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Introduction

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



DRAFT International Standard

ISO/DIS 10786

Space systems — Structural components and assemblies

Systèmes spatiaux — Composants et assemblages de structure

ICS: ISO ics

ISO/TC 20/SC 14

Secretariat: **ANSI**

Voting begins on:
2024-06-20

Voting terminates on:
2024-09-12

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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 10786:2011), which has been technically revised.

The main changes are as follows:

- Reflection of the systematic review comments for ISO 10786:2011.
- Clarification of the scope
- Updates for the normative references and the citations from the normative sections.
- Updates for the terms and definitions to harmonize with the other ISO structural related standards.
- Construction changes to meet the requirements in ISO/IEC Directives Part 2.

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

Structures are the backbones of all spaceflight systems. A structural failure could cause the loss of human lives for manned space systems or could jeopardize the intended mission for unmanned space systems. Currently, there is no document that covers all the aspects that can be used for spaceflight structural items such as spacecraft platforms, interstage adaptors, launch vehicle buses and rocket motor cases.

The purpose of this document is to establish general requirements for structures. It provides the uniform requirements necessary to minimize the duplication of effort and the differences between approaches taken by the participating nations and their commercial space communities in developing structures. In addition, the use of agreed-upon standards will facilitate cooperation and communication among space programmes.

Space systems — Structural components and assemblies

1 Scope

This document establishes requirements for the design; material selection and characterization; fabrication; testing and inspection of all structural items in space systems, including expendable and reusable launch vehicles, satellites and their payloads. This document, when implemented for a particular space system, will assure high confidence in achieving safe and reliable operation in all phases of its planned mission.

This document applies specifically to all structural items, including fracture-critical hardware used in space systems during all phases of the mission, with the following exceptions: adaptive structures, propulsion systems, nuclear systems, and thermal protection systems.

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 14953, *Space systems — Structural design — Determination of loading levels for static qualification testing of launch vehicles*

ISO 14954, *Space systems — Dynamic and static analysis — Exchange of mathematical models*

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

ISO 16454, *Space systems — Structural design — Stress analysis requirements*

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

ISO 21648, *Space systems — Flywheel module design and testing*

ISO 24638, *Space systems — Pressure components and pressure system integration*

ISO 24917, *Space systems — General test requirements for launch vehicles*

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

A-basis allowable

A-basis design allowable

A-value

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

[SOURCE: ISO 10786:2011, 3.1]

[SOURCE: ISO 14623:2003, 2.1]

[SOURCE: ISO 16454:2007, 3.1]

[SOURCE: ISO 21648:2008, 2.1.1]

[SOURCE: ISO 24638:2021, 3.1]

3.2

acceptance test

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

[SOURCE: ISO 10786:2011, 3.2]

[SOURCE: ISO 14623:2003, 2.2]

[SOURCE: ISO 21648:2008, 2.1.2, modified — The wording, “and that the hardware is acceptable for intended usage” has been added.]

[SOURCE: ISO 23835:2022, 3.4]

3.3

adaptive structures

autonomous structural systems which incorporate sensors, processors, and actuators to enable adaptation to changing environmental conditions, thereby enhancing safety, stability, vibration damping, acoustic noise suppression, aerodynamic performance and optimization, pointing accuracy, load redistribution, damage response, structural integrity, etc.

[SOURCE: ISO 10786:2011, 3.3]

3.4

allowable load

allowable stress

allowable strain

maximum load (stress, strain) that can be accommodated by a material/structure or a component of a structural assembly without potential rupture, collapse, or detrimental deformation in a given environment

Note 1 to entry: “Allowable loads (stress, strain)” commonly correspond to the statistically based ultimate strength, buckling strength, and yield strength, or maximum strain (for ductile materials).

[SOURCE: ISO 10786:2007, 3.7, modified — The preferred term, “allowable stress” and “allowable strain” have been added. The wording, “material/” has been inserted before “structure”, and the wording of “stress, strain) has been added after “allowable load” in the notes to entry. Note 2 to entry has been deleted.]

[SOURCE: ISO 14623:2003, 2.3, modified — The preferred term, “allowable load (stress)” has been separate to the preferred terms, “allowable load” and “allowable stress”, and “allowable strain” has been added as the preferred term. The wording “maximum load(stress)” has been replaced by “maximum load (stress, strain)” in the definition and the note to entry. The wording “respectively” in the note to entry has been replaced by “maximum strain (for ductile materials)”.]

[SOURCE: ISO 16454:2007, 3.2, modified — The wording “respectively” in the note to entry has been replaced by “maximum strain (for ductile materials)”.]

[SOURCE: ISO 21648: 2008, 2.1.3, modified — The wording, “maximum load” has been replaced by “maximum load (stress, strain) “. The wording, “a structure/material without rupture, collapse or detrimental deformation” has been replaced by “a material/structure or a component of a structural assembly without potential rupture, collapse, or detrimental deformation”. The wording “respectively” in the note to entry has been replaced by “maximum strain (for ductile materials)”.]

3.5

assembly

combination of parts, components and units that forms a functional entity

[SOURCE: ISO 10786:2011, 3.5 modified — The definition has been editorially revised. (The relative pronoun, “which” has been replaced by “that”.)]

[SOURCE: ISO 10795:2019, 3.23]

3.6

B-basis allowable

B-basis design allowable

B-value

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](#)). [ISO 10786:2007, 2011, 3.6, modified — Note 1 to entry has been added.]

[SOURCE: ISO 14623:2003, 2.3, modified — Note 1 to entry has been added to replace the wording, “cf. “A” basis allowable”]

[SOURCE: ISO 16454:2007, 3.4, modified — Note 1 to entry has been added.]

[SOURCE: ISO 21648:2008, 2.1.4]

[SOURCE: ISO 24638:2021, 3.3]

3.7

buckling

failure mode in which an infinitesimal increase in the load could lead to sudden collapse or detrimental deformation of a structure

EXAMPLE Snapping of slender beams, columns, struts and thin-wall shells.

[SOURCE: ISO 10786:2011, 3.7]

3.8

catastrophic failure

failure which results in the loss of human life, mission or a major ground facility, or long-term detrimental environmental effects

[SOURCE: ISO 10786:2011, 3.8]

3.9

collapse

failure mode induced by quasi-static loads (compression, shear or combined stress) accompanied by irreversible loss of load-carrying capability

[SOURCE: ISO 10786:2011, 3.9]

[SOURCE: ISO 16454:2007, modified — The wording, “quasi-static compression, shear or combined stress” has been replaced by “quasi-static loads (compression, shear or combined stress)”. The wording, “very rapid irreversible loss of load resistance capability” has been replaced by “irreversible loss of load-carrying capability”.]

3.10

composite material

combination of materials different in composition or form on a macro scale

Note 1 to entry: The constituents retain their identities in the composite.

Note 2 to entry: The constituents can normally be physically identified, and there is an interface between them.

Note 3 to entry: Composites include:

- fibrous (composed of fibres, usually in a matrix),
- laminar (layers of materials), and
- hybrid (combination of fibrous and laminar).

[SOURCE: ISO 10786:2011, 3.10, modified— EXAMPLE has been deleted and the note 3 to entry has been added, reflecting the contents of EXAMPLE.]]

[SOURCE: ISO 16454:2007, 3.6, modified— Note 3 to entry has been added.]

[SOURCE: ISO 21347:2005, 3.3, modified — The wording, “which differ” has been replaced by “different”. The wording in Note 1 to entry, “Normally, the constituents can be physically identified, and there is an interface between them. A bonded structure such as metallic honeycomb sandwich is not considered as a composite structure in this document.” has been deleted. Note2 to entry has been added separating from Note 1 to entry. Note 3 to entry has been added.]

[SOURCE: ISO 21648:2011, 2.1.6, modified — The wording, “which differ” has been replaced by “different”. The wording in Note 1 to entry, “i.e. they do not dissolve or otherwise merge completely into each other, although they act in concert. Normally, the composites can be physically identified and exhibit an interface between one another” has been deleted. Note2 to entry has been added separating from Note 1 to entry. Note 3 to entry has been added.]

[SOURCE: ISO 23020:2021, 3.1.6, modified— Note 3 to entry has been added.]

3.11

composite overwrapped pressure vessel COPV

pressure vessel with a fibre-based composite system fully or partially encapsulating a liner

Note 1 to entry: The liner serves as a liquid or gas permeation barrier and may or may not carry substantial pressure loads. The composite overwraps generally carry pressure and environmental loads.

[SOURCE: ISO 10786, 3.11]

[SOURCE: ISO 14623:2003, 2.11, modified — The wording in Note 1 to entry, “fluid” has been replaced by “liquid”.]

3.12

composite structure

structural components that are made of composite materials

[SOURCE: ISO 10786:2011, 3.12]

3.13

confidence level

value $(1 - \alpha)$ of the probability associated with a confidence interval or a statistical coverage interval

Note 1 to entry: $(1 - \alpha)$ is often expressed as a percentage.

Note 2 to entry: In some cases, the confidence level is dictated by the needs of the situation. In all other instances, use of $(1 - \alpha) = 0,95$ is recommended.

3.14

damage tolerance

ability of a structure or a component of a structural assembly to resist failure due to the presence of flaws, for a specified period of unrepaired usage

[SOURCE: ISO 10786:2011, 3.13, modified — The wording, “cracks, or other damage” placed after “flaws”, has been deleted.]

[SOURCE: ISO 14623:2003, 2.15 modified — The wording, “a material/structure”, has been replaced by “a structure or a component of a structural assembly”. The wording, “cracks, delaminations, impact damage or mechanical other damage” placed after “flaws”, has been deleted.]

[SOURCE: ISO 21347:2005, 3.7, modified — The wording, “a material/structure”, has been replaced by “a structure or a component of a structural assembly”]

[SOURCE: ISO 21648:2008, 2.1.7, modified — The wording, “structure/material”, has been replaced by “a structure or a component of a structural assembly”]

[SOURCE: ISO 24638:2021, 3.5, modified — The wording, “a material/structure”, has been replaced by “a structure or a component of a structural assembly”]

3.15

design parameter

physical feature which influences the design performance of the design of structural items

Note 1 to entry: According to the nature of the design variables, different design problems can be identified such as:

- structural sizing for the dimensioning of beams, shells, etc.;
- shape optimization;
- material selection;
- structural topology.

[SOURCE: ISO 10786:2011, 3.14]

3.16

design safety factor

safety factor

design factor of safety

factor of safety

multiplying factor to be applied to *limit loads* ([3.31](#)) and/or *maximum expected operating pressure (MEOP)* ([3.39](#))

Note 1 to entry: The factor is defined in order to account for the statistical variations of loads and structural strength, and inaccuracies in the knowledge of their statistical distributions.

Note 2 to entry: On above definition, the word, *maximum expected operating pressure (MEOP)* ([3.39](#)), may be replaced by *maximum design pressure (MDP)* ([3.38](#)).

[SOURCE: ISO 14623:2003, definition 2.17, modified — The preferred term “safety factor” and the admitted terms “design factor of safety” and “factor of safety” have been added; “MEOP (or MDP)” has been changed to “maximum expected operating pressure (MEOP)”. Note 1 and Note 2 to entry has been added.]

[SOURCE: ISO 10785:2011, 3.11, modified — The preferred term “safety factor” has been added; “MEOP (or MDP)” has been changed to “maximum expected operating pressure (MEOP)”. Note 1 and Note 2 to entry has been added.]

[SOURCE: ISO 24638:2021, 3.8, modified — The word “or maximum design pressure (MDP)” has been deleted from the definition statement. Note 1 and Note 2 to entry has been added.]

3.17

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]

[SOURCE: ISO 14623:2003, 2.19, modified —The wording, “some” has been added before “other system”]

[SOURCE: ISO 24638:2021, 3.9]

3.18

development test

test to provide information that can be used to check the validity of analytic techniques and assumed design parameters, uncover unexpected system response characteristics, evaluate design changes, determine interface compatibility, prove qualification and acceptance procedures and techniques, check manufacturing technology, or to establish accept/reject criteria

[SOURCE: ISO 10786:2011, 3.17, modified — The editorial correction has been incorporated.]

[SOURCE: ISO 14623: 2003, 2.20]

[SOURCE: ISO 16454:2007, 3.13]

3.19

dynamic load

time-dependent load with deterministic or stochastic variation

[SOURCE: ISO 10786:2011, 3.18]

3.20

failure mode

manner in which failure occurs

Note 1 to entry: A failure mode may be defined by the function lost or other state transition that occurred.

Note 2 to entry: Structural failure modes include: rupture, collapse, detrimental deformation, excessive wear or any other phenomenon resulting in an inability to sustain loads, pressures and corresponding environments, or that jeopardizes mission success.

[SOURCE: IEC 60050-192:2015, 192-03-17, modified – Note 2 to entry has been added reflecting the former term definition in ISO 10786:2011, 3.19.]

3.21

fail-safe structure

structural item for which it can be shown by analysis or test that, as a result of structural redundancy, the structure remaining after the failure of any element of the structural item can sustain the redistributed limit load, with an ultimate safety factor of 1,0

[SOURCE: ISO 21347:2005, 3.10, modified – Note 1 to entry has been deleted.]

[SOURCE: ISO 10786:2011, 3.20]

3.22

fatigue life

number of cycles of stress or strain of a specified character that a given structure or component of a structural assembly can sustain (without the presence of flaw) before failure of a specified nature could occur

[SOURCE: ISO 14623:2003, 2.24, modified —The wording “a given material or structure” has been replaced by “a given structure or component of a structural assembly”, and the wording “(without the presence of flaws)” has been added after the wording “can sustain”.]

[SOURCE: ISO 10785:2011, 3.14]

[SOURCE: ISO 10786:2011, 2.24]

3.23

flaw

local discontinuity in a structural material

EXAMPLE Crack, cut, scratch, void, delamination disbond, impact damage and other kinds of mechanical damage.

[SOURCE: ISO 14623:2003, 2.25, modified—The wording, “such as a scratch, notch or crack” has been deleted from the definition of the term, and EXAMPLES have been added.]

[SOURCE: ISO 21347:2005, 3.11, modified—In EAMPLES, the wording, “cut”, “scratch”, “void”, impact damage and other kinds of mechanical damage” has been added, and the wording, “debonding”, has been replaced by “disbond”.]

[SOURCE: ISO 21648:2008, 2.1.12, modified—In EAMPLES, the wording, “cut”, “scratch”, “void”, “disbond”, “impact damage and other kinds of mechanical damage” has been added.]

[SOURCE: ISO 10785:2011, 3.16]

[SOURCE: ISO 10786:2011, 3.23]

3.24

fracture control

application of design philosophy, analysis methods, manufacturing technology, verification methodology, quality assurance, including non-destructive evaluation (NDE) and operating procedures to prevent premature structural failure caused by the presence and/or propagation of flaws during fabrication, testing, transportation, handling, and service events such as launch, in-orbit operation, and return

[SOURCE: ISO 10786:2011, 3.24]

[SOURCE: ISO 14623:2003, 2.27, modified —The wording, “including non-destructive evaluation (NDE)” has been added after the wording “quality assurance”. The wording, “the propagation of cracks or crack-like flaws” has been replaced by “the presence and/or propagation of flaws”. The wording, “service” has been replaced by “service events such as launch, in-orbit operation, and return”]

[SOURCE: ISO 21347:2005, 3.12, modified —The wording, “including non-destructive evaluation (NDE)” has been added after the wording “quality assurance”. The wording, “the propagation of cracks or crack-like flaws” has been replaced by “the presence and/or propagation of flaws”. The wording, “service” has been replaced by “service events such as launch, in-orbit operation, and return”]

[SOURCE: ISO 21648:2008, 2.1.17, modified —The wording, “including non-destructive evaluation (NDE)” has been added after the wording “quality assurance”. The wording, “the propagation of cracks or crack-like flaws” has been replaced by “the presence and/or propagation of flaws”. The wording, “ground-handling and service” has been replaced by “handling, and service events such as launch, in-orbit operation, and return”]

3.25

fracture-critical item

fracture-critical part

structural part whose failure due to the presence of a flaw would result in a catastrophic hazard

[SOURCE: ISO 10786:2011, 3.25, modified — The wording, “failure” has been replaced by “hazard”]

3.26

full scale article

full-size test article which represents the whole flight structure or a part of the flight structure with representative loading and boundary conditions

[SOURCE: ISO 10786:2011, 3.26]

3.27

hydrogen embrittlement

reduction in the ductility or mechanical properties such as strength, toughness of a metal resulting from the absorption of hydrogen into a metal

Note 1 to entry: Mechanical environmental failure due the hydrogen embrittlement usually occurs in combination with residual or applied tensile stresses

3.28

human vibration

vibration transmitted to and/or induced by the crew members

[SOURCE: ISO 10786:2011, 3.28]

3.29

inspection

determination of conformity to specified requirements

Note 1 to entry: If the result of an inspection shows conformity, it can be used for purposes of *verification* (3.75).

Note 2 to entry: The result of an inspection can show conformity or nonconformity or a degree of conformity.

[SOURCE: ISO 9000:2015, 3.11.7]

3.30

life factor

factor by which the service life is multiplied to obtain total fatigue life or damage tolerance life

Note 1 to entry: Life factor is often referred to as a scatter factor that is normally used to account for the scatter of a material's fatigue or crack growth rate data.

Note 2 to entry: It can also account for the dispersion of loading spectra parameters and other uncertainties, when appropriate.

[SOURCE: ISO 21648:2008, modified —Note 1 to entry has been separated to Note 1 to entry and Note2 to entry.]

3.31

limit load

LL

design limit load

maximum load, or combination of loads, which a structure or a component in a structural assembly is expected to experience during its service life 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 24638:2021, 3.13, modified— “maximum expected load” has been replaced by “maximum load”.]

[SOURCE: ISO 14623:2003, 2.36, modified— “design limit load” has been added as an admitted term; Note 3 to the entry describing “design limit load” has been deleted.]

[SOURCE: ISO 10785:2011, 3.19, modified— “design limit load” has been added as an admitted term; Note 3 to the entry describing “design limit load” has been deleted.]

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

3.32**loading case**

combined loading case

particular condition of single (or combined) mechanical load, pressure and temperature that can occur for some structural components or a structural assembly (at the same time) during their service life

[SOURCE: ISO 10786, 3.31, modified— The wording, “, which” has been replaced by “that”, and “at the same time” has been replaced by “(at the same time)”.]

3.33**loading spectrum****load spectrum**

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

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

Note 2 to entry: Also referred as “service life spectrum” or “load history”.

[SOURCE: ISO 10786:2011, 3.32, modified— The preferred term, “load spectrum” and “loads spectrum” have been added. Note 2 to entry has been added]

[SOURCE: ISO 14623:2003, 2.38, modified— The preferred term, “load spectrum” and “loads spectrum” have been added. The wording, “loading” has been replaced by “loading levels and cycles associated” and the wording, “the structure under all expected operating environments” has been replaced by “the structure or component of a structural assembly according to its service life under all expected operating environments”. In note 1 to entry, the wording, “test,” has been inserted between “transportation” and “handling loads”. Note 2 to entry has been added.]

[SOURCE: ISO 24638:2021, 3.15, modified— The preferred term, “load spectrum” and “loads spectrum” have been added. Note 2 to entry has been added.]

3.34**manufacturing process**

set of interrelated or interacting activities or operations performed upon material to convert it from the raw material or a semifinished state to a state of further completion

[SOURCE: ISO 15531-1:2004, 3.6.25, modified — The wording “structured set of activities or operations” has been replaced by “set of interrelated or interacting activities or operations”. Note 1 to entry has been deleted.]

3.35**margin of safety****MS**

the parameter to express the margin of structural load carrying capability for the loads derived from multiplying design safety factor to loading cases defined as limit loads

Note 1 to entry: For a single loading condition, MS is expressed for both yield and ultimate criteria as follows:

$$M_{s,i} = \frac{L_{allow,i}}{S_{F,i} \times L_{limit}} - 1$$

where

- $M_{s,i}$ is margin of safety for the criteria i (yield or ultimate);
- $L_{allow,i}$ is allowable load for the criteria i (yield or ultimate);
- $S_{F,i}$ is design safety factor for the criteria i (yield or ultimate);
- L_{limit} is limit load.

Note 2 to entry: Load may mean force, stress, or strain, if the load-stress relationship is linear.

Note 3 to entry: The relation also can be expressed for a combined loading case, when the load-stress relationship remains linear for all the contributors of the loading case. Also see alternative methods in [Annex D](#).

[SOURCE: ISO 10786:2011, 3.33, modified—The wording of the definition, “measure of a structure's predicted reserve strength in excess of the design criteria” has been replaced to the above definition. Note 1 to entry has been restated as shown on the above.]

3.36

mass and inertia properties

the set of parameters to express the properties concerning mass and inertia

Note 1 to entry: Mass and inertia properties of a structure comprise its mass, the location of its centre of gravity, its moments and products of inertia, and, where applicable, its balancing masses.

[SOURCE: ISO 10786:2011, 3.34, modified—The definition of the term has been updated to the above, and the former definition has been changed to the note 1 to entry.]

3.37

material

raw, semi-finished or finished purchased item (gaseous, liquid, solid) of given characteristics from which processing into a functional element of the product is undertaken

[SOURCE: ISO 10795:2019, 3.148]

[SOURCE: ISO 23020:2021, 3.1.12, modified — Note 1 to entry has been deleted.]

3.38

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”.]

[SOURCE: ISO 24638:2021, 3.16]

3.39

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 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 particular project may replace MEOP by Maximum Design Pressure (MDP), 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 10785:2011, 3.20, modified — "maximum allowed working pressure", "MAWP", "maximum operating pressure", "MOP" have been added as admitted terms; note 3 to entry has been added.]

[SOURCE: ISO 10786:2011, 3.35, modified — "maximum allowed working pressure", "MAWP", "maximum operating pressure", "MOP" have been added as admitted terms; note 3 to entry has been added.]

[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.].

[SOURCE: ISO 24638:2021, 3.17]

3.40

metallic structural item

structural item made of metals

Note 1 to entry: In this document, load bearing metallic liners of COPVs are also referred to as metallic structural items.

[SOURCE: ISO 10786:2011, 3.36]

3.41

moving mechanical assembly

MMA

A device that controls the movement of a deployable or other movable system of a spacecraft or launch vehicle

Note 1 to entry: Moving mechanical assemblies include, but are not limited to, deployment mechanisms, sensor mechanisms, pointing mechanisms, drive mechanisms, de-spin mechanisms, separation mechanisms, momentum and reaction wheels, control-moment gyros, gimbals, switches, valves, and other mechanisms required to perform specific functions..

[SOURCE: ISO 10786:2011, 3.37, modified — The definition of the term has been updated to the above, and the former "EXAMPLES" have been updated with modification, to the note 1 to entry.]

3.42

POGO

instability due to the coupling between the launch vehicle axial motion and the dynamic response characteristic of the propulsion system

Note 1 to entry: The coupling between the dynamic behaviour of the launch vehicle structure and a fluctuating thrust, results in a fluctuation of the mass flow rate at the engine inlet.

[SOURCE: ISO 10786:2011, modified— The wording, "the vehicle" has been replaced by "the launch vehicle". Note 1 to entry has been added.]

3.43

pressure component

component in a pressure system, other than a pressure vessel, pressurized structure that is designed largely by the internal pressure

EXAMPLE Lines, fittings, pressure gauges, valves, bellows and hoses.

[SOURCE: ISO 24638:2021]

3.44

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 and pressure components.

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 is at least 0,69 MPa.

[SOURCE: ISO 24638:2021, 3.19]

3.45

pressurized equipment

special pressurized equipment

piece of equipment that meets the pressure vessel definition, but for which it is not feasible or cost effective to comply with the requirements applicable to pressure vessels

EXAMPLE Batteries, heat pipes, cryostats and sealed containers.

[SOURCE: ISO 10786:2011, 3.41]

3.46

pressurized hardware

hardware items that contain primarily internal pressure

Note 1 to entry: Pressurized hardware includes pressure vessels, pressurized structures, pressure components and pressurized equipment.

[SOURCE: ISO 10786:2011, 3.42, modified— The definition of the term has been updated to the above, and the former definition of the term has been changed to the note 1 to entry.]

[SOURCE: ISO 14623:2003, 2.47, modified— The note 1 to entry has been updated to the above, reflecting the definition of ISO 10786:2011]

[SOURCE: ISO 21347:2005, 3.28, modified— The note 1 to entry has been updated to the above, reflecting the definition of ISO 10786:2011]

3.47

pressurized structure

structure designed to carry both internal pressure and vehicle structural loads

EXAMPLE Main propellant tanks and solid rocket motor cases of launch vehicles, and crew cabins of manned modules.

[SOURCE: ISO 10786:2011, 3.43]

[SOURCE: ISO 14623:2003, 2.48, modified— EXMPLE has been updated to the above.]

[SOURCE: ISO 24638:2008, 3.23, modified— EXMPLE has been updated to the above.]

3.48

primary structure

part of a structure that carries the main flight loads and defines the overall stiffness of the structure influencing its natural frequencies and mode shapes

[SOURCE: ISO 10786:2011, 3.44, modified— The wording, “, thus” has been deleted.]

[SOURCE: ISO 16454:2007, 3.24, modified—The wording, “part of a vehicle” has been replaced by “part of a structure”. The wording, “the main loads” has been replaced by “the main flight loads”. The wording, “the fundamental resonance frequencies” has been replaced by “the overall stiffness of the structure influencing its natural frequencies and mode shapes”]

3.49

proof factor

multiplying factor applied to the limit load or maximum operating pressure (MEOP) or maximum design pressure (MDP) to obtain proof load or proof pressure for use in the acceptance test

[SOURCE: ISO 10785:2011, 3.23, modified —The wording, “acceptance testing” has been replaced by “acceptance test”.]

[SOURCE: ISO 10786:2011, 3.45, modified —The wording, “MEOP” has been replaced by “maximum expected operating pressure (MEOP) or maximum design pressure (MDP) and “acceptance testing” has been replaced by “acceptance test”.

[SOURCE: ISO 24638:2021, 3.22, modified —The wording, “acceptance testing” has been replaced by “acceptance test”.]

[SOURCE: ISO 14623:2003, 2.50, modified —The wording, “MEOP (or MDP)” has been replaced by maximum expected operating pressure (MEOP) or *maximum design pressure (MDP)* (3.20) and “acceptance testing” has been replaced by “acceptance test”.]

3.50

protoflight hardware

protoflight model

hardware that is qualified using a protoflight verification approach

3.51

protoflight test

test performed on flight or flight-like hardware (i.e., is built with same drawings, materials and processes as the flight unit) to demonstrate that the design meets structural integrity requirements.

Note 1 to entry: Protoflight tests combine elements of prototype test programmes and acceptance test programmes.

Note 2 to entry: The test is performed at loads or pressure in excess of limit load or maximum design pressure but below the yield strength of the structure. When performed on flight structure, the test also verifies the workmanship and material quality of the flight build.

3.52

prototype hardware

prototype model

proto model

hardware of a new design that is produced from the same drawings and using the same materials, tooling, manufacturing processes, inspection methods, and personnel competency levels as will be used for the flight hardware.

Note 1 to entry: Prototype hardware is dedicated test hardware that is not intended to be used as a flight unit.

3.53

prototype Test

test conducted using prototype hardware to demonstrate that all structural integrity requirements have been met.

Note 1 to entry: Prototype testing is performed at load levels sufficient to demonstrate that the test article will not fail at ultimate design loads.

3.54

qualification

act or conduct by the supplier to provide evidence to prove that design and manufacturing (including manufacturing process) of hardware /software is adequate to fulfil all requirements under required environment conditions

Note 1 to entry: This may be implemented by analysis, test, inspection, or demonstration.

[SOURCE: ISO 10795:2019, 3.183]

3.55**qualification test**

required formal contractual test conducted to demonstrate that the design, manufacturing, and assembly have resulted in hardware conforming to specification requirements

Note 1 to entry: Qualification tests are conducted on a flight-quality article at load levels and durations sufficient to demonstrate that all design requirements have been met under the specified environmental conditions. Both *protoflight test* (3.51) and *prototype test* (3.53) are considered qualification tests.

Note 2 to entry: The qualification test may also validate the planned acceptance programme including test techniques, procedures, equipment, instrumentation, and software.

[SOURCE: ISO10785:2011, 3.25, modified — The wording, “contractual tests” have been changed to “contractual test”. The wording, “at load levels and durations in order”, “of flight quality hardware”, and “that” have been deleted from the definition. The wording “conforms” has been changed to “conforming”. Note 1 to entry has been moved to note 2 to entry. New note 1 to entry as shown on the above has been added.]

[SOURCE: ISO10786:2011, 3.47, modified — The wording, “contractual tests” have been changed to “contractual test”. The wording, “at load levels and durations”, “of flight quality hardware”, and “that” have been deleted from the definition. The wording “conforms” has been changed to “conforming”. Note 1 to entry has been moved to note 2 to entry. New note 1 to entry as shown on the above has been added.]

[SOURCE: ISO 10795:2019, 3.187, modified — The word, “used”, has been replaced by “conducted”. Note 1 to entry and note 2 to entry have been added.]

[SOURCE: ISO 14623:2003, 2.52, modified — the term has been changed from “qualification tests” to “qualification test”, and the wording, “used”, has been replaced by “conducted”. Note 1 to entry and note 2 to entry have been added.]

[SOURCE: ISO 21648:2008, 2.1.32, modified — the term has been changed from “qualification tests” to “qualification test”. The wording, “required formal tests” and “used”, has been replaced by “required formal contractual test” and “conducted”, respectively. Note 1 to entry and note 2 to entry have been added.]

3.56**random load**

vibrating load or fluctuating load whose instantaneous magnitudes are specified only by probability distribution functions giving the probable fraction of the total time that the instantaneous magnitude lies within a specified range

Note 1 to entry: A random load contains non-periodic or quasi-periodic constituents.

[SOURCE: ISO 10786:2011, 3.48]

3.57**residual strength**

maximum value of load and/or pressure (stress) that a flawed or damaged structural item is capable of sustaining without further damage or collapse, considering appropriate environmental conditions

[SOURCE: ISO 10786:2011, 3.49]

[SOURCE: ISO 14623:2000, 2.53, modified — The wording, “cracked” has been replaced by “flawed”. The wording, “sustaining” has been replaced by “sustaining without further damage or collapse, considering appropriate environmental conditions”]

[SOURCE: ISO 21347:2005, 3.30, modified — The wording, “cracked” has been replaced by “flawed”. The wording, “sustaining, considering appropriate environmental conditions” has been replaced by “sustaining without further damage or collapse, considering appropriate environmental conditions”]

3.58**residual stress**

stress that remains in a structure after processing, fabrication, assembly, testing or operation

EXAMPLE Welding-induced residual stress.

[SOURCE: ISO 10786:2011, 3.50]

[SOURCE: ISO 14623:2003, 2.54]

3.59

S-basis allowable

mechanical strength value specified as a minimum by the governing industrial specification, or a particular contractor's specification

EXAMPLE Properties given in MMPDS (Metallic Materials Properties Development and Standardization).

[SOURCE: ISO 10786:2011, 3.51]

3.60

safe life

<methodologies> design criterion under which failure does not occur in the expected environment during the service life

Note 1 to entry: In this design criterion, a flaw is assumed consistent with the inspection process specified and it is shown that the largest undetected flaw that could exist in the structure will not grow to failure in durations multiplying life factors to service lifetimes when subjected to the cyclic and sustained loads in the environments encountered.

[SOURCE: ISO 10786:2011, 3.52, modified —The terminology entries have been separated to include only one definition. Note 1 to entry has been added to this entry.]

3.61

safe life

<time span> required period during which a structural item, even containing the largest undetected flaw, is shown by analysis or testing not to fail catastrophically under the expected service load and environment

Note 1 to entry: An equivalent definition is “period during which the structure is predicted not to fail in the expected service life environment”.

Note 2 to entry: Safe life is also referred as damage tolerance life.

[SOURCE: ISO 10786:2011, 3.52, modified —The terminology entries have been separated to include only one definition.]

3.62

safe-life structure

structure designed according to the safe-life design criterion

[SOURCE: ISO 10786:2011, 3.53]

3.63

scatter factor

multiplying factor to be applied to the number of load/pressure cycles defined as service life when performing fatigue and/or crack growth analysis, for the purpose of covering the scatters that potentially exist in the material's fatigue or crack growth data

Note 1 to entry: Scatter factor is sometimes referred to as life factor, which is usually used for just the difference in material data used in the analysis; for example, S-N data used in fatigue life analysis, or da/dN data used in crack growth analysis.

[SOURCE: ISO 10786:2011, 3.54, modified —The wording, “coefficient by which the number of cycles or time defined in service life is multiplied in order to account for uncertainties in material properties when performing fatigue and/or crack growth analysis” has been restated as shown on the above.]

[SOURCE; ISO 24638:2021, 3.24, modified —The wording, “multiplying factor to be applied to the number of load/pressure cycles, for the purpose of covering the scatters that potentially exist in the material’s fatigue or crack growth data” has been restated as shown on the above. Note 1 to entry has been added.]

3.64

secondary structure

structure attached to the primary structure with negligible participation in the main load transfer and overall stiffness

[SOURCE: ISO 10786:2011, 3.55]

3.65

service life

period of time (or number of cycles) that starts with item inspection after manufacturing and continues through all testing, handling storage, transportation, launch operations, orbital operations, refurbishment, retesting, re-entry or recovery from orbit, and reuse that can be required or specified for the item

[SOURCE: ISO 10785: 2011, 3.28, modified —The wording, “that starts with the manufacturing of the pressurized hardware” has been replaced by “that starts with item inspection after the manufacturing”. The wording, “all acceptance testing” has been changed to “all testing”.]

[SOURCE: ISO 10786:2011, 3.56, modified —The wording, “(or cycles)” has been replaced by “(or number of cycles)”.]

[SOURCE: ISO 14623:2003, 2.57, modified — The wording, “(or cycles)” has been replaced by “(or number of cycles)”. The wording, “that starts with the manufacturing” has been replaced by “that starts with item inspection after the manufacturing”. The wording, “all acceptance testing” has been changed to “all testing”.]

[SOURCE: ISO 21347:2005, 3.35, modified — The wording, “(or cycles)” has been replaced by “(or number of cycles)”. Note 1 to entry has been deleted.]

[SOURCE: ISO 21648:2008, 3.28, modified — The wording, “(or cycles)” has been replaced by “(or number of cycles)”. The wording, “specified for that part” has been replaced by “specified for the item”.]

[SOURCE: ISO 24638:2021, 3.25, modified —The wording, “(or cycles)” has been replaced by “(or number of cycles)”.]

3.66

shock load

special type of transient load, where the load shows significant peaks and the duration of the load is well below the typical response time of the structure

Note 1 to entry: This load can be induced by:

- shockwave phenomena;
- pyrotechnic systems;
- physical impacts by deployed appendages;
- explosions.

[SOURCE: ISO 10786:2011, 3.57, modified —Note 1 to entry has been added.]

[SOURCE: ISO 14622:2000, 2.5.3, modified —The definition wording, “load applied in the form of shocks or percussion and for which the structure’s dynamic response is significant” has been restated as shown on the above.]