BS EN 4533-003:2017

BSI Standards Publication

Aerospace series - Fibre optic systems - Handbook

Part 003: Looming and installation practices

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Full document details: BS EN 4533-003:2017

National foreword

This British Standard is the UK implementation of EN 4533-003:2017. It supersedes BS EN 4533-003:2006, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee ACE/6, Aerospace avionic electrical and fibre optic technology.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Published by BSI Standards Limited 2018

ISBN 978 0 580 98306 1

ICS 49.060

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 January 2018.

Amendments/corrigenda issued since publication

Date	Text affected

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Full document details: BS EN 4533-003:2017

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 4533-003

December 2017

ICS 49.060

Supersedes EN 4533-003:2006

English Version

Aerospace series - Fibre optic systems - Handbook - Part 003: Looming and installation practices

Série aérospatiale - Systèmes des fibres optiques - Manuel d'utilisation - Partie 003: Règles de l'art pour la fabrication et l'installation des harnais

Luft- und Raumfahrt - Faseroptische Systemtechnik - Handbuch - Teil 003: Praktiken zur Fertigung und Installation von Leitungsbündeln

This European Standard was approved by CEN on 23 July 2017.

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Ref. No. EN 4533-003:2017 E

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European Foreword

This document (EN 4533-003:2017) has been prepared by the Aerospace and Defence Industries Association of Europe - Standardization (ASD-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 ASD, 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of an identical text or by endorsement, at the latest by June 2018 and conflicting national standards shall be withdrawn at the latest by June 2018.

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Introduction

a) The Handbook

This handbook aims to provide general guidance for experts and non-experts alike in the area of designing, installing, and supporting 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, cleaning and inspection

b) Background

It is widely accepted in the aerospace industry that photonic technology 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). Significant weight savings can also be realized in comparison to electrical harnesses which may require heavy screening. To date, the EMI issue 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 sensor for monitoring aerostructure.

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, vibration, 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. This situation is changing with the adoption of more standardized (telecoms type) fibre types in aerospace cables and the availability of more ruggedized COTS components. These improved developments have been possible due to significant research collaboration between component and equipment manufacturers as well as the end use airframers.

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1 Scope

This handbook considers best practice during initial design and how the practices chosen affect through life support of the installation. Looming and installation practices are a critical aspect of any aircraft electrical/avionics installation. In order to provide a reliable and efficient system it is important that the fibre optic installation is designed for reliability and maintainability.

This document provides technical advice and assistance to designers and engineers on the incorporation of fibre optic harnesses into an airframe, while, wherever possible, maintaining maximum compliance with current aircraft electrical harness procedures.

All topics that are related to Installation of optical cables are addressed in EN 3197.

These rules are applicable for fibre optic cables and connectors defined by EN specifications.

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.

EN 3197, *Aerospace series — Design and installation of aircraft electrical and optical interconnection systems*

EN 4533-001, *Aerospace series — Fibre optic systems — Handbook — Part 001: Termination methods and tools*

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

EN 4533-004, *Aerospace series — Fibre optic systems — Handbook — Part 004: Repair, maintenance and inspection*

3 Initial design considerations

3.1 General

Wherever possible the installation of fibre optic links and bundles should aim to mirror that of copper systems and comply as much as possible with current general aircraft electrical harness procedures. There are numerous installation specifications detailing the requirements for the routing of copper based harnesses, however they are very similar in content, therefore fibre optic harness routing will have to fulfil the following criteria:

a) Accessibility for inspection and maintenance;

b) Prevent or minimise the risk of damage from:

- Chafing, scraping or abrasion;
- Use as handholds or as support for personal equipment;
- Damage by personnel moving within the aircraft;
- Stowage or movement of cargo;
- Battery electrolytes and fumes;

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