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## **Space systems — Programme management —**

### **Part 2: Product assurance**

*Systèmes spatiaux — Management de programmes —*

*Partie 2: Assurance produit*



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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 14300 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 14300-2 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 14, *Space systems and operations*.

ISO 14300 consists of the following parts, under the general title *Space systems — Programme management*:

- *Part 1: Structuring of a programme*
- *Part 2: Product assurance*

## Introduction

This part of ISO 14300 is intended to be applied for the product assurance in space programmes and applications.

Requirements in this part of ISO 14300 are defined in terms of what must 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 part of ISO 14300 takes into account the existing ISO 9000 family of documents and the content of ISO 14300-1.

Users should note that all International Standards undergo revision from time to time, and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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# Space systems — Programme management —

## Part 2:

## Product assurance

### 1 Scope

This part of ISO 14300 defines the product assurance (PA) policy, objectives, principles, and requirements for the establishment and implementation of PA programmes for space programmes covering mission definition, design, development, production and operations of space products including disposal.

The PA discipline covers: PA management, quality assurance, safety assurance, dependability assurance of software and hardware products including electrical, electromechanical, electronic components, materials, mechanical parts and processes.

This part of ISO 14300 defines their respective objectives, policies, and principles to achieve the stated overall PA objectives throughout the complete life cycle of the products.

The provisions of this part of ISO 14300 apply to space products.

### 2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 14300. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 14300 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 9000:2000, *Quality management systems — Fundamentals and vocabulary*

ISO 9000-4:1993, *Quality management and quality assurance standards — Part 4: Guide to dependability programme management*

ISO 9001:2000, *Quality management systems — Requirements*

ISO 14300-1, *Space systems — Programme management — Part 1: Structuring of a programme*

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

ISO 17666, *Space systems — Risk management*

### 3 Terms and definitions

For the purposes of this part of ISO 14300, the terms and definitions given in ISO 9000:2000 and the following apply.

### 3.1

#### product assurance

##### PA

discipline devoted to the study, planning and implementation of activities intended to assure that the design, controls, methods and techniques in a programme result in a satisfactory level of quality in a product

## 4 Objectives, policy and principles

### 4.1 Objectives

The prime objective of product assurance is to assure that the space products accomplish their defined mission objectives and more specifically that they are safe, available and reliable.

A further objective is to achieve more cost effective space programmes by co-ordinating the development and implementation of appropriate PA methods and standards.

In support of programme risk management, PA will assure an adequate identification, appraisal, prevention and control of technical risks within programme constraints.

### 4.2 Policy and principles

In order to meet these objectives, a PA policy is defined in this part of ISO 14300, which requires a PA programme derived from a system based on preventive approach and includes:

- a) protection of human life, space products, investment and environment;
- b) definition and maintenance of a programme PA function, with appropriate autonomy with respect to other lines and programme level organizations;
- c) integrated application of the PA disciplines and co-ordination with the associated functions of programme management and programme engineering;
- d) tailoring of the PA requirements to the specific programme needs;
- e) assignment of PA requirements and their control commensurate with the function criticality within the system;
- f) integrated PA participation to the overall risk management process;
- g) PA contribution to proper control of the technical risks and assuring awareness by the appropriate levels of management until the end of the disposal phase;
- h) implementation of a preventive approach, i.e. early identification of potential problems and continuous influence on the development process;
- i) verification activities consistent with programme objectives;
- j) certification activities by the supplier on the end product for customer's final acceptance.

## 5 Product assurance management

### 5.1 Objective

The objective of product assurance management is to ensure and achieve an adequate, effective and efficient co-ordination and implementation of the PA activities through a proper integration of the PA disciplines as well as the integration of PA with all programme management and engineering activities.

## 5.2 Policy and principles

**5.2.1** The PA management policy is that a PA programme is implemented throughout all programme phases and co-ordinated with all the actors, and is managed in such a way as to ensure that:

- a) the PA programme and organization, requirements, methods, tools and resources are well defined and implemented at each level from system down to piece part;
- b) the applicable standards are tailored appropriately;
- c) aspects are identified, which could affect programme requirements having major impacts on safety, mission success and the related cost and schedule consequences;
- d) adverse consequences of these aspects are prevented by the early detection, characterization, elimination, minimization and containment of problem contributors and initiators;
- e) risks are assessed and controlled, and that acceptability of the residual ones is evaluated;
- f) the end product conforms to its specifications and that observed non conformances are properly disposed.

Such a programme provides at any time the necessary visibility of the quality status of the product.

**5.2.2** The basic implementation principles are to:

- a) define all PA activities consistent with the programme objectives, requirements, criticality and constraints;
- b) ensure the allocation and availability of adequate resources, personnel and facilities to carry out the required PA tasks;
- c) ensure that lower level contractors and suppliers perform proper PA monitoring and control;
- d) ensure proper progress monitoring, reporting and visibility of all PA matters, in particular those related to risk dispositions, alerts, critical items, non-conformances, changes, deviations, waivers, actions and/or recommendations resulting from reviews, inspection and audits, qualification, verification and acceptance.

## 5.3 Requirements

### 5.3.1 Responsibility and authority

The requirements for responsibility and authority are as follows.

- a) The responsibility, the authority and the interrelation of PA shall be defined.
- b) The PA responsibilities and the interfaces of each organization, either external or internal, involved in a programme shall be defined and documented.
- c) The delegation of product assurance tasks by a supplier to another lower tier supplier shall be done in a documented and controlled way. The supplier retains the responsibility towards the customer.
- d) The parties involved shall take cognizance of ISO 17666.

### 5.3.2 Resources

The requirements for resources are as follows.

- a) The supplier shall provide adequate resources to perform the required PA tasks.
- b) Trained personnel shall be assigned to the various PA activities.
- c) The supplier shall assign a programme PA manager reporting to the programme manager and having unimpeded access to higher management through the company PA (or equivalent) executive as necessary to fulfil his duties.

### 5.3.3 Product assurance programme management

The requirements for a product assurance programme management are as follows.

- a) The appointed programme PA manager, irrespective of other responsibilities, shall have sufficient organizational authority and independence to propose and maintain a product assurance programme in accordance with the programme product assurance requirements.
- b) The supplier shall prepare and implement a programme product assurance plan.
- c) The supplier's PA plan shall be maintained throughout the programme life cycle.
- d) The supplier shall report on a regular basis as specified in the business agreement on the status of the product assurance programme implementation.
- e) The supplier shall plan and perform quality audits of the PA programme, processes and/or products using established and maintained procedures.

### 5.3.4 Contractual aspects

At any contractual level, the applicable PA programme shall provide evidence of the following.

- a) All contracts include suitable product assurance provisions based upon the knowledge of the products and on customer's requirements.
- b) The product assurance function is involved in the preparation and negotiations of the product assurance provisions.
- c) The product assurance function participates in the detailed review of the contract.
- d) The product assurance function is involved in the assessment and review of all changes to the contractual requirements.

### 5.3.5 Risk assessment and control

**5.3.5.1** PA shall provide inputs to the overall programme risk management process defined in ISO 14300-1. In the implementation of the process, the following PA aspects shall be considered systematically:

- a) likelihood and severity of risks or their uncertainties expected in demonstration of design performance, and with items having small design margins;
- b) risk identified by dependability and safety analyses;
- c) likelihood and severity of risks or their uncertainties expected in development of new products, components, parts, materials, processes and critical technologies;
- d) likelihood and severity of risks or their uncertainties expected in procurement, manufacturing, assembly, inspection, test, handling, storage and transportation, which may lead to unacceptable degradations in the quality of the product;
- e) likelihood and severity of risks anticipated in product utilization or service implementation;
- f) risk identified by suppliers at lower levels;
- g) risk of product quality degradation as the result of cost and schedule constraints imposed on the programme;
- h) effectiveness of risk reduction and control measures;
- i) acceptability of residual risks.

**5.3.5.2** Critical items shall be identified as a result from risk assessment. It is a programme responsibility to define the specific criteria for critical item identification, taking into account the capability for detection and control of risk occurrence.

**5.3.5.3** Dependability and safety are to be based on the following points.

- a) The dependability and safety concept of technical risk identification, reduction and control is part of the "Risk management process", which shall be a continuous and iterative process throughout the programme life cycle. The dependability and safety related technical risk reduction and control process are joint activities with engineering domains.
- b) The process of risk identification may be performed by applying two approach principles simultaneously: top down approach and bottom up approach.
- c) The dependability and safety related technical risk reduction and control process shall be applied to all identified hazards and failure modes, which have unacceptable consequences at any time in the programme.
- d) In identification of failure modes and hazards and associated technical risks, due consideration shall be given to past experience, studies, ground and flight tests, reviews, the industrial process as well as the operational use.
- e) Risk reduction measures as proposed for dependability and safety shall be assessed at system level in order to select the optimum solution to reduce the system level risk.

**5.3.5.4** The process of risk identification and assessment employs both qualitative and quantitative approaches as follows.

- a) All identified technical risks shall be assessed primarily for the severity of their consequences and categorized according to the appropriate programme severity class. Corresponding controls shall be implemented.
- b) After qualitative risk reduction is applied, the residual risks including probability shall be evaluated. The acceptability of these residual risks shall be justified according to defined criteria.

## 6 Quality assurance

### 6.1 Objective

The objective of quality assurance is to provide adequate confidence to the customer that the end product or service satisfies the requirements.

### 6.2 Policy and principles

The quality assurance policy is to ensure, in conjunction with other integrated programme and PA functions, that required quality is specified, designed-in and is incorporated, verified and maintained in the relevant hardware, software and associated documentation throughout all programme phases, by applying a programme where:

- a) assurance is provided that all requirements are adequately specified;
- b) design and development rules, methods and standards are consistent with the programme requirements;
- c) each applicable requirement is verified through a verification programme which includes one or more of the following methods:
  - analysis,
  - inspection,
  - test,
  - review of design,
  - audits;
- d) design and performance requirements including the specified margin are demonstrated through a qualification and acceptance process;
- e) inputs to the risk management process are provided;
- f) assurance is provided that the design is producible and repeatable, and that the specification of the resulting product can be verified and operated within the required operating limits;

- g) assurance that the operations including post-flight and disposal are carried out in a controlled way and in accordance with the relevant requirements;
- h) assurance is provided that suitable quality systems covering design, development, production, installation, servicing, final inspection and test, based on ISO 9001:2000 or equivalent, are in place and implemented by all participants to the programme.

## 7 Safety assurance

### 7.1 Objective

The objective of safety assurance is to ensure that all safety risks associated with the design, development, production and operations of space products are identified, assessed, minimized, controlled and finally accepted.

### 7.2 Policy and principles

#### 7.2.1 Policy

The safety policy shall ensure that space systems do not involve unacceptable hazards to, in order of priority:

- a) human life;
- b) the environment;
- c) public and private property;
- d) spacecraft and launcher;
- e) ground support equipment and facilities.

#### 7.2.2 Implementation principles

The safety policy shall be implemented by applying a safety programme which shall ensure that:

- a) safety is designed into the system;
- b) safety controls measures are adequately verified;
- c) safety requirements including launch centre safety regulations are met;
- d) hazards are identified, and eliminated or, where this is not possible, minimized, ranked and controlled in accordance with programme objectives in a manner acceptable to the customer and to the safety organizations involved in the implementation of the mission.

Furthermore, the safety policy shall be fully compatible and associated with the dependability programme.

#### 7.2.3 Safety programme

The safety programme shall comprise:

- a) the identification and control of all safety related risks with respect to the design, development and operations of space products;
- b) the assessment of the risks based on qualitative and quantitative analysis as appropriate;
- c) the application of a hazard reduction precedence and of control measures of the residual risks;
- d) resolution of all accidents and incidents;
- e) cognizance of ISO 14620-1.