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Space systems — Product assurance requirements for commercial satellites

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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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on 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 the following URL: 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*.

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Introduction

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

Commercial satellites are designed, manufactured, assembled, integrated, tested and launched in compliance with these PA requirements, which are applicable to prime contractor, subcontractors and suppliers. 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 more specifically, 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 and applicable to all phases of project up to launch of commercial satellite. PA programs also ensure that hardware and software of ground support equipment are also safe, reliable and do not degrade the flight hardware in any way.

The intent of this document is to clarify the best practices and typical requirements dealing with product assurance activities in commercial business, prevent recurrence of problem and realize quality improvement especially for customers having less experience.

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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, ISO 27025, ISO 14620-1, ISO 23460, ISO 10794 and ISO 14621-2 and unified as one PA process. Detailed requirements of product assurance (PA), quality assurance (QA), dependability, EEE parts, material, mechanical parts and processes, software product assurance and ground support equipment are selected from relevant proven standards.

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Space systems — Product assurance requirements for commercial satellites

1 Scope

This document provides the recommended practices of product assurance (PA) requirements applicable to commercial satellite.

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 10794:2011, *Space systems — Programme management — Material, mechanical parts and processes*

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

ISO 14620-1:2002, *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 14644-1, *Cleanrooms and associated controlled environments — Part 1: Classification of air cleanliness by particle concentration*

ISO 15388, *Space systems — Contamination and cleanliness control*

ISO 27025, *Space systems — Programme management — 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 terminological databases for use in standardization at the following addresses:

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

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

3.1
commercial satellite
satellite used for private business

Note 1 to entry: Non-commercial satellite is military satellite or civil satellite developed on behalf of government organization, space agency and/or research organization.

3.2
proto-flight level testing (PFT)
test of the flight quality product subjected to the qualification levels and acceptance duration

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4 Abbreviated terms

AT	Acceptance Test
CCB/CRB	Configuration Control Board/Change Review Board
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
FDIR	Failure Detection Isolation and Recovery
FMECA	Failure Mode, Effect and Criticality Analysis
FRR	Flight Readiness Review
FTA	Fault Tree Analysis
GSE	Ground Support Equipment
HSIA	Hardware-Software Interaction Analysis
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 Conformance Inspection
QSL	Qualification Status List

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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
SOW	Statement Of Work
TRB	Test Review Board
TRR	Test Readiness Review
WCA	Worst Case Analysis

5 Product assurance

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5.1 PA management

Product assurance management policy for commercial satellite project is that PA plan which is implemented throughout all phases, coordinated with involved parties, and is managed in such a way as to:

a) ensure that 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 could 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-conformances are properly disposed.

Contractor shall designate a PA manager who shall have prime responsibility for the management and direction of the PA program.

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

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

a) to propose, establish and implement the product assurance program in accordance with project product assurance requirements;

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b) to have unimpeded access to top management through the company PA executive as necessary to fulfill the duties.

Contractor shall report on a regular basis as specified in the applicable statement of work (SOW) on the status of the product assurance program implementation. Contractor shall plan and perform quality audits using established and maintained procedures. 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 compliance of the product at each stage of product life cycle (i.e. specified, designed, manufactured, in use).

5.2 PA plan

The detailed implementation of this program shall be defined in PA plan which shall be based on normal commercial practices and comply with the requirements defined herein. Conformity with AS 9100 [29] or equivalent standards should be indicated. This plan shall describe the task descriptions, responsibilities and implementation methods in accordance with product assurance requirements described in the applicable SOW. The plan shall also identify any relevant specifications, procedures, standards and manuals that shall be applicable to the implementation of this plan. The plan shall clearly identify and define contractor's product assurance organization and its relationship with 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).

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5.3 Audit

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

Contractor shall perform external audits over the facilities of the supplier, sub-tier supplier, parts/materials manufacturer, and/or outside manufacturer facilities to confirm that the procured items are in compliance with PA requirements specified in the applicable SOW. The representative of contractor shall confirm the following items as the surveillance:

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

2) the activities of supplier satisfy the requirements in this document and SOW.

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

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

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