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Space engineering - Mechanical shock design and verification handbook

Ingénierie spatiale - Chocs mécaniques: Manuel de conception et de vérification

Raumfahrttechnik - Handbuch zu mechanischem Design und Verifikation für Stöße

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European Foreword

This document (CEN/TR 17603-32-25:2022) 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 17603-32-25:2022) originates from ECSS-E-HB-32-25A.

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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

In recent years, discussions concerning "what to do about shock" in relation to spacecraft have taken more importance. During launch and deployment operations, a spacecraft can be exposed to energetic shock environments. As spacecraft have become more capable, more equipment can be flown, and components are closer together. In addition, more sophisticated and delicate instruments are flown to maximize mission results.

As such, the shock environment has become a source of concern for spacecraft and payload developers. However, not only the definition of the environment, but also the analysis and test verification is complex.

In the same way than for other mechanical environment, it is important to properly address the shock early in the development phase until the final verification of the shock environment, to ensure a successful qualification.

The experience, gained over the past years by Agencies and industries, greatly improves the state of the art in this domain and has helped clear a large number of equipment and spacecraft for launch.

However, one of the problems with respect to mechanical shock design and verification is the fact that relevant information is spread over ESA and industry documents and specialists. To improve this, the current know-how on mechanical shock design and verification is documented in the present handbook in order to make this expertise available to all European spacecraft and payload developers.

The handbook is divided into four parts:

- Part 1 Overview
- Part 2 Shock input derivation to space segment elements and equipment
- Part 3 Shock verification approach
- Part 4 Shock damage risk assessment

1 Scope

The intended users of the "Mechanical shock design and verification handbook" are engineers involved in design, analysis and verification in relation to shock environment in spacecraft. The current know-how relevant to mechanical shock design and verification is documented in this handbook in order to make this expertise available to all European spacecraft and payload developers.

The handbook provides adequate guidelines for shock design and verification; therefore it includes advisory information, recommendations and good practices, rather than requirements.

The handbook covers the shock in its globally, from the derivation of shock input to equipment and sub-systems inside a satellite structure, until its verification to ensure a successful qualification, and including its consequences on equipment and sub-systems. However the following aspects are not treated herein:

- No internal launcher shock is treated in the frame of this handbook even if some aspects are common to those presented hereafter. They are just considered as a shock source (after propagation in the launcher structure) at launcher/spacecraft interface.
- Shocks due to fall of structure or equipment are not taken into account as they are not in the frame of normal development of a spacecraft.

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