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Space systems — Pressure components and pressure system integration

Systèmes spatiaux — Intégration des composants sous pression et des systèmes sous pression

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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 24638:2008), which has been technically revised.

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

— 6.8.4 was revised to make the requirement a more general statement;

— corrections were made to Tables 1 and A.1.

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

Space vehicles and their launch systems usually have a series of engines to use for both primary propulsion and secondary propulsion functions, such as attitude control and spin control.

Different engines have different propellant feed systems. For example, the gas-pressure feed system is typically used for liquid propellant engines; it consists of a high-pressure gas tank, a fuel tank and an oxidizer tank, valves and a pressure regulator. All these components are referred to as pressurized hardware.

Due to their specific usage, the liquid propellant tanks and the high-pressure gas bottles are often referred to as pressure vessels, while valves, regulators and feed lines are usually called pressure components.

ISO 14623 sets forth the standard requirements for pressure vessels in order to achieve safe operation and mission success. However, the requirements for pressure components are not covered in ISO 14623. Furthermore, the standard requirements for pressure system integration are lacking.

Significant work has been done in the area of design, analysis and testing of pressure components for use in space systems. This document establishes the preferred methods for these techniques and sets forth the requirements for the assembly, installation, test, inspection, operation and maintenance of the pressure systems in spacecraft and launch vehicles.

Space systems — Pressure components and pressure system integration

1 Scope

This document establishes the baseline requirements for the design, fabrication and testing of space flight pressure components. It also establishes the requirements for the assembly, installation, test, inspection, operation and maintenance of the pressure systems in spacecraft and launch vehicles. These requirements, when implemented on a particular space system, ensure a high level of confidence in achieving safe and reliable operation.

This document applies to all pressure components other than pressure vessels and pressurized structures in a pressure system. It covers lines, fittings, valves, bellows, hoses and other appropriate components that are integrated to form a pressure system.

The requirements for pressure vessels and pressurized structures are set forth in ISO 14623.

This document does not apply to engine components.

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

ISO 21347, *Space systems — Fracture and damage control*

ISO 24113, *Space systems — Space debris mitigation requirements*

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 http://www.electropedia.org/

3.1
A-basis allowable
mechanical strength value above which at least 99 % of the population of values is expected to fall, with a confidence level of 95 %

Note 1 to entry: See also *B-basis allowable* (3.3).

[SOURCE: ISO 14623:2003, 2.1, modified — Note 1 to entry has been added.]

3.2
applied load
applied stress
actual load (stress) imposed on the hardware in the service environment

[SOURCE: ISO 14623:2003, 2.4, modified — “the structure” has been changed to “the hardware”.]

3.3
B-basis allowable
mechanical strength value above which at least 90 % of the population of values is expected to fall, with a confidence level of 95 %

Note 1 to entry: See also *A-basis allowable* (3.1).

[SOURCE: ISO 14623:2003, 2.6, modified — Note 1 to entry has been added.]

3.4
component
set of materials, assembled according to defined and controlled processes, which cannot be disassembled without destroying its capability and which performs a simple function that can be evaluated against expected performance requirements

[SOURCE: ISO 10795:2019, 3.48, modified — The preferred term "part" has been removed.]

3.5
damage tolerance
ability of a material/structure to resist failure due to the presence of flaws for a specified period of unrepaired usage

[SOURCE: ISO 21347:2005, 3.7]

3.6
damage tolerance analysis
safe-life analysis

fracture mechanics-based analysis that predicts the flaw growth behaviour of a flawed hardware item which is under service *loading spectrum* (3.15) with a pre-specified *scatter factor* (3.24)

3.7

design burst pressure
burst pressure
ultimate pressure
differential pressure that pressurized hardware must withstand without burst in the applicable operational environment

Note 1 to entry: Design burst pressure is equal to the product of the *maximum expected operating pressure (MEOP)* (3.17) or *maximum design pressure (MDP)* (3.16) and a design burst factor.

[SOURCE: ISO 14623:2003, 2.16, modified — In Note 1 to entry, “the MEOP or MDP” has been changed to “the maximum expected operating pressure (MEOP) or maximum design pressure (MDP)”.]

3.8
design safety factor
safety factor
design factor of safety
factor of safety
multiplying factor to be applied to *limit loads* (3.13) and/or *maximum expected operating pressure (MEOP)* (3.17) or *maximum design pressure (MDP)* (3.16)

[SOURCE: ISO 14623:2003, 2.17, modified — The preferred term “safety factor” has been added; “MEOP (or MDP)” has been changed to “maximum expected operating pressure (MEOP) or maximum design pressure (MDP)“.]

3.9
detrimental deformation
structural deformation, deflection or displacement that prevents any portion of the structure or some other system from performing its intended function or that jeopardizes mission success

[SOURCE: ISO 10786:2011, 3.16]

3.10
fitting
pressure component (3.18) of a pressurized system used to connect *lines* (3.14), other pressure components and/or *pressure vessels* (3.19) within the system

3.11
hazard
existing or potential condition of an item that can result in an accident

Note 1 to entry: This condition can be associated with the design, fabrication, operation or environment of the item, and has the potential for introducing an accident.

Note 2 to entry: "Item" can include human beings.

[SOURCE: ISO 10795:2019, 3.120, modified — In note 1 to entry, "the potential for accidents" has been changed to "the potential for introducing an accident".]

3.12
hydrogen embrittlement
mechanical-environmental process that results from the initial presence or absorption of excessive amounts of hydrogen in metals, usually in combination with residual or applied tensile stresses

[SOURCE: ISO 14623:2003, 2.31]

3.13
limit load
design limit load
maximum expected load, or combination of loads, which a structure or a *component* (3.4) in a structural assembly is expected to experience during its *service life* (3.25), in association with the applicable operating environments

Note 1 to entry: Load is a generic term for thermal load, pressure, external mechanical load (force, moment, or enforced displacement) or internal mechanical load (residual stress, pretension, or inertial load)..

Note 2 to entry: The corresponding stress or strain is called limit stress or limit strain.

[SOURCE: ISO 10786:2011, 3.30, modified — "design limit load" has been added as an admitted term; Note 3 to the entry describing "design limit load" has been deleted.]

3.14
line
tubular *pressure component* (3.18) of a *pressure system* (3.21) provided as a means for transferring fluids between *components* (3.4) of the system

Note 1 to entry: Flexhoses are included.

3.15
loading spectrum
representation of the cumulative loading levels and associated cycles anticipated for the structure or *component* (3.4) of a structural assembly according to its *service life* (3.25) under all expected operating environments

Note 1 to entry: Significant transportation, test, and handling loads are included in this definition.

[SOURCE: ISO 10786:2011, 3.32]

3.16
maximum design pressure
MDP
highest pressure, as defined by maximum relief pressure, maximum regulator pressure and/or maximum temperature, including transient pressures, at which a pressurized hardware item retains two-fault tolerance without failure

[SOURCE: ISO 21347:2005, 3.20, modified — “pressure vessel” has been changed to “pressurized hardware item”.]

3.17
maximum expected operating pressure
MEOP
maximum allowed working pressure
MAWP
maximum operating pressure
MOP
highest differential pressure which a pressurized hardware item is expected to experience during its *service life* (3.25) and retain its functionality, in association with its applicable operating environments

Note 1 to entry: MEOP includes the effects of temperature, transient peaks, relief pressures, regulator pressure, vehicle acceleration, phase changes, transient pressure excursions, and relief valve tolerance.

Note 2 to entry: Some projects may replace MEOP with *maximum design pressure (MDP)* (3.16), which takes into account more conservative conditions.

Note 3 to entry: The terms MAWP and MOP are used when required to replace the term MEOP in a specific application.

[SOURCE: ISO 14623: 2003, 2.41, Modified — "maximum allowed working pressure", "MAWP", "maximum operating pressure", "MOP" have been added as admitted terms; notes 1, 2 and 3 to entry have been added.]

3.18
pressure component
component (3.4) in a *pressure system* (3.21), other than a *pressure vessel* (3.19), or *pressurized structure* (3.20) that is designed largely by the internal pressure

EXAMPLE *Lines* (3.14), *fittings* (3.10), pressure gauges, valves, bellows and hoses.

3.19
pressure vessel
container designed primarily for the storage of pressurized fluids, which either contains gas/liquid with high energy level, or contains gas/liquid that will create a mishap (accident) if released, or contains gas/liquid with high pressure level

Note 1 to entry: This definition excludes *pressurized structures* (3.20) and *pressure components* (3.18).

Note 2 to entry: Energy and pressure levels are defined by each project and approved by the procuring authority (customer). If appropriate values are not defined by the project, the following levels are used:

— stored energy is at least 19 310 J, based on adiabatic expansion of perfect gas;

— *MEOP* (3.17) is at least 0,69 MPa.

3.20
pressurized structure
structure designed to carry both internal pressure and vehicle structural loads

EXAMPLE Launch vehicle main propellant tank, crew cabins, manned modules.

