International Standard

ISO 16454

Space systems — Structural design — Stress analysis requirements

Systèmes spatiaux — Conception des structures — Exigences relatives à l'analyse des contraintes

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Contents

Page

Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 14, *Space systems and operations*.

This second edition cancels and replaces the first edition (ISO 16454:2007), which has been technically revised.

The main changes are as follows:

— updated the terms and definitions;

— updated requirements in Clause 4.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

From the beginning of the space age, structural integrity verification has been one of the main fields of activity of experts in the domain of mechanics. Mission failure and potential danger to human life, expensive ground constructions and other public and private properties are the most probable consequences of a space structural integrity failure. Static strength is one of the most important critical conditions for structural integrity analysis. It is usually the main criterion for space structure weight evaluation. If the space structure is too heavy, the mission can be extremely expensive or impossible to achieve. If the space structure is under-designed, it can result in mission failure, structural failure, leading to high risk associated with safety of life, and loss of expensive hardware and other properties. It is therefore necessary to specify unique requirements for static strength analysis in order to provide cost-effective design and light-weight, reliable and low-risk structures for space application.

Space systems — Structural design — Stress analysis requirements

1 Scope

This document provides requirements for the determination of maximum stress and corresponding margin of safety under loading and defines criteria for static strength failure modes, such as rupture, collapse and detrimental yielding. This document does not cover critical-conditions-induced fatigue, creep and crack growths. Notwithstanding these limitations in scope, the results of stress calculations based on the requirements of this document are applicable to other critical condition analysis.

This document is applicable to the determination of the stress/strain distribution and margins of safety in launch vehicles and spacecraft load-bearing elements design. Liquid propellant engine structures, solid propellant engine nozzles and the solid propellant itself are not covered, but liquid propellant tanks, pressure vessels and solid propellant cases are within the scope of this document.

In accordance with the requirements of this document, the models, methods and procedures for stress calculation can also be applicable to the displacements and deformation calculation, as well as the calculation of loads, applied to substructures and structural elements under consideration. When this document is applied, it is assumed that temperature distribution has been determined and is used as input data.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 14622, *Space systems — Structural design — Loads and induced environment*

ISO 14623, *Space systems - Pressure vessels and pressurized structures — Design and operation*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
A-basis allowable
mechanical strength value above which at least 99 % of the population of values is expected to fall, with a confidence level of 95 %

3.2
allowable load
allowable stress
allowable strain
maximum *load* (3.18) that can be accommodated by a material or *structure* (3.31) without potential *rupture* (3.25), *collapse* (3.5) or *detrimental yielding* (3.12) in a given environment

Note 1 to entry: The load can imply the corresponding stress or strain.