SLOVENSKI STANDARD
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Space product assurance - General requirements - Part 3: Materials, mechanical parts and processes

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Luft- und Raumfahrt - Raumfahrtproduktsicherung - Teil 3: Materialien, mechanische Teile und Prozesse

Assurance produits des projets spatiaux - Exigences générales - Partie 3: Matériaux, composants mécaniques et procédés

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This European Standard was approved by CEN on 1 October 2003.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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Foreword

This document (EN 13291-3:2003) has been prepared by CMC.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2004, and conflicting national standards shall be withdrawn at the latest by June 2004.

It is based on a previous version[1)] originally prepared by the ECSS Product Assurance Working Group, reviewed by the ECSS Technical Panel and approved by the ECSS Steering Board. The European Cooperation for Space Standardization (ECSS) is a cooperative effort of the European Space Agency, National Space Agencies and European industry associations for the purpose of developing and maintaining common standards.

EN 13291 Space product assurance is published as four parts:

— Part 1: Policy and principles

— Part 2: Quality assurance

— Part 3: Materials, mechanical parts and processes

— Part 4: Software product assurance

This European Standard is one of the series of space standards intended to be applied together for the management, engineering and product assurance in space projects and applications.

Requirements in this European Standard are defined in terms of what shall be accomplished, rather than in terms of how to organize and perform the necessary work. This allows existing organizational structures and methods to be applied where they are effective, and for the structures and methods to evolve as necessary without rewriting the standards.

The formulation of this European Standard takes into account the existing ISO 9000 family of documents.

Annex A is informative.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

1) ECSS-Q-70A.

1 Scope

1.1 General

The purpose of this European Standard is to define the requirements and statements applicable to materials, mechanical parts and processes to satisfy the mission performance requirements.

1.2 Objectives

This European Standard covers the following requirement domains:

- management, including organization, reviews, acceptance status and documentation control;
- selection criteria and rules;
- evaluation, validation or qualification testing;
- procurement and receiving inspection;
- utilization criteria and rules.

The relationship between activities and programme phases is defined in annex A.

1.3 Applicability

The provisions of this European Standard apply to all actors involved at all levels in the production of space systems. These include manned and unmanned spacecraft, launchers, satellites, payloads, experiments, electrical ground support equipment, mechanical ground support equipment, and their corresponding organizations.

When viewed from the perspective of a specific project context, the requirements defined in this standard should be tailored to match the genuine requirements of a particular profile and circumstances of a project.

NOTE Tailoring is a process by which individual requirements of specifications, standards and related documents are evaluated and made applicable to a specific project by selection, and in some exceptional cases, modification of existing or addition of new requirements.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 13701:2001, *Space systems — Glossary of terms.*

EN 13291-1, *Space product assurance — General requirements — Part 1: Policy and principles.*

EN 13291-2, *Space product assurance — General requirements — Part 2: Quality assurance.*

EN ISO 14620-1, *Space systems — Safety requirements — Part 1: System safety (ISO 14620-1:2002).*

EN 14090, *Space product assurance — Flammability testing for the screening of space materials.*

EN 14091, *Space product assurance — Thermal vacuum outgassing test for the screening of space materials.*

EN 14100, *Space product assurance — The determination of offgassing products from materials and assembled articles to be used in a manned space vehicle crew compartment.*

EN 14101:2001, *Space product assurance — Material selection for controlling stress corrosion cracking.*

ECSS-Q-70-06:—[1)], *Space product assurance — The particle and ultraviolet (UV) radiation testing of space materials.*

prEN 14102, *Space product assurance — Determination of the susceptibility of metals to stress corrosion cracking.*

ECSS-Q-70-71: —[1)], *Space product assurance — Data for selection of space materials (or MSFC-SPEC-250 Protective finishes for space vehicle structures).*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN 13701:2001 and the following apply.

3.1.1
mechanical part
see EN 13701

NOTE In the text of this standard, the term "part" is used to mean "mechanical part". The work unit employed is clearly defined.

3.1.2
process
see EN 13701

NOTE The definition excludes mechanical operations such as standard milling, drilling, turning and mechanical assembly. The concept of process also covers all the facilities required: personnel, environment, equipment, tooling and corresponding methods.

3.1.3
request for approval (RFA)
document with which the supplier or user asks the competent body for permission to use a critical material, part or process

3.2 Abbreviated terms

The following abbreviated terms are defined and used within this European Standard:

Abbreviation	Meaning
CDR	critical design review
DML	declared material list

[1] To be published

DMPL	declared mechanical part list
DPL	declared process list
ECSS	European Cooperation for Space Standardization
EEE	electrical, electronic and electromechanical
GSE	ground support equipment
MIP	mandatory inspection point
NRB	nonconformance review board
PA	product assurance
PDR	preliminary design review
QR	qualification review
RFA	request for approval

4 General requirements

4.1 Materials, parts and processes programme management

4.1.1 Product assurance plan

Each supplier shall define in his product assurance plan the materials, parts and processes organization and tasks in accordance with EN 13291-1 and in accordance with the current standard.

4.1.2 Materials, parts and processes manager

a) A contact person shall be appointed representing the supplier who ensures that the requirements laid out in this standard are met, each supplier shall appoint a materials, parts and processes manager to supervise all related activities.

b) This manager shall be the customer's contact as far as application of this standard is concerned within the overall PA reporting system. He shall periodically inform the customer of the progress of tasks relating to its application. The manager shall ensure that both technical and scheduling aspects of the various actions undertaken are met (status of material validation, part qualification and process validation).

c) The materials, parts and processes manager shall ensure that the requirements of this standard are applied by all suppliers.

4.1.3 Materials, parts and processes board

To coordinate the fulfilment of the requirements laid out in this standard, particularly as concerns critical materials, parts and processes, a materials, parts and processes board shall be set up by each supplier.

4.1.4 Materials, parts and processes reviews

To obtain the validation status for materials and processes and qualification status for parts, the materials, parts and processes manager shall present to the customer those activities that have been performed in order to comply with this standard together with results obtained.

The materials, parts and processes manager shall organize technical review meetings with his suppliers as appropriate.

4.2 Management and consolidation of the materials, parts and processes

4.2.1

Each supplier and subsupplier shall establish, collect, review and deliver the materials, parts and processes lists including all the materials, parts and processes intended for use in the flight. They shall reflect the current design at the time of issue.

The objectives are the following:

- make sure that all requirements of the programme are met;
- verify the materials, parts and processes activity of equipment suppliers;
- control and monitor the status of materials, parts and processes in accordance with programme milestones.

4.2.2

The materials, parts and processes manager is in charge of the consolidation of the lists with his materials, parts and processes homologous within the programme so as to ensure that all the information needed is given and that the approval status is consistent with technical and scheduling objectives. The consolidation of the lists shall be understood as technical and not as a compilation.

The required content of the lists is given hereafter.

4.2.3

These lists shall be open to modifications, and shall be updated during the course of the project:

- preliminary lists shall include the materials, parts and processes from supplier's preliminary needs and are used to identify those that are critical. (Available for the PDR);
- as-designed lists shall include the materials, parts and processes from the baseline's various design files. (Available for the CDR);
- as-built lists shall include the materials, parts and processes used in the qualification and flight models. (Available for the QR).

Any change after CDR or QR shall be reflected, if applicable, in the lists and a request for approval (RFA) shall be issued if necessary.

4.3 Technical Constraints

4.3.1

Materials and parts shall satisfy the mission's functional constraints with the specified or with sufficient margins.

4.3.2

Materials, parts and processes shall satisfy both ground environment constraints (e.g. manufacture, tests, storage, maintenance, transport and integration) and flight constraints (e.g. launch and orbit).

4.3.3
The following constraints shall be taken into account according to the mission:

- resistance to corrosion;
- resistance to mechanical load (dynamic or static);
- resistance and performance in vacuum;
- performance in weightlessness;
- resistance to radiation;
- resistance to thermal cycling;
- resistance to fluids according to mission requirements;
- resistance to other conditions specific to the mission (e.g. atomic oxygen, offgassing, flammability and odour);
- resistance to combined actions of the environment and loads (e.g. stress corrosion cracking, thermoelastic behaviour and cold welding).

4.3.4
The estimated availability of the parts and products obtained from materials and processes used shall be compatible with the final system's life cycle (tests, storage, mission).

4.4 Contamination and cleanliness control

4.4.1
Each supplier shall establish and maintain an effective contamination and cleanliness control programme including as a minimum;

- cleaning procedures, and
- cleanliness monitoring procedures or methods.

4.4.2
Materials, parts or processes shall be identified and the variety reduced in accordance with mission requirements (contamination or cleanliness analysis).

4.4.3
For contamination or cleanliness critical applications, a specific cleanliness control plan and requirement specification (chemical and particle) shall be established.

Guidelines for contamination and cleanliness control are given in ECSS-Q-70-01A (see Bibliography).

4.5 Safety hazardous materials and parts

Materials and parts with hazardous characteristics shall be identified, managed and processed according to EN ISO 14620-1.

4.6 Mechanical GSE or electrical GSE hardware

When mechanical GSE or electrical GSE hardware used in thermal vacuum or interfacing with flight hardware are selected, possible degradation (e.g. contamination, surface degradation, electro-mechanical, and chemical effects) shall be taken into account.

5 Materials control

5.1 Selection of materials

5.1.1 Technical criteria

The following requirements shall only be taken into account if the environmental conditions of the mission require their application.

Particular attention shall be paid to certain constraints and the resistance of the material in question should be demonstrated.

a) Vacuum:

Outgassing tests shall be carried out as per specification EN 14091 or ASTM E 595-93 on materials whose conditions of use can lead to contamination. The acceptance criteria for materials used in space applications shall be as follows: Total Mass Lost < 1,00 %. Collected Volatile Condensable material < 0,10 %.

Materials close to optical surfaces can require additional testing to be evaluated on a case-by-case basis.

Pure mercury, cadmium and zinc shall not be used.

b) Thermal cycling:

Materials subject to thermal cycling shall be assessed to ensure their capability to withstand the induced thermal stresses.

c) Radiation:

Materials used on the spacecraft's external surfaces shall be assessed to determine their resistance to the radiation dosage expected during the mission.

ECSS-Q-70-06 shall be applied in order to demonstrate resistance of materials to radiation (electromagnetic and particles).

d) Atomic oxygen:

The extent to which materials used in the outer surfaces of space systems in low Earth orbit are resistant to atomic oxygen, acceptance criteria shall be defined on a case-by-case basis.

e) Meteoritic environment:

The influence of a meteoritic environment on the materials shall be examined on a case-by-case basis.

f) Electrochemical compatibility:

When bimetallic contacts are used, the choice of the pair of metallic materials used shall take into account ECSS-Q-70-71 or MSFC-SPEC-2 50 data.

Maximum allowed couple is 0,5 V in controlled environments and 0,25 V in uncontrolled environments (no temperature or humidity controls).

g) Corrosion:

Corrosion resistance shall be demonstrated for materials subject to corrosion throughout their life cycle (e.g. storage, transportation and launch). Data are available in MFSC HDBK 527 (guideline document - see Bibliography).