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

Systèmes spatiaux — Conception des structures — Détermination des niveaux de chargement pour un essai statique de qualification des véhicules lanceurs

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Contents

Page

Foreword

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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 14953:2000), which has been technically revised.

The main changes are as follows:

— the formula for J_C has been changed so that all the terms are multiplicative,

— a new correction factor has been introduced to take into account the structure imperfections.

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.

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

1 Scope

This document specifies a procedure for determining the loading level of a qualification test of a launch vehicle structure and takes into account all the minimum allowable strength characteristics necessary for these structures.

2 Normative references

There are no normative references in this document.

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:

— ISO Online browsing platform: available at https://www.iso.org/obp

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

3.1
external loading
system of forces, moments and pressures external to a structure and applied to that structure

3.2
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 definition in ISO 10786:2011, 3.19.]

3.3
limit load
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".]

3.4
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 and prototype tests 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: ISO 10795:2019, 3.187, modified — The word "used" has been replaced by "conducted"; "hardware designs" has been changed to "hardware"; note 1 to entry and note 2 to entry have been added.]

3.5
safety factor
J
coefficient by which limit loads are multiplied in order to account for the statistical variations of loads and structure resistance, and inaccuracies in the knowledge of their statistical distributions

Note 1 to entry: The two main safety factors are the yield safety factor (for metals) and the ultimate safety factor. They are used to define respectively the yield load and the ultimate load.

[SOURCE: ISO 16454:2007, 3.10, modified — The term has been changed from "design safety factor" to "safety factor"; the symbol "*J*" and note 1 to entry have been added.]

4 Design of loading levels

4.1 General

Qualification tests shall be conducted on a flight-type structure. Because such structures are unlikely to include minimum values for all allowable characteristics, the loads used for design shall be corrected before use in qualification tests. All areas of the launch-vehicle flight structure shown to be critical in probable failure modes shall be considered for the following correction which shall be used to determine the qualification test loading.

4.2 Calculation of qualification test loading

The corrected external loading, P_Q, (force, moment, pressure) used for qualification tests shall be calculated from the following formula:

$$P_Q = P_{lim} \times J_C$$

where

P_{lim} is the limit load used for design;

J_C is the corrected safety factor.

4.3 Corrected safety factor

The corrected factor, J_C, is given by the following formula:

$$J_C = J \times K_{min} \times K_{adj} \times K_T \times K_\theta \times K_\sigma \times K_{imp}$$