
**Space systems — Paints and varnishes
— Processes, procedures, and
requirements for coating materials
and coatings**

*Systèmes spatiaux — Peintures et vernis — Procédés, modes
opératoires et exigences concernant les produits de peinture et les
revêtements*

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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).

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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*.

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

Nowadays, there are a large number of paints and varnishes (coating materials), on the basis of which coatings for space systems products can be developed and manufactured.

For the use of coating materials, requirements are additionally imposed on the selection processes and procedures for verifying coating materials, surface preparation before painting, application conditions and quality control of coatings.

The main purpose of this document is to harmonize the requirements of existing international and national standards in this area.

Manufacturers of space systems products usually prepare coating materials for application and form coatings under the required operating conditions; therefore, this document aims to optimize the processes of verification, preparation and application of coating materials to improve the quality of painting.

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Space systems — Paints and varnishes — Processes, procedures, and requirements for coating materials and coatings

1 Scope

This document establishes the main requirements for:

- a choice of coating materials and coatings for space applications;
- processes and procedures for the verification of coating materials;
- processes of preparation and quality control of the painted surface;
- the quality control of the applied coatings.

This document also describes the causes of possible defects in coatings.

This document is applicable to coating materials and coatings based on them; it is intended for use by manufacturers of space systems products for various surfaces of spacecraft's and its constitutive parts (on-board systems, facilities, tools, electronic component base products) with long active lifetimes.

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 1514, *Paints and varnishes — Standard panels for testing*

ISO 4628-8, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 8: Assessment of degree of delamination and corrosion around a scribe or other artificial defect*

ISO 9000, *Quality management systems — Fundamentals and vocabulary*

ISO 9227, *Corrosion tests in artificial atmospheres — Salt spray tests*

ISO 10794, *Space systems — Programme management — Material, mechanical parts and processes*

ISO 16691, *Space systems — Thermal control coatings for spacecraft — General requirements*

ECSS-Q-ST-70-71C, *Space product assurance. Materials, processes and their data selection*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 9000 and the following 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

coat

layer of a *coating material* (3.3) resulting from a single application

Note 1 to entry: For fillers the word “coat” is used instead of “film”.

[SOURCE: ISO 4618:2014, 2.49]

3.2

coating

layer formed from a single or multiple application of a *coating material* (3.3) to a *substrate* (3.12)

[SOURCE: ISO 4618:2014, 2.50.1]

3.3

coating material

product, in liquid, paste or powder form, that, when applied to a *substrate* (3.12), forms a layer possessing protective, decorative or other specific properties

Note 1 to entry: The term “specific properties” means insulating, anti-corrosive, thermal control and other properties.

[SOURCE: ISO 4618:2014, 2.51, modified — Note 1 to entry has been replaced by a new one.]

3.4

coating process

method of application of a *coating material* (3.3) to a *substrate* (3.12)

[SOURCE: ISO 4618:2014, 2.53]

3.5

coating system

combination of all *coats* (3.1) of *coating materials* (3.3) which are to be applied or which have been applied to a *substrate* (3.12)

Note 1 to entry: The actual system can be characterized by the number of coats involved.

Note 2 to entry: See also *coating* (3.2).

[SOURCE: ISO 4618:2014, 2.54]

3.6

flow time

relative viscosity

time that elapses from the moment when the material under test starts to flow from the orifice of the filled flow cup to the moment when the flow stream of material first breaks off close to the orifice

[SOURCE: ISO 2431:2019, 3.1, modified — The symbol “*t*” has been removed; the alternative term “relative viscosity” has been added.]

3.7

functional coat

coat (3.1) of *coating system* (3.5) with specific properties, designed to perform additional functions

Note 1 to entry: Additional functions may include: corrosion protection, protect from UV radiation and from other types of radiation, low and high temperatures and also from other factors of space environment.

3.8**normative documentation**

specifications, standards, rules or instructions, to which adherence is required through citation in the design documentation or the construction, fabrication, manufacture, purchase or production documentation for the manufacture and operation of the facility, system or equipment

Note 1 to entry: In this document, the term is applied to the documentation for a specific *coating material* (3.3) or *coating* (3.2).

[SOURCE: ISO 16159:2012, 2.11, modified — Note 1 to entry has been added.]

3.9**paint**

pigmented *coating material* (3.3) which, when applied to a *substrate* (3.12), forms an opaque dried film having protective, decorative or specific properties

Note 1 to entry: For coating materials with protective and specific properties in *normative documentation* (3.8), the term "enamel" may be used for a liquid or paste-like pigmented coating material in which the coating medium is a solution of the film-forming substance of the coating material in organic solvents.

[SOURCE: ISO 4618:2014, 2.184, modified — Note 1 to entry has been added.]

3.10**priming coat**

first *coat* (3.1) of a *coating system* (3.5)

Note 1 to entry: Priming ensures better adhesion of *coating material* (3.3) to the surface, increases *paint* (3.9) durability, and provides additional protection for the material being painted.

[SOURCE: ISO 4618:2014 2.207, modified — Note 1 to entry has been added.]

3.11**ready-to-apply coating material**

coating material (3.3) or coating material after mixing of its certain components (multicomponent coating material) and after dilution if it is necessary with certain solvents and/or with certain dilutants according to *normative documentation* (3.8) and that is ready to apply by certain painting methods

3.12**substrate**

surface to which a *coating material* (3.3) is applied or is to be applied

[SOURCE: ISO 4618:2014, 2.244]

3.13**surface preparation**

physical and/or chemical treatment of the surface to be painted in order to clean it and improve the adhesion of the *coating material* (3.3) to the surface to be painted

3.14**thermal control coating**

TCC

coating (3.2) that is used to maintain certain temperature conditions of an object by way of establishing the balance between the heat absorbed from an environment and/or emitted by internal heat sources and the energy radiated by object's surface in an environment

Note 1 to entry: In this document, the term refers to TCC based on *coating materials* (3.3).

[SOURCE: ISO 16691:2014, 3.1.15, modified — Note 1 to entry has been added.]

3.15

varnish

transparent *coating material* ([3.3](#))

Note 1 to entry: See also clear coating material (ISO 4618:2014, 2.47).

[SOURCE: ISO 4618:2014, 2.266, modified — Note 1 to entry has been replaced by a new one.]

4 General provisions

4.1 General requirements for coating materials and coatings

4.1.1 To apply coatings for products of space systems, coating materials shall be selected that meet the requirements for their operation in space environment conditions.

4.1.2 For products of space systems, coatings with the following specific properties are used:

- a) thermal control;
- b) electrically conductive;
- c) electrically insulating;
- d) thermal resistant;
- e) anticorrosive;
- f) chemically resistant;
- g) resistant to space environment factors.

4.1.3 Coating materials shall meet the requirements of the normative documentation, be manufactured according to technological documentation for each material, and be delivered to the customer with quality document according to the delivery documentation, taking into consideration specific national and local requirements.

4.1.4 The delivery documentation for a particular material specifies the scope of the coating material, specification and conditions for coatings' formation.

4.1.5 A warranty period of storage shall be established for the coating materials.

4.1.6 To confirm the durability (service life) of coatings as part of the product, the following tests shall be carried out:

- accelerated aging tests to simulate storage in land conditions (accelerated climatic tests) according to ISO 4628-8 and ISO 9227;
- accelerated simulation tests of space environment factors (atomic oxygen, electron, proton, ultraviolet radiation, thermal cycling);
- tests to determine the outgassing.

4.1.6.1 In the process of testing, the parameters given in [Table A.1](#) are controlled in accordance with the established requirements for a specific coating.

4.1.6.2 Test methods, their scope and sufficiency shall be selected depending on the operating conditions of the coatings in the composition of the product and depending on the requirements of the normative documentation.

4.1.7 The main outgassing characteristics of coatings for space applications are as follows:

- total mass loss (TML);
- recovered mass loss (RML);
- collected volatile condensable materials (CVCM).

Materials having TML of less than 1,0 %, RML of less than 1,0 % and CVCM of less than 0,1 % are generally considered as low-outgassing materials.

The outgassing requirements shall be based on the quantity of material concerned and the specific environmental conditions.

When contamination-sensitive products are involved or for materials in the vicinity of cryogenic surfaces, more stringent requirements shall apply in order to compensate the missing details.

4.1.8 Coating materials used for space systems products shall be subjected to the procedures of verification and validation in ISO 10794 and ECSS-Q-ST-70-71C.

4.1.9 To obtain coatings with specified characteristics, coating materials shall meet the requirement of the normative documentation for coatings; for example, thermal control coatings shall meet the requirements of ISO 16691.

4.1.10 For particular coatings, additional requirements for coating materials apply according to the normative documentation and ECSS-Q-ST-70-31C.

4.2 Main processes and procedures to manufacture coatings

4.2.1 For the production of coatings, the main processes and procedures are:

- a) verification of coating materials in accordance with the normative documentation;
- b) preparation of the surface before painting;
- c) preparation of coating materials for the application of a coating;
- d) filling layer applying (if the coating's system includes this layer):
 - 1) drying;
 - 2) operational inspection;
- e) priming coat applying (if the coating system includes this coat):
 - 1) drying or curing (depending on the physico-chemical properties of coating materials);
 - 2) operational inspection;
- f) functional coat applying:
 - 1) drying or curing (depending on the physico-chemical properties of coating materials);
 - 2) operational inspection;

NOTE The coating system may consist of several functional coats.