
Space systems — Vibration testing

Systèmes spatiaux — Essais de vibration



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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 documents 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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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

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

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

Vibration testing is one of the most important test items of space systems. The primary goals of vibration testing are to verify the design and to detect manufacturing issues of spacecraft, subsystems and units that could result in in-flight failures. In design, material selection, manufacture, assembly and integration phase, the test aims on exposing defects and non-conformances existing and eliminating potential quality problems. With regard to the launch phase, it also serves to prevent structural failure of a space system, loosening of fasteners and connectors, failure of electronic components, leakage of sealing elements or malfunction of mechanical system.

During vibration testing, over-testing can result in unnecessary destruction of the test specimen. In the 1990s, at the Jet Propulsion Laboratory, Mr. Terry Scharton elaborated the methodology of force notching for qualification of satellites and spacecraft to mitigate unnecessary over-testing. Since then, several attempts have been made to establish this methodology for a broader range of application. This document includes the methodology of force-based testing.

Space systems — Vibration testing

IMPORTANT — The electronic file of this document contains colours which are considered to be useful for the correct understanding of the document. Users should therefore consider printing this document using a colour printer.

1 Scope

This document provides guidance and requirements for test providers and interested parties to implement vibration testing.

This document specifies methods, including the force limiting approach, to mitigate unnecessary over-testing of spacecraft, subsystems and units for space application.

The technical requirements in this document can be tailored to meet the actual test objectives.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitute 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 15864:2021, *Space systems — General test methods for space craft, subsystems and units*

ISO 19924:2017, *Space systems — Acoustic testing*

3 Terms and definitions

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

ISO and IEC maintain terminological 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

notching

reduction of the input level or spectrum in a vibration testing to limit structural responses at resonant frequencies according to qualification or acceptance loads to avoid over-testing.

3.2

response limited vibration testing

reduction of input acceleration in a vibration testing to maintain the measured response at or below a specified value

3.3

force limited vibration testing

reduction of reaction force in a vibration testing to specified values, which are usually the interface forces predicted for flight, plus a desired margin.

3.4

statistical DOF

number of independent variables in a statistical estimate of a probability

Note 1 to entry: The number of degrees of freedom determines the statistical accuracy of an estimate.