EESTI STANDARD

EVS-EN 4533-004:2006

Aerospace series - Fibre optic systems - Handbook - Part 004: Repair, maintenance and inspection

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EESTI STANDARDIKESKUS

EESTI STANDARDI EESSÕNA	NATIONAL FOREWORD
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Käsitlusala:	**Scope:**
The original task headings in the Fibre Optic Harness Study were 'Inspection and Fault Analysis' and 'Repair and Maintenance'. However, to create a more coherent and readable handbook these have been re-arranged in this part of EN 4533 to make two new topic headings – 'Fault analysis and repair' and 'Scheduled maintenance and inspection'.	The original task headings in the Fibre Optic Harness Study were 'Inspection and Fault Analysis' and 'Repair and Maintenance'. However, to create a more coherent and readable handbook these have been re-arranged in this part of EN 4533 to make two new topic headings – 'Fault analysis and repair' and 'Scheduled maintenance and inspection'.

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This European Standard was approved by CEN on 28 April 2006.

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Foreword

This European Standard (EN 4533-004:2006) has been prepared by the European Association of Aerospace Manufacturers - Standardization (AECMA-STAN).

After enquiries and votes carried out in accordance with the rules of this Association, this Standard has received the approval of the National Associations and the Official Services of the member countries of AECMA, prior to its presentation to CEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 2007, and conflicting national standards shall be withdrawn at the latest by January 2007.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

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Introduction

a) The handbook

The handbook draws on the work of the Fibre-Optic Harness Study, part sponsored by the United Kingdom's Department of Trade and Industry, plus other relevant sources. It aims to provide general guidance for experts and non-experts alike in the area of designing, installing, and supporting multi-mode fibre-optic systems on aircraft. Where appropriate more detailed sources of information are referenced throughout the text.

It is arranged in 4 parts, which reflect key aspects of an optical harness life cycle, namely:

— Part 001: *Termination methods and tools*

— Part 002: *Test and measurement*

— Part 003: *Looming and installation practices*

— Part 004: *Repair, maintenance and inspection*

b) Background

It is widely accepted in the aerospace industry that photonic technology offers a number of significant advantages over conventional electrical hardware. These include massive signal bandwidth capacity, electrical safety, and immunity of passive fibre-optic components to the problems associated with electromagnetic interference (EMI). To date, the latter has been the critical driver for airborne fibre-optic communications systems because of the growing use of non-metallic aerostructures. However, future avionic requirements are driving bandwidth specifications from 10's of Mbits/s into the multi-Gbits/s regime in some cases, i.e. beyond the limits of electrical interconnect technology. The properties of photonic technology can potentially be exploited to advantage in many avionic applications, such as video/sensor multiplexing, flight control signalling, electronic warfare, and entertainment systems, as well as in sensing many of the physical phenomena on-board aircraft.

The basic optical interconnect fabric or `optical harness' is the key enabler for the successful introduction of optical technology onto commercial and military aircraft. Compared to the mature telecommunications applications, an aircraft fibre-optic system needs to operate in a hostile environment (e.g. temperature extremes, humidity, vibrations, and contamination) and accommodate additional physical restrictions imposed by the airframe (e.g. harness attachments, tight bend radii requirements, and bulkhead connections). Until recently, optical harnessing technology and associated practices were insufficiently developed to be applied without large safety margins. In addition, the international standards did not adequately cover many aspects of the life cycle. The lack of accepted standards thus lead to airframe specific hardware and support. These factors collectively carried a significant cost penalty (procurement and through-life costs), that often made an optical harness less competitive than an electrical equivalent.

c) The fibre-optic harness study

The Fibre-Optic Harness Study concentrated on developing techniques, guidelines, and standards associated with the through-life support of current generation fibre-optic harnesses applied in civil and military airframes (fixed and rotary wing). Some aspects of optical system design were also investigated. This programme has been largely successful. Guidelines and standards based primarily on harness study work are beginning to emerge through a number of standards bodies. Because of the aspects covered in the handbook, European prime contractors are in a much better position to utilise and support available fibre optic technology.

1 Scope

The original task headings in the Fibre Optic Harness Study were ‘Inspection and Fault Analysis’ and ‘Repair and Maintenance’. However, to create a more coherent and readable handbook these have been re-arranged in this part of EN 4533 to make two new topic headings – ‘Fault analysis and repair’ and ‘Scheduled maintenance and inspection’. The first deals with what to do when something goes wrong – how to go from a fault notification to locating the fault, and finally, repairing it. The second covers the recommended procedures for upkeep and maintaining harness health over the lifetime of its installation. It is beneficial to read both sections together as many of the practices and techniques are applicable to both situations.

Two supplemental sections consider designing a harness with repair and maintenance in mind and good practices when maintaining or repairing a harness.

To keep the handbook to a reasonable size, other Harness Study reports are called up where more detail is required. This handbook does not contain sufficient information, for example, to be the sole reference for harness fault finding but it should provide adequate background for somebody working in that field.

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.

EN 4533-002, *Aerospace series — Fibre optic systems — Handbook — Part 002: Test and measurement.*

3 Fault analysis and repair

3.1 From notification to repair

Once notified of a fault, choosing a repair strategy depends on a multitude of factors; accessibility of the fault, criticality of the system, availability of spares etc. These same issues already exist for electrical harnesses for which proven strategies are in place. What the Harness Study set out to provide were similar strategies taking into account the unique aspects of fibre optic harnesses. The result is the “Repair and Maintenance Strategy” which contains a comprehensive list of fibre optic harness faults, their symptoms and how to locate and repair them. Much of the information in this section is taken from that document.

3.2 Fault notification

A fault notification will arise from one or more of three sources; scheduled maintenance, Built-In-Test (BIT), or failure of equipment dependent upon the harness.

Ideally, scheduled maintenance should highlight all latent faults i.e. those which initially have no effect on the system performance but may lead to a problem sometime later during aircraft operation. It should also highlight faults of the gradual degradation type i.e. those which gradually deteriorate the system performance but have yet to cause a failure and any other faults that slipped through the BIT net.

BIT is the ability of the aircraft’s systems to diagnose themselves. It should identify all faults that occur in the time between scheduled maintenance and, with the exception of sudden catastrophic faults, before a failure occurs. It should also be able to provide some help in locating the fault.

Failure is the worst case and should only be the result of a fault occurring which cannot be prepared for.