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Space systems — Off-the-shelf item utilization

Systèmes spatiaux — Utilisation d'équipement prêt à l'emploi

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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 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 21350:2007), which has been technically revised.

The main changes are as follows:

- normative references updated, and related terms and definitions added and renumbered;
- minor changes in [clauses](#) 4, 5, 6 and annexes.

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

Space projects and organizations are more often faced with proposals to use off-the-shelf (OTS) items which can offer opportunities for reduced cycle time, faster insertion of new technology and lower procurement costs.

Space projects and organizations have successfully used OTS items in a wide variety of space applications, largely in part, through structured application of best practices in business, management and engineering by understanding ~~of~~ the risk associated with using OTS items.

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Space systems — Off-the-shelf item utilization

1 Scope

This document contains requirements and guidelines for the utilization of off-the-shelf (OTS) items, their selection, acquisition, integration, qualification and implementation related to a space product or system.

This document doesn't cover piece parts and materials, such as electrical, electronic and electromechanical (EEE) parts, thermocouples, rivets, fasteners, connectors, fittings, adhesives, insulation, wiring and plumbing.

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 9000, *Quality management systems — Fundamentals and vocabulary*

ISO 14300-1:2001, *Space systems — Programme management — Part 1: Structuring of a programme*

ISO 14300-2, *Space systems — Programme management — Part-2: Product assurance*

ISO 17666, *Space systems — Risk management*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 9000, ISO 10795 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

critical application

application where a failure can cause loss of life or loss of mission

3.2

high heritage

item from the original supplier that has maintained the great majority of the original service, design, performance and manufacturing characteristics

Note: ~~for 1 to entry.~~ For this item all essential product characteristics must be assessed to establish its product heritage

3.3

low heritage

item that is not build by the original manufacturer, does not have a significant history of successful test and usage, or has significant aspects of the original service, design performance and manufacturing characteristics altered

3.4

off-the-shelf

OTS

existing item which has been developed for a specific application and is intended to be used in another application

3.5

product heritage

collection of data supporting adequacy for the intended use by time in service, number of units in service, mean time between failures (MTBF) performance, failure history, number of use cycles and manufacturing characteristics

4 Requirements

4.1 Responsibilities

It is the responsibility of the project or engineering organization to procure OTS items in accordance with this document.

4.2 Tailoring

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

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

5 Policy

5.1 Evaluation of the OTS item design

5.1.1 General

This document is intended for use complementary to the requirements of ISO 14300-1, and ISO 14300-2. For projects which have design responsibility, the following practices shall be adhered to in the application of OTS items. These practices shall address the potential impact of an OTS item at any level of functionality.

5.1.2 OTS item requirements

Requirements shall be defined and baselined for each OTS item application.

5.1.3 OTS item evaluation

Early environmental and performance tests on sample OTS items that verify supplier compliance with procurement specifications shall be performed. The extent of this testing will be determined by design based on the criticality of the application and the significance of any modifications performed and approved by the project. For critical applications, product data, inspection data, and test or usage data shall be reviewed prior to final selection of the OTS item.

During the design phase, the OTS item shall be specifically evaluated to see if the proposed application is within the range of environments and operating conditions which are consistent with the OTS use experience and advertised specifications. This includes evaluation of advertised specification data, vendor inspection and test data, if available, or the generation of additional data over the intended operating and environmental range by the project or organization intending to use the flight time testing. For an OTS item to be selected, there shall be data showing the OTS item's conformance to its specification, including the availability of associated documentation.

If the intended operation of an OTS item is outside the specified operating conditions or environments over which the item has demonstrated successful performance, then either or both of the following requirements apply.

- a) An appropriate conservative design margin (i.e., margin) shall be applied by the responsible design organization for the intended use conditions.
- b) A comprehensive inspection and test programme shall be implemented to prove that the OTS item is acceptable.

Since the OTS item is being operated outside its envelope, these extra measures provide the confidence in the design that is not available through the empirical body of data that is implicit in repeated successful operations of a common design under specified environments and operating conditions.

Qualification assessment should be conducted in accordance with ISO 15865.

5.2 Rules in a critical application of OTS

5.2.1 Operational boundaries

The OTS item shall not operate near the boundaries of its performance or environmental envelopes. To ensure this, specific margins shall be established during the design phase of the project and adhered to during the selection of the OTS.

5.2.2 Design evaluation

Prior to preliminary design review, critical application of a design that utilizes OTS items shall be identified and evaluated. This evaluation shall ensure that the intended mission applicable functions to be performed by the OTS items are addressed and that the previous existing functions of the OTS items are consistent with the new application.

5.2.3 OTS item modifications

Following the configuration management rules applicable to the project, the OTS item modifications shall be developed jointly by the project or organization intending to use the flight item and the vendor, if practical. OTS items shall not be modified for a critical application unless adequate vendor design disclosure is obtained, or the project or engineering organization developing/proving the flight item have an adequate understanding of the OTS item design.

5.2.4 Qualification requirements

The project or organization intending to use the OTS item shall establish a qualification plan on the basis of Annex B. OTS items utilized in critical applications should be reviewed at each scheduled design review and approved as appropriate. For implementation of OTS items in a non-critical application, the selected Annex B requirements, or exceptions thereto, should at a minimum be reviewed and approved by the leader of the project or organization intending to use the OTS item.

6 Precautions and warning notes

6.1 Notes about product heritage of OTS item

6.1.1 OTS product heritage

The heritage of an OTS item can be an indicator of the quality or reliability of OTS items in a space application.

High heritage does not exist on all OTS items. An OTS item may have a low heritage due to limited production because of recent availability, low sales volume, unique application, etc.

6.1.2 Application of OTS item design/manufacturing practices

OTS design or manufacturing practices may not be acceptable despite the heritage of mass production. Inspection and/or testing should confirm workmanship acceptability to the degree determined by the project or organization intending to use the OTS item as appropriate for its application.

6.1.3 OTS item design margins

OTS design margins should be verified with the vendor, determined by testing, or an additional safety factor included, particularly for critical application items.

6.2 Acquisition of OTS items

6.2.1 General

When a project or organization decides to use OTS item in a space application, unique acquisition issues may be encountered. The areas specified in 6.2.2 to 6.2.6 should be considered.

6.2.2 Specification

The project or organization should ensure that the OTS item that is purchased to work within the expected specification required by the application and should obtain environmental specifications and/or test data from the vendor to confirm compatibility. There shall be data showing the OTS item's conformance to its specification, including the availability of associated documentation.

6.2.3 Space environment

Vendors (designers or manufacturers) of OTS items may not be sensitive to space environment issues, such as, radiation, vacuum, thermal extremes, lack of convection cooling in zero-G, launch vibration, or enriched oxygen atmosphere. Therefore, the project or engineering organization providing/developing the flight item should accept the responsibility for assessing space environment compatibility.

6.2.4 Configuration control

The vendor configuration control of OTS items may not ensure that all products are manufactured/developed identically. OTS items designed and manufactured at different times (different lot numbers) may exhibit differences in materials, parts and/or development process. Whenever feasible, all OTS items (including development test units and spares) should be purchased from a single lot to minimize material/part/process differences. If not feasible, OTS items purchased should be traceable to lot, if possible.

6.2.5 Acceptance testing

OTS item acceptance testing may need to be more comprehensive than the typical manufacturing defect screening tests, especially when the purchase of a single lot is not feasible. The more comprehensive acceptance testing should include workmanship as well as performance under expected use environments.

6.2.6 Maintenance

If the project or organization intending to use the OTS item is to become responsible for maintenance of the OTS item during its service life, this requirement should be addressed during procurement of the OTS item to ensure that the total quantity of hardware required for the project is adequate to include spares and replacement parts.

6.3 Management of modified OTS item

6.3.1 Purchasing

When purchasing a modified OTS item, the modified hardware should be treated as a new design and all appropriate processes associated with the design change should be reviewed. An OTS item which has been modified or needs modifications for use is no longer "off the shelf".

6.3.2 Qualification

The project or organization intending to use the flight item is not always qualified to work on or modify OTS hardware, so OTS vendor involvement should be considered as appropriate. Depending on the nature and degree of modification, the vendor may be the only one qualified to make the changes.

6.4 Programmatic decision to use an OTS item

The decision by a project or organization to use an OTS item in a space application shall include the results of a risk assessment in accordance with ISO 17666.

6.4.1 Functional/technical capability

OTS items shall meet the requirements of the project or organization intending to use the flight item requirements. This is more than functional similarity. The project or organization intending to use the flight items should develop good performance and environmental requirements for a potential OTS application and ensure that the OTS candidate is screened against this comprehensive set of requirements.

6.4.2 Interface definition

When using an OTS item in a space system application, the interface requirements between the OTS item and other hardware/software items in the system should be defined such that the OTS item is operated in accordance with the OTS manufacturer's performance and environmental specifications, as well as the performance and environmental specifications of interfaced parts/systems.

6.4.3 Modification versus heritage

The OTS heritage should be preserved to the maximum extent possible. Even apparently simple modifications often compromise the OTS heritage.

7 Decision logic for OTS item usage

A decision logic for OTS item usage is contained in Annex A. The project or organization intending to use the OTS item should consider this logic when determining whether to use an OTS item.

8 Procedure

8.1 Categorizing of available OTS items

A survey of available OTS items should be made. The OTS items identified for consideration during the survey shall be sorted into the following three categories:

- a) those which meet all the programme or project requirements;