



BSI Standards Publication

## Space engineering — Structural materials handbook

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

## National foreword

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## **European Foreword**

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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.

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.

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

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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
TR 17603-32-02	Part 2	Design calculation methods and general design aspects	Clauses 10 - 22
TR 17603-32-03	Part 3	Load transfer and design of joints and design of structures	Clauses 23 - 32
TR 17603-32-04	Part 4	Integrity control, verification guidelines and manufacturing	Clauses 33 - 45
TR 17603-32-05	Part 5	New advanced materials, advanced metallic materials, general design aspects and load transfer and design of joints	Clauses 46 - 63
TR 17603-32-06	Part 6	Fracture and material modelling, case studies and design and integrity control and inspection	Clauses 64 - 81
TR 17603-32-07	Part 7	Thermal and environmental integrity, manufacturing aspects, in-orbit and health monitoring, soft materials, hybrid materials and nanotechnologies	Clauses 82 - 107
TR 17603-32-08	Part 8	Glossary	

# 82

## Thermal behaviour

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### 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](#),