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Space systems — Design qualification and acceptance tests of small spacecraft and units

Systèmes spatiaux — Qualification de la conception et essais de réception des petits véhicules spatiaux

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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 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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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 vehicles*, Subcommittee SC 14, *Space systems and operations*.

This second edition cancels and replaces the first edition (ISO 19683:2017), which has been technically revised.

The main changes are as follows:

— updated terms and definitions;

— added 5.10 on testing of satellite constellation program;

— added Clause 8 on satellite constellation tests;

— updated Clause 9 on test requirements;

— updated Annex C.

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.

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Introduction

There is an increasing demand for small, micro, nano or pico satellite development and utilization worldwide; yet, there is no clear and globally accepted definition of what is considered “small”, “micro”, “nano” or “pico” satellites. These satellites are often built with emphasis on low cost and fast delivery. They are characterized by extensive use of non-space-qualified commercial-off-the-shelf (COTS) units (component). For the sake of convenience, the term “small spacecraft” is used throughout this document as a generic term to refer to these satellites.

A small spacecraft is a satellite that utilizes non-traditional risk-taking development and management approaches to achieve low cost and fast delivery with a small number of team. To achieve these two points, low cost and fast delivery, satellite design relies on the use of non-space-qualified COTS units (components), making satellite size inherently smaller. The design accepts a certain level of risk associated with the use of COTS. Because of the risk taking approach, small spacecraft often fails in orbit. But the replacement spacecraft is quickly built and launched reflecting the lessons obtained in the previous spacecraft. As the launch cost depends on the spacecraft size and/or mass, the spacecraft size becomes “small”.

Figure 1 illustrates the applicability of this document.

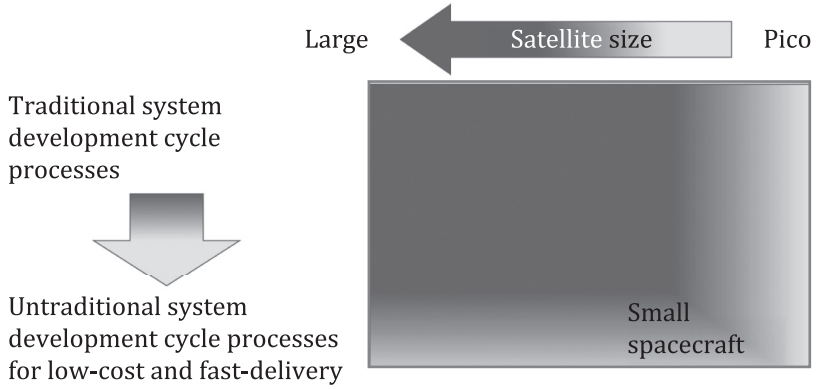


Figure 1 — Applicability of this document

A certain set of tests is necessary to ensure the mission success of small spacecraft. Applying the same test requirements and methods as those applied to traditional large or medium satellites, however, nullifies the low-cost and fast-delivery advantages possessed by small spacecraft.

This document is meant to improve the reliability of small spacecraft, especially those with commercial purpose, with emphasis on achieving reliability against infant mortality after satellite launch to orbit, while maintaining the low-cost and fast-delivery nature of small spacecraft.

This document intends to promote worldwide trade of small spacecraft products by providing a minimum level of assurance that a product made of non-space-qualified commercial-off-the-shelf parts and units can work in space. This document also aims to serve as a testing guideline for those who intend to enter satellite manufacturing through development of small spacecraft products.

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Space systems — Design qualification and acceptance tests of small spacecraft and units

1 Scope

This document provides test methods and test requirements for design either qualification or acceptance, or both of small spacecraft or units. It provides the minimum test requirements and test methods to qualify the design and manufacturing methods of commercial small spacecraft and their units and to accept the final products.

This document is applicable to satellites whose development methods are different from the ones used for traditional satellites that have little room for risk tolerance. The scope of this document encompasses different categories of small spacecraft, so-called mini-, micro-, nano-, pico- and femto spacecraft.

This document includes CubeSat, as long as it is developed with the untraditional processes.

This document does not cover satellite deployment mechanisms, such as picosatellite orbital deployer (POD), as the verification requirements are defined in the interface control document (ICD) with the launcher, such as ISO 26869[1].

This document does not cover software testing, although some tests such as functional test, mission test and end-to-end test are inherently used to test the software installed in the hardware being tested. General requirements and processes of satellite software testing can be found in various references, such as ECSS-E-ST40[2].

This document does not cover requirements regarding safety nor debris mitigation. Appropriate documents such as ISO 14620-1[3] or ISO 24113[4] can be referred to. Other common requirements for small spacecraft can be found in ISO 20991[5].

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 11221:2011, *Space systems — Space solar panels — Spacecraft charging induced electrostatic discharge test methods*

ISO 14302, *Space systems — Electromagnetic compatibility requirements*

ISO 15864:2021, *Space systems — General test methods for spacecraft, subsystems and units*

ISO 17566:2011, *Space systems — General test documentation*

ISO 24411:2022, *Space systems — Micro-vibration testing*

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:

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

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