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# TECHNICAL REPORT

colour inside

## 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

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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# CONTENTS

FOREWORD ..... 3
INTRODUCTION ..... 5
1 Scope ..... 6
2 Optical fibre connectors and the pistoning failure mode ..... 6
3 Demarcation map theory for thermally activated processes ..... 6
3.1 Concept of demarcation energy ..... 6
3.2 Demarcation maps ..... 8
4 Plausible physical effects in a model of the degradation process associated with fibre pistoning ..... 9
4.1 General ..... 9
4.2 Simple temperature humidity models ..... 10
4.3 Temperature humidity models with diffusion ..... 11
4.4 A model of delamination ..... 11
4.5 A model of stress relaxation ..... 13
4.6 Two models bounding cyclic hysteresis ..... 14
5 Summary of results and discussion ..... 16
Bibliography ..... 18

Figure 1 – Reaction extent as a function of activation energy compared to the $\Delta k_1 t$ function ..... 7
Figure 2 – Demarcation maps for service life and accelerated test of example in 4.2 ..... 8
Figure 3 – Schematic for the delamination process ..... 12

Table 1 – Accelerated test index of coverage for simple temperature-humidity model ..... 10
Table 2 – Index of coverage, numerical experiments ..... 16

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# 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

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IEC 62627-03-01, which is a technical report, has been prepared by subcommittee 86B: Fibre optic interconnecting devices and passive components, of IEC technical committee 86: Fibre optics.

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

| Enquiry draft | Report on voting |
|---|---|
| 86B/2996/DTR | 86B/3038/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.

A list of all parts of the IEC 62627 series, published under the general title *Fibre optic interconnecting devices and passive components,* 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.

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

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# INTRODUCTION

Fibre optic connectors rely on accurate positioning of the fibre with respect to an optical interface to achieve and maintain acceptable performance. Degradation of performance due to fibre motion (fibre pistoning) is a well known failure mode. It is activated by temperature and humidity exposure, especially cyclic. Clause 3 provides background on the pistoning failure mode.

An acceptance test is an accelerated test designed to detect degradation or failure modes if they would occur during life, and to show no change if no degradation or failure modes will occur. A perfect acceptance test is impossible [1][1] because (a) there can always be non-accelerable failure modes and (b) some failures may occur under acceleration that may not occur in service. However, a well-designed acceptance test provides for a supplier a reasonable check of the space of accelerable modes and is of great value in testing for reliability.

Demarcation mapping provides a method of viewing possible chemical and physical processes that can occur during a given stress exposure over a given time [1-4] and allows for selection of accelerating test conditions that will produce potential degradation or failure mechanisms during service. Clause 2 provides an overview of the demarcation approach and its application to developing acceptance tests.

Clause 3 provides a discussion of plausible physical processes accompanying degradation and fibre pistoning, based on an assumed service environment. It includes some models based on these processes, and mathematical tools necessary to develop the demarcation maps. Clause 4 summarizes the results of a numerical experiment, using demarcation maps for each of the processes developed in Clause 3, to compare 20-year life in an extreme tropical climate with accelerated tests.

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1 Figures in square brackets refer to the Bibliography.

# 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

## 1 Scope

This part of IEC 62627 gives an example of the design of an acceptance test for ferrule style connectors when the dominant failure mode is fibre pistoning. The example applies to connectors which use epoxies or other adhesive polymers to bond the fibre into a ferrule. It combines existing evidence, mechanistic hypotheses and the demarcation approximation to develop an accelerated environmental exposure sequence that can be used on a pass-only basis to help ensure reliable service. This technical report was developed to serve only as an example of how accelerated acceptance tests can be designed. It is not intended as a normative standard for any specific application.