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**Raumfahrttechnik –
Bodensysteme und Bodenbetrieb –
Teil 2: Dokumente mit Definitionen von Anforderungen;
Englische Fassung EN 14737-2:2004**

Space engineering –
Ground systems and operations –
Part 2: Documents requirements definitions (DRDs);
English version EN 14737-2:2004

Ingénierie spatiale –
Systèmes sol et exploitation –
Partie 2: Définition des exigences documentaires (DRD);
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Nationales Vorwort

Die *European Cooperation for Space Standardization (ECSS)*, eine Einrichtung zur Erstellung eines kohärenten, einheitlichen Normenwerkes zur Anwendung in allen europäischen Raumfahrtprojekten, hat am 1996-11-13 vom *Europäischen Komitee für Normung (CEN)* das Mandat (M/237) erhalten, für den CEN-Subsector T02 „Aerospace“ Europäische Normen (EN) auszuarbeiten.

Aufgrund der zwischen ISO/TC 20/SC 14 „Raumfahrt“ und ECSS vereinbarten A-Liaison werden die Normungsprogramme dieser Partner abgestimmt und die Abstimmungsregeln gemäß Abschnitt 5.2 der Wiener-Vereinbarung angewendet.

Die vorliegende Norm EN 14737-2:2004 wurde von CEN/CS T02 auf Basis der ECSS-E-70 erarbeitet.

English version

Space engineering - Ground systems and operations - Part 2: Documents requirements definitions (DRDs)

Ingénierie spatiale - Systèmes sol et exploitation - Partie 2 :
Définition des exigences documentaires (DRD)

Raumfahrttechnik - Bodensysteme und Bodenbetrieb - Teil
2: Dokumente mit Definitionen von Anforderungen

This European Standard was approved by CEN on 2 February 2004.

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, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.



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Foreword

This document (EN 14737-2:2004) has been prepared by CMC.

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 2004, and conflicting national standards shall be withdrawn at the latest by September 2004.

It is based on a previous version¹⁾ originally prepared by the ECSS Space Engineering Working Group, reviewed by the ECSS Technical Panel and approved by the ECSS Steering Board. The European Cooperation for Space Standardization (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.

This European 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.

EN 14737 “*Space engineering – Ground systems and operations*” is published in 2 Parts:

Part 1: Principles and requirements

Part 2: Document requirements definitions (DRDs)

Requirements in this European Standard are defined in terms of what shall 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 European Standard takes into account the existing EN ISO 9000 family of documents.

The annexes A, B, C, D, E, F, G, H and I are normative.

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

¹⁾ ECSS-E-70-2A.

Introduction

Ground systems and operations are key elements of a space system and as such play an essential role in achieving mission success. Mission success is defined here as the achievement of the target mission objectives as expressed in terms of the quantity, quality and availability of delivered mission products and services within a given cost envelope.

Mission success requires successful completion of a long and complex process covering the definition, design, implementation, validation, in flight operations and post operational activities, involving both the ground segment and also space segment elements. It involves technical activities, as well as human and financial resources, and encompasses the full range of space engineering disciplines. Moreover it necessitates a close link with the design of the space segment in order to ensure proper compatibility between both elements of the complete space system.

1 Scope

Part 2 of ECSS-E-70 “Space engineering — Ground systems and operations” specifies the content of the document requirements definitions (DRDs) which are called up by other European Space Standards and specifically referenced in EN 14737-1: “Principles and requirements”.

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 the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 13701:2001, *Space systems — Glossary of terms*.

EN 14737-1, *Space engineering — Ground systems and operations — Part 1: Principles and requirements*.

ECSS-E-70-41A, *Space engineering — Ground systems and operations — Telemetry and telecommand packet utilization*.

3 Terms, definitions and abbreviated terms

For the purposes of this European Standard, the terms, definitions and abbreviated terms given in EN 13701 and EN 14737-1 apply.

4 Document requirements definitions (DRD) list

European Space Standards specify the production and use of project documents. Document requirements definitions are defined to control the content of the project documents.

Document requirements definitions serve to ensure:

- a) completeness and consistency of information within documents;
- b) that the information contained in a document conforms to its defined scope, and correctly implements its interfaces with other documents; and
- c) that portions of a document can be generated or maintained by separate organizational groups and seamlessly integrated into a coherent whole.

Table 1 lists and gives a summary of the DRDs that are defined in the annexes of this European Standard and called up in EN 14737-1.

Table 1 — EN 14737-2 DRD list

DRD ID	DRD title	DRD summary content	Applicable to (phase)	Delivered (phase)	Remarks
EN 14737-2:2004, annex A	Customer document (CRD)	requirements	B	B	
EN 14737-2:2004, annex B	Ground segment Definition (GSBD)	baseline	C to F	B	
EN 14737-2:2004, annex C	Mission operations concept document (MOCD)		A, B	A ^a /B	
EN 14737-2:2004, annex D	Space segment user manual (SSUM)	Provides all information required to implement the ground segment and to operate the space segment, i.e.: — space segment design characteristics of operational relevance (e.g. operational modes, constraints); — telemetry and telecommand lists (i.e. all information items required for ground processing of TM and TC); — nominal and contingency recovery procedures (only covering space segment aspect).	C to F	C ^a /D	Used in phases C/D for design of G/S and maintenance in phase F
EN 14737-2:2004, annex E	Operational validation plan (OVP)	Provides all information required to execute the operational validation of the ground segment, i.e.: — definition of simulations and rehearsal activities; — timeline of above activities; — related organizational aspects and required resources and participation.	D	D	

Table 1 — EN 14737-2 DRD list

DRD ID	DRD title	DRD summary content	Applicable to (phase)	Delivered (phase)	Remarks
EN 14737-2:2004, annex F	Flight operations plan (FOP)	Defines information required to operate the space segment during all applicable in-orbit phases of the mission, i.e.: — general operation organization and decision making process and major mission rules; — detailed schedule of flight operations; — Flight control procedures (FCP see below) for both nominal operations and major contingencies.	D	E, F	To contain also space segment disposal procedures
EN 14737-2:2004, annex G	Ground operations plan (GOP)	Defines all information required to operate the corresponding ground facility and its constituent elements in order to support the mission, i.e.: — operations management and organizational aspects; — detailed schedule of activities for the entity in relation to mission events; — elementary entity operation procedures.	D	E, F	To contain also ground segment disposal procedures
EN 14737-2:2004, annex H	Operations anomaly report (OAR)	Documents a departure from the expected performance of an item during its operation. Includes: — date and time of anomaly occurrence and unique identifier for the anomaly; — summary description of the symptoms and impacts; — corrective actions and recommendations.	E	E	
EN 14737-2:2004, annex I	Flight control procedure (FCP)	Elementary constituent of the FOP. — Defines all actions to be performed to ensure adequate configuration of the space segment to achieve a given mission goal. — Addresses operational responsibilities, system prerequisites and post execution verification conditions. Two types of FCPs can be distinguished, for nominal and routine operations, and contingency operations respectively.	D	E, F	To contain also space segment disposal procedures
a	Delivery phase marked with an asterisk indicates a preliminary (draft) delivery.				

Annex A (normative)

Customer requirements document (CRD) DRD

A.1 Introduction

The customer requirements document (CRD) defines the requirements from the space segment customer on the supplier of the ground segment and operations.

A.2 Scope and applicability

A.2.1 Scope

This document requirements definition (DRD) establishes the data content requirements for the customer requirements document. This DRD does not define format, presentation or delivery requirements for the customer requirements document.

A.2.2 Applicability

This DRD is applicable to all projects using the European Space Standards.

A.3 References

A.3.1 Glossary and dictionary

This DRD uses terminology and definitions controlled by:

EN 13701:2001, *Space systems — Glossary of terms*.

EN 14737-1, *Space engineering — Ground systems and operations — Part 1: Principles and requirements*.

A.3.2 Source documents

This DRD defines the content and data requirements of a Customer Requirements Document as controlled by the following source document: EN 14737-1, *Space engineering — Ground systems and operations — Part 1: Principles and requirements*.

A.4 Definitions and abbreviations

For the purposes of this DRD the definitions and abbreviations given in EN 13701 and in EN 14737-1 shall apply.

The following abbreviated terms are defined and used within this DRD:

Abbreviation Meaning

AOCS	attitude and orbit control system
CRD	customer requirements document
DRD	document requirements definition
GSBD	ground segment baseline definition
HCI	human-computer interaction
LEOP	launch and early orbit phase

A.5 Description and purpose

The CRD contains all the essential top-level assumptions, constraints and operational requirements for the [insert project name] mission to allow the supplier of the ground segment and operations to perform a design of the ground segment and to develop an operations concept

A.6 Application and interrelationship

The CRD shall be written by the space project customer and is the highest-level requirements document defining the requirements on the ground segment and operations. The supplier of the ground segment and operations shall formally respond to the CRD with the ground segment baseline definition document (GSBD) where all requirements in the CRD can be traced to a proposed implementation.

A.7 Customer requirements document preliminary elements

A.7.1 Title

The document to be created based on this DRD shall be titled “[insert project name] customer requirements document”.

A.7.2 Title page

The title page shall identify the project document identification number, title of the document, date of release and release authority.

A.7.3 Contents list

The contents list shall identify the title and location of every clause and major sub-clause, figure, table and annex contained in the document.

A.7.4 Foreword

A foreword shall be included in the document which describes the following items:

- a) identification of which organizational entities prepared the document;
- b) information regarding the approval of the document;
- c) identification of other organizations that contributed to the preparation of the document;
- d) a statement of effectivity identifying which other documents are cancelled or replaced in whole or in part;
- e) a statement of significant technical differences between this document and any previous document;
- f) the relationship of the document to standards or other documents.

A.7.5 Introduction

An introduction shall be included to provide specific information or commentary about the technical content of the CRD and the reasons prompting its preparations. The introduction shall not contain requirements.

A.8 Customer requirements document content

A.8.1 Scope and applicability

A.8.1.1 General

This clause shall be numbered 1 and shall describe the scope and applicability of the customer requirements document.

A.8.1.2 Scope

This sub-clause shall be numbered 1.1 and shall contain the following statements:

“The [insert project name] customer requirements document constitutes the highest level requirements document formally defining the requirements on [insert ground systems and operations supplier name] for the operation of the [insert project name] mission.

The response to the [insert project name] customer requirements document shall be contained in the [insert project name] ground segment baseline definition, produced by the [insert ground systems and operations supplier name]. In case differences arise between the [insert project name] customer requirements document and the [insert project name] ground segment baseline definition, the [insert project name] customer requirements document shall have priority.”

A.8.1.3 Applicability

This sub-clause shall be numbered 1.2 and shall define the applicability of the [insert project name] customer requirements document with respect to the design, implementation, verification and validation and operations of entities of the [insert project name] ground segment and of the operations of the [insert project name] mission.

A.8.2 References

A.8.2.1 General

This clause shall be numbered 2 and shall contain the following sub-clauses.

A.8.2.2 Normative references

This sub-clause shall be numbered 2.1 and shall contain the following statements:

“The following normative documents contain provisions which, through reference in this text, constitute provisions of this customer requirement document. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this customer requirement document 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.

[insert document identifier] [insert document title].”

A.8.2.3 Informative references

This sub-clause shall be numbered 2.2 and shall contain the following statement:

“The following documents, although not a part of this customer requirements document, amplify or clarify its contents:

[insert document identifier] [insert document title].”

A.8.3 Definitions and abbreviations

A.8.3.1 General

This clause shall be numbered 3 and shall contain the following sub-clauses.

A.8.3.2 Definitions

This sub-clause shall be numbered 3.1 and shall list any applicable project dictionary or glossary, and all unusual terms or terms with a meaning specific to this customer requirements document, with the definition for each term.

If a project dictionary or glossary is applicable the following sentence shall be inserted:

“The definitions of [insert title and identifier of applicable dictionaries or glossaries] apply to this document.”

If a list of definitions is required the following sentence shall be inserted:

“The following terms and definitions are specific to this document:

[insert term] [insert definition].”

A.8.3.3 Abbreviations

This sub-clause shall be numbered 3.2 and shall list all abbreviations used in the customer requirements document with the full meaning or phrase for each abbreviation.

A.8.4 Mission overview

A.8.4.1 General

This clause shall be numbered 4 and shall contain the following sub-clauses.

A.8.4.2 Mission description

This sub-clause shall be numbered 4.1 and shall briefly describe the main objectives and characteristics of the space mission.

A.8.4.3 Spacecraft

This sub-clause shall be numbered 4.2 and shall briefly describe the spacecraft.

A.8.4.4 Instruments

This sub-clause shall be numbered 4.3 and shall briefly describe the instruments on-board the spacecraft.

A.8.4.5 Ground segment

This sub-clause shall be numbered 4.4 and shall briefly describe the ground segment that is foreseen for the control and operations of the spacecraft, the instruments and the ground segment itself.

A.8.4.6 Operations

This sub-clause shall be numbered 4.5 and shall briefly describe the operations that are foreseen to achieve the goal of the space project.

A.8.5 Project responsibilities

This clause shall be numbered 5 and shall briefly describe the distribution of responsibilities within the space project. This shall include the responsibilities of the space project customer and those of the ground systems and operations supplier.

A.8.6 Major project milestones

A.8.6.1 General

This clause shall be numbered 6 and shall contain the following sub-clauses.

A.8.6.2 Space segment milestones

This sub-clause shall be numbered 6.1 and shall summarize the major project milestones relating to the space segment.

A.8.6.3 Ground segment milestones

This sub-clause shall be numbered 6.2 and shall summarize the major project milestones relating to the ground segment.

A.8.7 Mission constraints

A.8.7.1 General

This clause shall be numbered 7 and shall contain the following sub-clauses describing any constraints or other essential mission information that impacts on the design of the ground systems or the mission operations.

A.8.7.2 Launch

This sub-clause shall be numbered 7.1 and shall identify the launch vehicle, the launch site location, the ascent trajectory and the injection characteristics.

A.8.7.3 Orbit

This sub-clause shall be numbered 7.2 and shall identify the main orbital parameters for each distinct orbital phase i.e. wherever the orbit changes significantly.

A.8.7.4 Operational period

This sub-clause shall be numbered 7.3 and shall identify the intended operational period(s).

A.8.7.5 Operational phases and facility utilization

This sub-clause shall be numbered 7.4 and shall identify each distinct operational phase and shall identify any constraints on the use of ground segment facilities for each phase. Typical mission phases shall include LEOP, in-orbit commissioning, routine operations, disposal (e.g. de-orbiting). For deep space missions this can include periods of hibernation.

Constraints on the use of ground segment facilities may identify, for example:

- experimenter-supplied or operated facilities to be used for payload monitoring and control or for payload data processing;
- satellite manufacturer's facilities to be used for the post-launch maintenance of on-board software.

A.8.7.6 Satellite

This sub-clause shall be numbered 7.5 and shall identify any constraints imposed on the ground segment by the satellite. For example, uplink and downlink RF frequencies, on-board antenna patterns.

A.8.7.7 Other constraints

This sub-clause shall be numbered 7.6 and shall identify any other constraints not covered by the above categories.

A.8.8 Mission operations requirements

A.8.8.1 General

This clause shall be numbered 8 and shall identify the high level requirements on the mission operations and, by derivation, on the ground segment.

The requirements shall be specified at a level appropriate to permit all significant aspects of the mission operations concept to be developed. This in turn shall allow all major decisions concerning the deployment of ground segment facilities and their major design drivers to be established.

Requirements shall be organized according to the operations functional breakdown given in the A.8.8.1 to A.8.8.8. Requirements of the following classes shall be included for each major functional heading, where applicable:

- functional;
- performance;
- availability;
- operational;
- interface;
- design (implementation);
- maintainability;
- safety;
- security;
- human-computer interface (HCI).

Often the requirements for a given function differs for different mission phases. In these instances, requirements shall first be defined for the routine mission phase and then those requirements that are different for other mission phases shall be specified.

A.8.8.2 Mission planning and scheduling

This sub-clause shall be numbered 8.1 and shall identify the requirements for the mission planning function. This includes all activities relating to the processing of planning inputs and planning requests, the resolution of planning conflicts and the planning of on-board and ground resources utilization. It also includes the preparation of plans, schedules or timelines of operations as a result of the planning exercise.

A.8.8.3 Mission implementation

This sub-clause shall be numbered 8.2 and shall identify the requirements for the implementation of mission operations i.e. requirements relating to the commanding of the satellite and the payload instruments, the real-time monitoring of these operations and the verification of commanding activities.

A.8.8.4 Health monitoring

This sub-clause shall be numbered 8.3 and shall identify the requirements for routine monitoring of the health of the platform subsystems and the payload elements.

A.8.8.5 Performance monitoring and evaluation

This sub-clause shall be numbered 8.4 and shall identify the requirements for off-line processing of satellite telemetry data for the purposes of tuning of telemetry calibration data, for evaluating long-term performance trends and for monitoring the utilization of on-board resources.

A.8.8.6 Flight dynamics

This sub-clause shall be numbered 8.5 and shall identify the requirements for orbit and attitude determination and control. This shall include (as applicable): tracking data scheduling, acquisition and processing, support for AOCS data uplinking, manoeuvre planning, execution and evaluation, thruster calibration and performance

monitoring, fuel management (e.g. logging, budgeting and lifetime prediction), implementation of collision avoidance strategy.

A.8.8.7 Mission product management

This sub-clause shall be numbered 8.6 and shall identify the requirements relating to the management of mission products or services. This shall include (as applicable): scheduling of data collection, data reception, data processing including value-added processing (e.g. meteorological product extraction), data archiving and cataloguing, data distribution (including mechanisms and media) and on-line access to data.

A.8.8.8 On-board software maintenance

This sub-clause shall be numbered 8.7 and shall identify the requirements for post-launch maintenance of on-board software for each distinct on-board processor within the satellite subsystems and the payload elements.

A.8.8.9 Other mission-specific operations functions

This sub-clause shall be numbered 8.8 and shall identify the requirements for other mission-specific operations functions not covered by any of the above categories. For example, special requirements pertaining to in-orbit testing, in-orbit commissioning or end-of-life operations, such as technological experiments, de-orbiting or other disposal operations.

Annex B (normative)

Ground segment baseline definition (GSBD) DRD

B.1 Introduction

The ground segment baseline definition document (GSBD) constitutes the formal response to the customer requirements document (CRD) and establishes the ground segment technical baseline for its design, implementation and operations. It includes the supplier's compliance with CRD requirements, identifies derived requirements, major constraints and assumptions.

B.2 Scope and applicability

B.2.1 Scope

This document requirements definition (DRD) establishes the data content requirements for the ground segment baseline definition. This DRD does not define format, presentation or delivery requirements for the ground segment baseline definition.

B.2.2 Applicability

This DRD is applicable to all projects using the European Space Standards.

B.3 References

B.3.1 Glossary and dictionary

This DRD uses terminology and definitions controlled by:

EN 13701, *Space systems — Glossary of terms*.

EN 14737-1, *Space engineering — Ground systems and operations — Part 1: Principles and requirements*.

B.3.2 Source documents

This DRD defines the data requirements of the ground segment baseline definition as controlled by the following source document: EN 14737-1, *Space engineering — Ground systems and operations — Part 1: Principles and requirements*.

B.4 Definitions and abbreviations

For the purposes of this DRD the definitions and abbreviations given in EN 13701 and in EN 14737-1 apply.

The following abbreviated terms are defined and used within this DRD:

Abbreviation Meaning

AOCS	attitude and orbit control system
CRD	customer requirements document
DDF	design definition file
DRD	document requirements definition
EGSE	electrical ground support equipment
GSBD	ground segment baseline definition
GSS	ground segment supplier
MEC	mission exploitation centre
OCS	operation control system
PCC	payload control centre
RF	radio frequency
SSC	space system customer
TT&C	telemetry, tracking and command

B.5 Description and purpose

The GSBD is the top-level design document produced by the ground segment and operations supplier (GSS) to define the support to be provided for the mission. The GSBD forms the basis for all other specification and design activities undertaken by the GSS, as well as constituting the baseline for generating cost and schedule information.

B.6 Application and interrelationship

The GSBD constitutes the formal response to the CRD. All requirements in the CRD shall be traced in the GSBD and appropriately apportioned into specific GSBD clauses (mainly in clause 7 and its sub-clauses). Furthermore, any additional requirements may be derived in the GSBD to ensure common understanding and unambiguous interpretation of the CRD requirements.

B.7 Ground segment baseline definition preliminary elements

B.7.1 Title

The document to be created based on this DRD shall be titled “[insert project name] ground segment baseline definition”.

B.7.2 Title page

The title page for this document shall identify the project document identification number, title of the document, date of release and release authority.

B.7.3 Contents list

The contents list shall identify the title and location of every clause and major sub-clause, figure, table and annex contained in the document.

B.7.4 Foreword

A foreword shall be included in the document which describes the following items:

- a) a statement of significant technical differences between this document and any previous release;
- b) the distribution list for the project document indicating the name of the recipient and his organization;
- c) the identification of which organization(s) have prepared or contributed to the preparation of the document;
- d) information regarding the approval of the document;
- e) an abstract.

B.7.5 Introduction

An introduction shall be included to provide specific information or commentary about the technical content of the GSBD and the reasons prompting its preparations. The introduction shall not trace CRD requirements nor contain requirements.

B.8 Ground segment baseline definition content

B.8.1 Scope and applicability

B.8.1.1 General

This clause shall be numbered 1 and shall contain the following sub-clauses.

B.8.1.2 Scope

This sub-clause shall be numbered 1.1 and shall contain the following statements:

“The [insert project name] ground segment baseline definition constitutes the formal technical response of [insert ground segment supplier name] to the [insert project name] customer requirements document produced by [insert space system customer name]. It is an element of the [insert project name] design definition file (DDF) and is complemented by a management plan that includes work package definitions, planning and costs. When signed, the [insert project name] ground segment