEC 62572-3, *Fibre optic active components and devices – Reliability standards – Part 3: Laser modules used for telecommunication*

IEC/TR 62048, *Optical fibres – Reliability – Power law theory*

IEC/TR 62343-6-6, *Dynamic modules – Part 6-6: Failure mode effect analysis for optical units of dynamic modules*

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

IEC/TR 62627-03-01, *Fibre optic interconnecting devices and passive components – Part 03-01: Reliability – Design of an acceptance test for fibre pistoning failure of connectors during temperature and humidity cycling: demarcation analysis*