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BSI Standards Publication

Space engineering — Structural materials handbook

Part 7: Thermal and environmental integrity, manufacturing aspects, in-orbit and health monitoring, soft materials, hybrid materials and nanotechnologies

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee ACE/68, Space systems and operations.

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

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Space engineering - Structural materials handbook - Part 7: Thermal and environmental integrity, manufacturing aspects, in-orbit and health monitoring, soft materials, hybrid materials and nanotechnologies

Ingénierie spatiale - Manuel des matériaux structuraux - Partie 7 : Intégrité thermique et en environnement, aspects fabrication, surveillance des matériaux, matériaux souples, matériaux hybrides et nanotechnologies

Raumfahrttechnik - Handbuch der Strukturwerkstoffe - Teil 7: Thermische und umweltbedingte Integrität, Herstellungsaspekte, In-Orbit- und Gesundheitsüberwachung, weiche Werkstoffe, Hybridwerkstoffe und Nanotechnologien

This Technical Report was approved by CEN on 29 November 2021. It has been drawn up by the Technical Committee CEN/CLC/JTC 5.

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European Foreword

This document (CEN/TR 17603-32-07:2022) has been prepared by Technical Committee CEN/CLC/JTC 5 “Space”, the secretariat of which is held by DIN.

It is highlighted that this technical report does not contain any requirement but only collection of data or descriptions and guidelines about how to organize and perform the work in support of EN 16603-32.

This Technical report (CEN/TR 17603-32-07:2022) originates from ECSS-E-HB-32-20 Part 7A.

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This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

This document has been developed to cover specifically space systems and has therefore precedence over any TR covering the same scope but with a wider domain of applicability (e.g.: aerospace).

Introduction

The Structural materials handbook is published in 8 Parts.

A glossary of terms, definitions and abbreviated terms for these handbooks is contained in Part 8.

The parts are as follows:

TR 17603-32-01	Part 1	Overview and material properties and applications	Clauses 1 - 9
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82 Thermal behaviour

82.1 Introduction

82.1.1 General

The two principal issues in the behaviour of high-temperature materials are the:

- physical response to thermal loads, i.e. thermal cycling and thermal shock.
- physical properties, i.e. thermal conductivity and diffusivity, specific heat capacities, emissivity and surface catalyticity.

82.1.2 Physical response

Information on physical response shows the temperature ranges to which different materials can be applied and the level of microstructural changes that can occur. This is viewed in conjunction with the effects of thermal loads which are likely to be compounded by:

- mechanical loading, [See: Chapter 83], and
- operating environments, [See: Chapter 85].

Any modification to the material's microstructure alters the physical properties.

82.1.3 Physical properties

Physical properties are used to establish the amount of heat energy that a structural design can absorb. Thermal conductivity is a non-linear parameter whose value is temperature dependent.

Thermal cycling is divided into two major regimes:

- Low Range: Cryogenic up to 300°C. For:
  - magnesium,
  - aluminium, and
  - glass composites.
- High Range: Above 300°C. For propulsion system materials and thermo-structural designs, i.e.
  - copper,
  - titanium,