SLOVENSKI STANDARD
SIST EN 13292:2000

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Space engineering standards - Policy and principles

Space engineering standards - Policy and principles

Raumfahrttechnik Normen - Grundsätze und Verfahrensweise

Normes d'ingénierie spatiale - Politique et principes

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49.140	Vesoljski sistemi in operacije	Space systems and operations

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Space engineering standards - Policy and principles

Normes d'ingénierie spatiale - Politique et principes

Raumfahrttechnik Normen - Grundsätze und Verfahrensweise

This European Standard was approved by CEN on 26 November 1998.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

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Foreword

This European Standard has been prepared by CEN/CS.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 1999, and conflicting national standards shall be withdrawn at the latest by September 1999.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

This standard is one of the series of space standards intended to be applied together for the management, engineering and product assurance in space projects and applications.

Requirements in this standard 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 standard takes into account the existing ISO 9000 family of documents.

This standard has been prepared by the ECSS Engineering Standards Working Group, reviewed by the ECSS Technical Panel and approved by the ECSS Steering Board. ECSS is a cooperative effort of the European Space Agency, National Space Agencies and European industry associations for the purpose of developing and maintaining common standards.

Introduction

The production of complex products requires the cooperation of several organizations which share a common goal to provide a product which satisfies the consumer's needs (technical performance) under cost and schedule constraints.

To reach this goal, corresponding technical activities, human and financial resources, are commonly organized and coordinated in a structured manner in order to obtain the end product also known as system. This structure, together with related processes, constitutes a project. It implies a target (system), a time frame, and actions to be performed under resources constraints.

Project management consists of the definition, implementation and execution of such actions including the verification that corresponding obtained results match with the expected ones.

Project management requires thinking carefully about what shall be accomplished, laying out all the steps needed to build that future, and obtaining the resources required to carry out those steps. But most important, it requires dealing with reality, problems, delays, changes, obstacles and, sometimes, opportunities that arise as a project takes place.

1 Scope

This standard, which is informative in nature, contains the basic rules and overall principles to be applied to all engineering activities during performance of a space project. It addresses the establishment, based on customer needs, of mission objectives, requirements, and specifications for space systems, and the design, definition, production, verification, operation, and eventual disposal of the systems themselves. It defines the scope and interfaces of these activities relative to the domains of management and product assurance, and explains how they may apply in different ways depending on the type of space system concerned. It also introduces the lower level engineering standards within the space standards system, and proposes how they may be used (after "tailoring" if required) to facilitate space project operations.

This standard is intended to help customers in formulating their needs and suppliers in preparing their response and implementing the work.

2 Normative references

This European standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these apply to this Space Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 13290-1	Space Project Management - General requirements – Part 1 : Policy and Principles
ECSS-M-10A	Space Project Management - Project Breakdown Structures
ECSS-M-30A	Space Project Management - Project Phasing and Planning
ECSS-M-70A	Space Project Management - Integrated Logistic Support
ECSS-P-001A, Rev 1	ECSS - Glossary of Terms
EN 13291-1	Space Product Assurance – General requirements – Part 1 : Policy and Principles
ECSS-Q-20A	Space Product Assurance - Quality Assurance
ECSS-Q-30A	Space Product Assurance - Dependability
ECSS-Q-40A	Space Product Assurance – Safety
ISO 9001:1994	Quality systems - Model for quality assurance in design/development, production, installation and servicing

3 Definitions and abbreviations

3.1 Definitions

For the purposes of this standard, the definitions given in ECSS-P-001 apply.

3.2 Abbreviations

The following abbreviations are defined and used within this standard.

Abbreviation	Meaning
DDF	Design Definition File
DJF	Design Justification File
ECLS	Environmental Control and Life Support
ECSS	European Cooperation for Space Standardization
RE	Requirements Engineering

4 Space project engineering

The purpose of a space project is to deliver to a customer (and subsequently support or operate if required) a system which includes one or more elements intended for operation in outer space. The activities carried out by the system supplier are conveniently and conventionally categorized into five domains:

- project management, responsible for achievement of the totality of the project objectives, and specifically for organization of the project, and its timely and cost–effective execution;
- engineering, responsible for definition of the system, verification that the customer's technical requirements are achieved, and compliance with the applicable project constraints;
- production, responsible for manufacture, assembly and integration of the system, in accordance with the design defined by engineering;
- operations, responsible for exercising and supporting the system in order to achieve the customer's objectives during the operational phases (note: operations may be carried out by the customer, by the supplier or a third party on the customer's behalf, or by a combination of these);
- product assurance, responsible for the implementation of the quality assurance element of the project and also for certain other specialist activities. (EN 13291-1)

The boundaries between these activities are not always clearly defined. For example:

- the engineering, production, operations and product assurance domains each include an element of management which overlaps with the project management domain proper;
- production and operations include preparatory and supportive engineering activities, which may also be considered as part of the engineering domain;
- product assurance includes reliability, availability, maintainability and safety activities, which form an essential part of the design process in the engineering domain.

Nevertheless, categorization into these five principal domains provides a useful first–level partition of space–project activities, enabling a complex activity to be split into less complex elements which can be addressed separately and in parallel. This categorization is adopted as the first–level breakdown of the space standards architecture, except that no standards are defined which address the totality of the production and operations domains; requirements for relevant aspects of production and operations are, however, addressed within the project management, engineering, and product assurance standards.

This document, which is the top–level standard in the engineering branch of the space standards system, serves to introduce and define the engineering domain within a space project, and to describe the principal activities within it. It also serves as an introduction to the lower level standards in the space engineering branch, which define the requirements for these engineering activities, and also provides guidance in the use of the engineering standards in project applications.

It is emphasized that this standard is applicable to all the elements of a space system, including the space segment, the launch service segment, and the ground segment (see Figure 1).

5 The engineering domain

5.1 Introduction to the engineering domain

The project engineering process aims at a satisfactory response to a user's needs by the creation and delivery of a product for the intended mission; it occurs within a domain which can be represented as illustrated in Figure 2. Three orthogonal axes can be identified within this domain:

- The "system engineering process" axis, which includes the function within the domain which guides and powers the engineering process (called "integration and control"), and those processes which are exercised iteratively through the project in order to design and verify a product which meets the customers requirements. The functions within the system engineering process are introduced in subclause 5.2 below, and described in more detail in clause 6.

- The "engineering disciplines" axis that includes those engineering disciplines (systems, electrical, mechanical, software, communications, control and operations engineering) which contribute their expertise to the engineering process. The engineering disciplines are addressed in subclause 5.3.

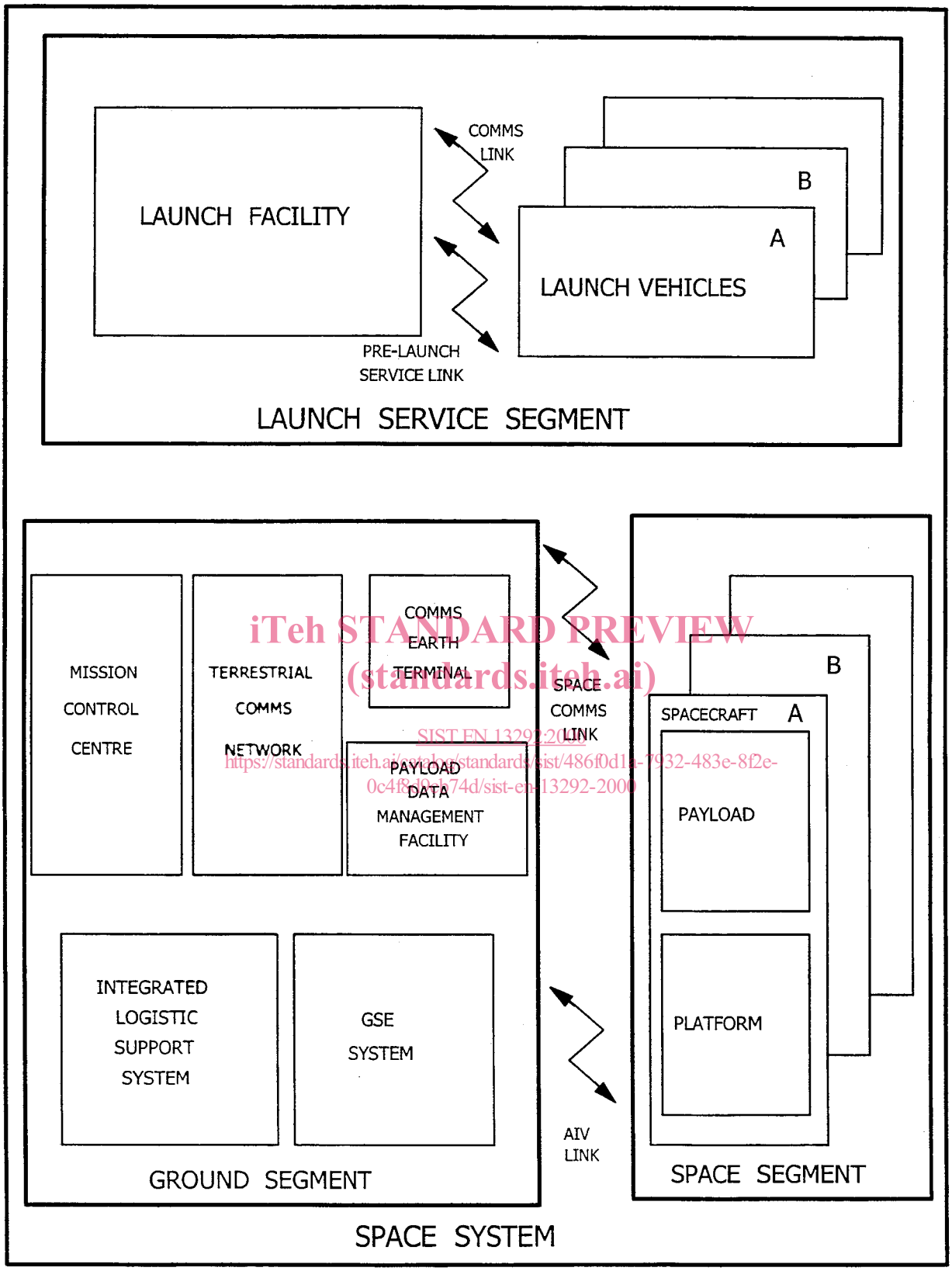
- The "levels of decomposition" axis, which indicates the level (part, assembly, equipment, subsystem, system) at which the engineering process is being exercised. Levels of decomposition are addressed in subclause 5.4.

Each cell within the domain in Figure 2 represents a potential project engineering activity; it can be identified by means of three labels, which indicate:

- the type of system engineering activity;

- the engineering discipline concerned;

- the level of decomposition.



NOTE GSE = Ground Support Equipment; AIV = Assembly, Integration, Verification

Figure 1 — Illustration of the scope of a typical space system

For example, the cell marked in Figure 2 indicates mechanical analysis at equipment level.

The activities on the system engineering process axis should not be confused with the phases in the project life cycle, (defined in ECSS-M-30), even though similar nomenclature may be adopted. Rather, they should be thought of as activities in a process, which may need to be iterated several times during the course of a project, in order to achieve a satisfactory outcome at each stage. The way in which these activities are arranged, their relative importance and the amount of effort devoted to each activity will vary according to the type of project, its complexity and the extent of the technological advance and innovation required to implement it; generally, however, each activity should be considered and exercised concurrently during each project phase, with its relative importance adjusted appropriately, so that the downstream implications of each decision are fully assessed and recognized.

As examples:

- a feasibility study should address operations as well as requirements and architectural design;
- it is important to verify that requirements have been realistically allocated in a way which satisfies all participants during a project definition phase;
- it is imperative that production and verification are addressed during design engineering activities, to ensure that the product is manufacturable and verifiable;
- it is necessary to exercise the complete system engineering process if modifications to the design are introduced during the project operations phase.

Equally, the predominant level of assembly at which engineering activities take place, and the involvement of the engineering disciplines, will vary with time in a way that depends on the nature of the product.

Consequently, the activity level in each cell in the engineering domain will vary in a complex way with time. Figure 3 illustrates the typical variation of the level of engineering activity with time, related to project phases, for sample cells within the engineering domain.