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Space systems — General test methods for spacecraft, subsystems and units

Systèmes spatiaux — Méthodes d'essai générales pour véhicules spatiaux, sous-systèmes et équipements

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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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 15864:2004), which has been technically revised.

The main changes compared to the previous edition are as follows:

— harmonized expressions throughout this document, including terminologies;

— added necessary but minimum modifications to requirements such as traceability in 4.9.6 and magnetic test in 7.4;

— added the most current published documents as normative references: ISO 19924 and ISO 21494.

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

Throughout this document, the minimum essential criteria are identified by the use of the keyword "shall". Recommended criteria are identified by the use of the keyword "should" and, while not mandatory, are considered to be of primary importance in providing serviceable, economical and practical designs. Deviations from the recommended criteria should occur only after careful consideration, extensive testing and thorough service evaluation have shown alternative methods to be satisfactory. The acceptance criteria, specifications or procedures, and other detail test requirements applicable to a particular programme are defined in the applicable technical specifications and statement of work. When requirements have to be verified by measuring product performance and function under various simulated environments, the method is referred to as "Test". The requirements of this document may be tailored for each specific space programme application.

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Space systems — General test methods for spacecraft, subsystems and units

1 Scope

This document provides the baseline standard on the subject of testing at the system, subsystem and unit levels for applicable unmanned spacecraft programmes. It also provides the requirements for documentation associated with testing activities.

This document contains provisions for qualification and acceptance testing, or proto-flight testing (PFT). It assumes that hardware development is complete.

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 14302, *Space systems — Electromagnetic compatibility requirements*

ISO 14303, *Space systems — Launch-vehicle-to-spacecraft interfaces*

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

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

ISO 19924, *Space systems — Acoustic testing*

ISO 21494, *Space systems — Magnetic testing*

ISO 23461, *Space systems — Programme management — Non-conformance control system*

3 Terms, definitions and abbreviated terms

3.1 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 http://www.electropedia.org/

3.1.1
development model
representative of *spacecraft* (3.1.10), *subsystem* (3.1.11) or *unit* (3.1.14) dedicated to increasing confidence in design and subjected to development tests

3.1.2
flight model
spacecraft (3.1.10), *subsystem* (3.1.11) or *unit* (3.1.14) model dedicated to being launched and operated in orbit and subjected to acceptance testing

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3.1.3
maximum predicted level
highest level that can be expected during a structure's service life in association with the applicable operating environments

Note 1 to entry: See 4.4.

3.1.4
maximum predicted temperature
highest temperature that can be expected to occur during the entire life cycle of the *subsystem* (3.1.11)/ *unit* (3.1.14) in all *operational modes* (3.1.6) plus an uncertainty factor

3.1.5
minimum predicted temperature
lowest temperature that can be expected to occur during the entire life cycle of the *subsystem* (3.1.11)/ *unit* (3.1.14) in all *operational modes* (3.1.6) plus an uncertainty factor

3.1.6
operational modes
modes for *spacecraft* (3.1.10), *subsystems* (3.1.11) and *units* (3.1.14) that include all combinations of operational configurations that can occur during service life

EXAMPLE Power on or power off, the main or redundant system is selected.

3.1.7
proto-flight model
model that is intended for both qualification and flight and is subjected to the qualification levels and acceptance duration during testing

3.1.8
qualification model
spacecraft (3.1.10), *subsystem* (3.1.11), or *unit* (3.1.14) dedicated to qualifying the design of *flight model* (3.1.2) and subjected to qualification testing

3.1.9
quasi-static load
load with magnitude and direction that are independent of time; includes that varies slowly and in which dynamic response of the structure is insignificant

Note 1 to entry: This load can be induced by steady wind, aerodynamic forces and thrust (constant or wind slow variations), manoeuvres and spin stabilization.

3.1.10
spacecraft
integrated set of *subsystems* (3.1.11) and *units* (3.1.14) designed to perform specific tasks or functions in space

3.1.11
subsystem
assembly of functionally related *units* (3.1.14), which is dedicated to specific functions of a system

3.1.12
test article
spacecraft (3.1.10), *subsystem* (3.1.11) or *unit* (3.1.14) on which a test is conducted

3.1.13
test facility
technical plant or location (including equipment, fixtures, instrumentation and all associated infrastructure) capable of performing a test

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3.1.14
unit
lowest level of hardware assembly that works with specified complex electrical, thermal and/or mechanical functions

3.2 Abbreviated terms

AT	acceptance test
CG	centre of gravity
EED	electro-explosive devices
EMC	electromagnetic compatibility
LBB	leak-before-burst
MEOP	maximum expected operating pressure
MMA	moving mechanical assembly
PFT	proto-flight test
QT	qualification test
RF	radio frequency

4 General requirements

4.1 Testing philosophy

In principle, testing is one verification method that ensures that the spacecraft meets all design, performance and product assurance requirements.

Performance requirements contained in the contract documentation are compared to performance achieved during testing and provide the basis for judging the capability of the spacecraft to operate as intended. Besides verifying performance, test programmes provide the following items:

a) training for personnel in the operation of the spacecraft;

b) incorporation of corrective actions taken for non-conformances;

c) validation of data processing;

d) opportunity to perform calibrations under simulated space conditions;

e) verification of ground hardware compatibility with the spacecraft for operations.

Factors that contribute to the provisions of test specifications include experience with similar spacecraft, subsystem and unit; cost considerations; and reliability requirements and risk tolerance. This document contains range conditions to which the items under test shall be operated and test conditions that shall be used to demonstrate capability.

4.2 Tailoring of requirements

The test requirements may be tailored to fulfil the objectives of individual tests. Tailoring parameters shall be determined by negotiations among the customer, spacecraft manufacturer and launch service provider.

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