
**Space systems — General test
requirements for launch vehicles**

*Systèmes spatiaux — Exigences générales d'essai pour véhicules
lanceurs*

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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.

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The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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ISO 24917 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 14, *Space systems and operations*.

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Introduction

This International Standard provides space launch vehicle customers, contractors and manufacturers with general requirements for test types and programmes for space launch vehicles and rocket units (modules) to be used in the documentation associated with their test activity.

This International Standard is intended to help reduce the development time and cost of space launch vehicles and rocket units, and to enhance their quality and reliability through the use of common, optimized and approved requirements in the space launch vehicle test scope and organization.

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Space systems — General test requirements for launch vehicles

1 Scope

This International Standard establishes general test requirements for launch vehicles equipped with liquid-propellant engines, launched from stationary ground-, sea- and air-based launchers, in all phases of their development.

2 Normative references

The following referenced documents are indispensable for the application 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*

3 Terms and definitions

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

3.1

space-rocket complex

set of a space vehicle or space launch vehicles with functionally interconnected means and the constructions intended for transportation, storage, maintenance service, preparation, launching and flight control of space launch vehicles on a trajectory of launching of payload

3.2

space rocket

space launch vehicle plus space nose section integration

3.3

space launch vehicle

component of the space rocket designed for payload injection in a pre-assigned trajectory or orbit

3.4

rocket unit

space launch vehicle stage including the upper stage vehicle, body, propulsion system, control systems or control system elements, rocket units separation aids and telemetry hardware

3.5

upper stage vehicle

upper stage of flight vehicle capable of injecting a space vehicle or vehicles into their orbit from the sub-orbital trajectory that resulted from operation of a launch vehicle

3.6
space nose section

set of a space vehicle with fairing and adapter and upper stage vehicle

NOTE Upper stage vehicle can be absent.

3.7
fairing

technical device intended for protection of a space vehicle or of a space nose section from external influences at transportation of the space launch vehicle on a launcher and on a start of the space launch vehicle and on a trajectory of launching into an orbit of a space vehicle

3.8
integration site

equipment and facility designed for launch vehicle storage, assembly, testing, preparation, maintenance, servicing and preparation for transportation to the launch pad

[ISO/TR 17400:2003, definition 3.1]

3.9
launch pad

equipment and facility designed to provide for the pre-launch and launch operations of spacecraft

[ISO/TR 17400:2003, definition 3.3]

3.10
launch pad for space launch vehicle

device intended to maintain the space launch vehicle in readiness for launch, and for the launch itself

3.11
technical project on development of a product

initial document establishing a complex of technical requirements to created products, and to the contents, volume and terms of performance of design experiment works as well

3.12
technical specification

specification expressing technical requirements for designing and developing the solution to be implemented

NOTE The technical specification evolves from the functional specification and defines the technical requirements for the selected solution as part of a business agreement.

[ISO 21351:2005, definition 3.1.11]

3.13
requirement

need or expectation that is stated, generally implied or obligatory

NOTE 1 "Generally implied" means that it is custom or common practice for the organization, its customers and other interested parties that the need or expectation under consideration is implied.

NOTE 2 A qualifier can be used to denote a specific type of requirement, e.g. product requirement, quality management requirement, customer requirement.

NOTE 3 A specified requirement is one which is stated, for example, in a document.

NOTE 4 Requirements can be generated by different interested parties.

[ISO 9000:2005, definition 3.1.2]

3.14**interface control document****ICD**

document of launcher and fairing/payload which defines all physical, electrical and mechanical interfaces between the payload and the launch vehicle hardware and software, and interfaces between payload and support equipment and space site facilities, systems and hardware used for spacecraft launch preparation

3.15**test**

formal process of exercising or putting to trial a system or item by manual or automatic means to identify differences between specified, expected and actual results

3.16**test conditions**

combination of effects of factors, or object operation conditions, or both, during the test

3.17**test metrological provision**

establishment and application of scientific and organizational basis, technical means, rules and standards necessary for achieving the measurement unity demanded, precision, completeness, operativeness and the reliability of parameters control and technical characteristics of items

3.18**ground test programme**

organizational-methodological document obligatory for execution, which specifies the test object and objectives, types, sequence and scope of conducted experiments, order, conditions, place, time and support of test, test reporting, as well as responsibility for test support and conduct

3.19**reliability assurance programme**

programme document specifying a set of requirements and measures aimed at providing and controlling the satisfaction of requirements established for the statement of work for a space launch vehicle and its components reliability during their development

3.20**space launch vehicle (unit) experimental optimization**

operations of modelling units, mock-ups, test prototypes in order to assure operation of items in accordance with statement of work, definition their efficiency margins

3.21**safety assurance programme**

programme document which establishes a set of requirements and measures aimed at assuring that all safety risks associated with the space launch vehicle design, development, manufacture and use are accordingly identified, assessed, minimized, controlled and accepted

3.22**telemetry measurement programme**

programme document establishing the composition of telemetry measurement hardware born set on space launch vehicle, launch pad and positioned along the flight route necessary for satisfying the measurement requirements as well as places and orientation of sensors arrangement and their characteristics, frequency bands, minimal frequency of sensor polling

3.23**flight test**

tests in real conditions of functioning and performance of target tasks

3.24

test prototype of rocket and space technology item

item produced in the research and development process applying the newly developed working engineering and technological documentation for test verification of the conformity of its parameters and characteristics with the requirements specified in statement of work to research and development and correctness of adopted technical solutions

3.25

test mock-up (model)

structurally, or physically, or structurally and physically similar item presenting a simplified reproduction of a test object or its part intended for test

3.26

structural model

model representing the structural flight characteristics

3.27

electrical model

model representing the electrical flight characteristics

3.28

test object

item under test

3.29

test type

classified test grouping identified according to a certain attribute

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3.30

preliminary (development) tests

check test of test object prototypes conducted with the purpose of evaluating their conformity with the statement of work requirements and determining their readiness for flight test

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NOTE Items are subjected to development tests as required, in order to minimize design risk, to demonstrate manufacturing feasibility, to establish packaging designs, to demonstrate electrical and mechanical performance and to demonstrate the capability to withstand environmental stress, including storage, transportation, extreme combined environments and launch base operations

3.31

qualification tests

required formal contractual tests used to demonstrate that the design, manufacturing, and assembly have resulted in hardware designs conforming to specification requirements

[ISO 14623:2003, definition 2.52]

3.32

acceptance tests

required formal tests conducted on flight hardware to ascertain that the materials, manufacturing processes and workmanship meet specifications and that the hardware is acceptable for intended usage

[ISO 14623:2003, definition 2.2]

3.33

operational tests

tests conducted at the launch vehicle site in an operational environment, with the equipment in its operational configuration

3.34**service (guarantee) life**

period starting at the completion of fabrication and continuing through all acceptance testing, maintenance, handling, storage, transportation, pre-launch testing, all phases of launch, orbital operations, disposal, re-entry or recovery from orbit

3.35**critical unit**

unit whose failure can affect the system operation sufficiently to cause the failure of the stated vehicle objectives or a partial loss of the mission, or whose proper performance is essential from a safety standpoint

3.36**explosive-ordnance device**

device that contains explosives or is operated by explosives

NOTE A cartridge actuated device, one type of explosive device, is a mechanism that employs the energy produced by an explosive charge to perform or initiate a mechanical action.

4 Abbreviated terms

CTS control-test station

EMC electromagnetic compatibility

FTP flight test programme

GTP ground test programme

ICD interface control document

IS integration site

LPRE liquid-propellant engine

LS launching site

LV launch vehicle

OCN on-board cable network

PHS pneumatic/hydraulic system

RAP reliability assurance programme

SC spacecraft

SLV space launch vehicle

SNS space nose section

SOW statement of work

SGP safety guarantee programme

SRC space rocket complex

TMP telemetry measurements programme

USV upper stage vehicle

5 Testing philosophy

5.1 Objectives, tasks and principles of launch vehicle and rocket unit experimental optimization

5.1.1 Experimental optimization is one of the methods of verification which guarantees that all characteristics of the space launch vehicle (SLV) meet the requirements of the statement of work (SOW). The SLV is tested in the structure of the space rocket complex (SRC).

Experimental optimization of SLV, launch vehicle (LV) units and unit components includes ground experimental optimization phases and flight test. The complete test programme for launch vehicles, upper stage, encompasses development, qualification, acceptance, pre-launch validation and follow-on operational test and evaluations. The test programme encompasses the testing of progressively more complex assemblies of hardware and computer software. Generally the SLV experimental optimization structure may be represented as a scheme (see Figure 1).

5.1.2 The major objective of ground experimental optimization is to optimize and verify the SLV preparation technology for launch and launch itself, preliminarily verify and evaluate implementation of the project-specified parameters and characteristics, operation and interaction patterns of all SLV components and SLV as a whole when the operation conditions are being simulated (or under effect of these conditions).

5.1.3 The major objective of flight test is to comprehensively check the SLV serviceability and confirm the SOW-specified requirements for the space rocket complex under real operation conditions.

5.1.4 One of the major objectives of SLV [upper stage vehicle (USV)] ground experimental optimization is to achieve the SOW-assigned levels of reliability and safety indexes before flight test commencement to be confirmed during the flight test. The reliability and safety index levels are normalized in the reliability assurance programme (RAP) and the safety guarantee programme (SGP), the latter including environment safety guarantee.

5.1.5 The main objectives of experimental optimization of SLV, LV units and SLV unit components are as follows:

- a) verification of unit structure strength, rigidity, confirmation of rocket module parameters, verification of equipment mechanical loading regimes;
- b) breadboarding;
- c) optimization of technological cycle of preparing SLV for launch and launch itself;
- d) comprehensive verification of rocket unit systems functioning during launch and propulsion system operation in the assigned regimes;
- e) verification of the ground technical means/launch vehicle compatibility;
- f) optimization of SLV interfaces [LV, upper stage vehicle, spacecraft (SC)];
- g) experimental confirmation of the correctness of adopted engineering solutions;
- h) verification of the sufficiency of measuring aids and TM data processing techniques;
- i) individual optimization of all SLV components;
- j) verification of operation convenience;
- k) personnel training.

5.1.6 The problems to be solved while testing specific LVs are identified according to the engineering make, assigned characteristics, LV optimization degree, design novelty (modification scope), dedicated operation conditions change and are presented in the test programmes.

The environmental factors specified in SOW tests are intended to be imposed sequentially, rather than in combination. Nevertheless, features of the hardware design or of the service environments may warrant the imposition of combined environments in some tests, e.g. combined shock, vibrations. In formulating the test requirements in these situations, a logical combination of environmental factors should be imposed to enhance test effectiveness.

5.1.7 Organization and order of conducting the experimental optimization are determined by the comprehensive experimental optimization programme.

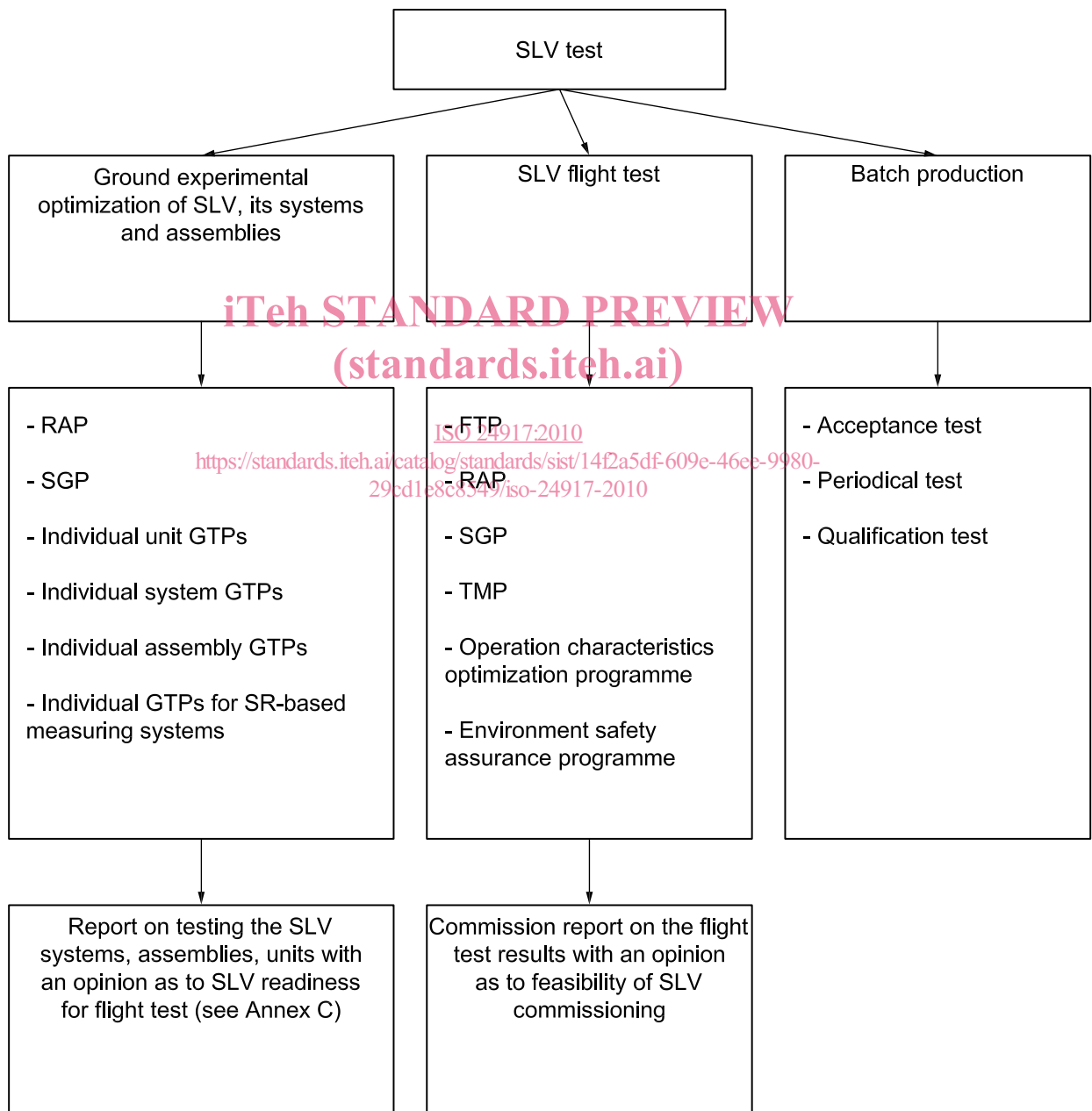


Figure 1 — Space launch vehicle experimental optimization structure