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Space systems — Product assurance requirements for commercial satellites

Systèmes spatiaux — Exigences en matière d'assurance produit des satellites commerciaux

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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 20188:2018), which has been technically revised.

The main changes are as follows:

— normative references with related references in the text have been updated;

— requirement related to the role of product assurance manager has been added;

— requirements have been updated in 6.21 (non-conformity control), in 6.25 (quality assurance role in configuration management, in Clause 7 (dependability) and in Clause 8 (safety);

— the Bibliography has been updated.

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

This document specifies the product assurance (PA) activities from the standpoint of commercial business during each phase of the project such as design, procurement, manufacturing, assembly, integration, test, and launch. These product assurance requirements are requested by customers for accomplishing the mission successfully and can lead to customer satisfaction.

The responsibility of the prime contractor is to allocate these requirements to subcontractors and suppliers, and to ensure their implementation.

The prime objective of PA is to ensure that commercial satellites accomplish their defined mission objectives and that they are safe and reliable.

A further objective is to achieve more cost-effective space projects and thereby to promote competitiveness by coordinating the development and implementation of appropriate PA methods and standards.

PA requirements defined in this document have been established to prevent potential problems. PA programmes also ensure that hardware and software of ground support equipment are also safe, reliable and do not degrade the flight hardware in any way.

This document intends to clarify the best practices and typical requirements dealing with product assurance activities in commercial business and realize quality improvement especially for customers having less experience.

The requirements described in this document are created by comparing and mixing experience and practical management methodologies used by main actors of aerospace industry in the world. The framework of PA policy and principles are based on ISO 14300-2,[24] ISO 27025, ISO 14620-1, ISO 23460, ISO 10794 and ISO 14621-2 and unified as one PA process. Detailed requirements of PA, quality assurance (QA), dependability, electrical, electronic, and electromechanical (EEE) parts, material, mechanical parts and processes, software product assurance and ground support equipment are referenced from relevant standards.

Space systems — Product assurance requirements for commercial satellites

1 Scope

This document provides product assurance requirements and recommendations for commercial satellites throughout all phases. This document is applicable to the prime contractor, subcontractors and suppliers.

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 10007, *Quality management — Guidelines for configuration management*

ISO 10794:2018, *Space systems — Programme management — Material, mechanical parts and processes*

ISO 10795, *Space systems — Programme management and quality — Vocabulary*

ISO 14620-1, *Space systems — Safety requirements — Part 1: System safety*

ISO 14621-1, *Space systems — Electrical, electronic and electromechanical (EEE) parts — Part 1: Parts management*

ISO 14621-2, *Space systems — Electrical, electronic and electromechanical (EEE) parts — Part 2: Control programme requirements*

ISO 16192, *Space systems — Lessons learned — Principles and guidelines*

ISO 17666, *Space systems — Risk management*

ISO 21886, *Space systems — Configuration management*

ISO 23460, *Space projects — Programme management — Dependability assurance requirements*

ISO 23461:2010, *Space systems — Programme management — Non-conformance control system*

ISO 27025, *Space systems — Programme management — Product quality assurance requirements*

3 Terms and definitions

For the purpose of this document, the terms and definitions given in ISO 10795 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

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

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

3.1
commercial satellite
satellite used for private business

Note 1 to entry: Non-commercial satellites are military satellites or civil satellites developed on behalf of government organizations, space agencies and/or research organizations.

4 Abbreviated terms

CDR	critical design review
CIL	critical item list
DMPL	declared mechanical parts list
DPA	destructive physical analysis
EEE	electrical, electronic, and electromechanical
EIDP	end item data package
EQSR	equipment qualification status review
ESD	electrostatic discharge
FRR	flight readiness review
GSE	ground support equipment
LAT	lot acceptance test
MIP	mandatory inspection point
MMPP	materials, mechanical parts and processes
MMPPCB	materials, mechanical parts and processes control board
MRB	material review board
MRR	manufacturing readiness review
PAD	parts approval document
PCB	parts control board
PDA	percent defective allowable
PDR	preliminary design review
PIND	particle impact noise detection
PSR	pre-shipment review
QCI	quality conformity inspection
RVT	radiation verification test
SCCB	software configuration control board
SCM	software configuration management

SCMS	software configuration management system
SEE	single event effect
SEU	single event upset
SET	single event transient
SDR	special design review
TRB	test review board
TRR	test readiness review

5 Product assurance

5.1 PA management

The PA programme shall be implemented throughout all phases with coordination of all parties involved. It shall be managed in such a way as to:

a) ensure that the project and PA organization, requirements, methods, tools and resources are well-defined before development and implemented at each level from system down to piece part;

b) ensure that aspects are identified, which can affect project requirements having major impacts on safety, mission success and the related cost and schedule consequences;

c) ensure that adverse consequences of these aspects are prevented by the early detection, characterization, elimination, minimization and containment of problem contributors and initiators;

d) ensure that risks are assessed and controlled, and that acceptability of the residual ones is evaluated;

e) provide at any time the necessary visibility of the quality status of the product;

f) ensure that the end product conforms to its specifications and that observed non-conformities are properly disposed.

The contractor shall designate a PA manager who shall have the prime responsibility for the management and direction of the PA programme. In addition, the PA manager shall ensure that waivers or deviations are acceptable to the customer for the non-conformity, if the non-conformity needs to be accepted by the customer.

The PA manager shall act as the focal point of contact within the project for the customer.

The PA manager, irrespective of other responsibilities, shall have sufficient organizational authority and independence:

— to propose, establish and implement the product assurance programme in accordance with project product assurance requirements;

— to have unimpeded access to the top management through the company PA executive to fulfil the duties.

The contractor shall report on a regular basis on the status of the product assurance programme implementation. The contractor shall plan and perform quality audits using established and maintained procedures. The contractor shall prepare and implement a project product assurance plan that shall be maintained throughout the project life cycle.

The role of the PA manager is to provide to the top management and to the customer the guaranties (i.e. confidence) of the conformity of the product at each stage of product life cycle (i.e. specified, designed, manufactured, in use). In addition, the PA manager should not only inform the top management and the customer, but also provide the status to the project, programme manager and team to allow measures to be taken.

5.2 PA plan

The detailed implementation of this programme shall be defined in PA plan which shall meet the requirements in this document. Conformity with AS 9100[21] standards should be indicated. This plan shall describe the task descriptions, responsibilities and implementation methods in accordance with product assurance requirements. The plan shall also identify any relevant specifications, procedures, standards and manuals that are applicable to the implementation of this plan. The plan shall clearly identify and define the contractor's product assurance organization and its relationship with the contractor's overall organizational interfacing functions and activities.

The PA plan should cover, as a minimum, the following disciplines:

a) product assurance management;

b) quality assurance;

c) dependability;

d) safety;

e) selection, procurement and control of materials, EEE parts, mechanical parts and processes;

f) software product assurance;

g) ground support equipment (design reviews and controls including dependability and safety).

5.3 Audit

The contractor shall perform internal and external audits to ensure appropriate implementation of the requirements of the PA programme. The customer shall be informed of the conclusion of the audits initiated in the area of the project. Audit reports shall be delivered to the customer for review on site.

The contractor shall perform external audits over the facilities of the supplier, sub-tier supplier, parts/materials manufacturer, and/or outside manufacturer facilities to confirm the procured items. However, audits should not be limited to facilities, but also include relevant processes. The representative of the contractor shall confirm the following items as the surveillance:

a) contents of each design, quality assurance programme task and performance meet these PA requirements;

b) the activities of supplier satisfy the requirements in this document.

The contractor shall cooperate when the customer personnel or its designated representatives perform surveillance of the contractor's facilities. The contractor shall include provisions to accommodate such representatives.

The contractor shall perform audits of subcontractors and suppliers to ensure that the required quality standards and contractual requirements are appropriately implemented.

The customer should participate in the surveillance.

The contractor shall establish and maintain an audit plan for procurement activities on the project, designating the lower-tier subcontractors and suppliers to be audited, the current status and the schedule for auditing. In addition to the planned audits, extra audits shall be performed when necessary to overcome failure, inconsistent poor quality, or other problems.

5.4 Customer right of access

Authorized representatives of the customer shall have the right of access at any reasonable time to all areas where the work is performed under the contract. This includes access to relevant documentation and records.

If the contract is for the entire satellite system or subsystem level rather than at unit level, then a visibility agreement which defines the implementation procedure of the customer's right of access to the test witness, document review and material review board is identified project to project.

5.5 PA progress reports

The contractor shall prepare and submit a periodic progress report.

The PA progress report should include the following items:

a) current status of dependability and safety programmes;

b) status summary of critical items control;

c) review board activities;

d) status of parts, materials, and processes concerns;

e) significant problems in hardware quality assurance, software development, design reviews, configuration management and the safety programme;

f) programme product assurance audits and action items status;

g) class I (major) changes and waiver/deviation status;

h) summary of any planned activities in the forthcoming period.

The PA progress status can be tracked by meetings and/or reviews, not only by reports, with the project manager, PA manager and customer participation, depending on the subjects concerned.

5.6 Risk management

The contractor shall perform a systematic risk assessment, reduction and control in achievement of required technical performance, within the project cost and schedule constraints. The methodology for risk management shall cover all areas of the project such as technology, management, customer relationship, supplier relationship, manufacturing, design, parts, materials, processes, qualification and resources.

Risk management of PA shall be restricted within the range of risk related to the product as defined in 5.7 to ensure the independence of PA activities from the management of organization which belong to PA.

Risk management shall be in accordance with ISO 17666.

5.7 Critical item management

The following items will be classified as critical items for the project:

a) items not qualified;

b) items with highly sensitive processes;

c) items which are difficult to test on ground;

d) items containing limited life parts;

e) items which are radiation-sensitive;

f) items using new technologies;

g) items causing critical or catastrophic hazards;

h) critical single point failures;

i) other items identified by the risk assessment analysis;