SLOVENSKI STANDARD
SIST EN 16603-70-11:2015

01-april-2015

Vesoljska tehnika - Obratovalnost vesoljskega segmenta

Space engineering - Space segment operability

Raumfahrttechnik - Raumsegment-Bedienbarkeit

Ingénierie spatiale - Opérabilité du segment spatial

Ta slovenski standard je istoveten z: **EN 16603-70-11:2015**

ICS:

49.140	Vesoljski sistemi in operacije	Space systems and operations

SIST EN 16603-70-11:2015 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 16603-70-11

January 2015

ICS 49.140

English version

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Ingénierie spatiale - Opérabilité du segment spatial

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Foreword

This document (EN 16603-70-11:2015) has been prepared by Technical Committee CEN/CLC/TC 5 “Space”, the secretariat of which is held by DIN.

This standard (EN 16603-70-11:2015) originates from ECSS-E-ST-70-11C.

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of an identical text or by endorsement, at the latest by July 2015, and conflicting national standards shall be withdrawn at the latest by July 2015.

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This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

This document has been developed to cover specifically space systems and has therefore precedence over any EN covering the same scope but with a wider domain of applicability (e.g. : aerospace).

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Introduction

The operability of the space segment has an impact on total life cycle cost inasmuch as increased operability can increase development costs, but certainly decreases operations and maintenance costs. Therefore, the adoption of specific operability goals for a given mission is decided by careful balancing of costs, risks, and schedules for both the development and the operations and maintenance phases.

The objective of this standard is to define operability requirements that:

- ensure that the space segment can be operated in a safe and cost-effective manner;
- facilitate the tasks of preparation for, and execution and evaluation of, space segment check-out and mission operations activities;
- facilitate the tasks of space segment suppliers when preparing a proposal in response to a request for proposal (RFP).

1
Scope

This Standard contains provisions for the design of on-board functions for unmanned space segments in order to ensure that the space segment can be operated in-flight in any nominal or predefined contingency situation.

The requirements in this Standard are grouped in two clauses, containing general operability requirements and detailed operability requirements, respectively. The general operability requirements can be applied to all missions, whilst the detailed operability requirements are only applicable if the corresponding on-board function is implemented.

The operability of the space segment to meet mission-specific requirements is outside the scope of this standard.

To support the users of this Standard in tailoring the requirements to the needs of their particular mission, Annex B contains a table that indicates, for each requirement, the potential impact of its omission.

This standard may be tailored for the specific characteristics and constraints of a space project, in conformance with ECSS-S-ST-00.

2
Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this ECSS Standard. For dated references, subsequent amendments to, or revisions of any of these publications, do not apply. However, parties to agreements based on this ECSS Standard 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 publication referred to applies.

EN reference	Reference in text	Title
EN 16601-00-01	ECSS-S-ST-00-01	ECSS system – Glossary of terms
EN 16603-50-03	ECSS-E-ST-50-03	Space engineering – Space data links – Telemetry transfer frame protocol
EN 16603-50-04	ECSS-E-ST-50-04	Space engineering – Space data links – Telecommand protocols, synchronization and channel coding
EN 16603-70-41	ECSS-E-ST-70-41	Space engineering – Telemetry and telecommand packet utilization

3
Terms, definitions and abbreviated terms

3.1 Terms from other standards

For the purpose of this Standard, the terms and definitions from ECSS-S-ST-00-01 apply.

3.2 Terms specific to the present standard

3.2.1 Categories of operability

3.2.1.1 commandability

provision of adequate control functions to configure the on-board systems for the execution of nominal mission operations, failure detection, identification, isolation, diagnosis and recovery, and maintenance operations

3.2.1.2 compatibility

ability of two or more systems or components to perform their specified functions without interference

3.2.1.3 deactivation

capability to undertake planned operations to terminate the mission at the end of its useful lifetime

NOTE Terminate can mean to deactivate the spacecraft, to de-orbit it, or both.

3.2.1.4 flexibility

capability to configure and make optimum use of existing on-board functions, the capacity of the space-Earth communications links, and any redundancy built into the design in order to meet the reliability targets

3.2.1.5 observability

availability to the ground segment and to on-board functions of information on the status, configuration and performance of the space segment

3.2.1.6 testability

capability to test the on-board functions of the space segment including those that are “off-line”

NOTE “Off-line” means functions that do not form part of the current operational configuration.

3.2.2 Terms pertaining to critical functions

3.2.2.1 commandable vital function

vital function that is commandable by high-priority commands without the involvement of on-board software

3.2.2.2 high priority command

pulse command that is routed directly to hardware by means of an on-board command pulse distribution unit (CPDU)

3.2.2.3 high priority telemetry

telemetry that enables a reliable determination of the current status of vital on-board equipment and which is available under all circumstances

NOTE High priority telemetry can be managed by a mechanism that is independent of the one used for standard housekeeping telemetry and normally without any microprocessor involvement.

3.2.2.4 locally-critical function

function that, when executed in the wrong context (e.g. at the wrong time), can cause temporary or permanent degradation of the associated local functions, but does not compromise higher level functionality

3.2.2.5 mission-critical function

function that, when executed in the wrong context (e.g. at the wrong time), or wrongly executed, can cause permanent mission degradation

3.2.2.6 permanent degradation of space segment function

situation where a given on-board function cannot be achieved either on the nominal or on any redundant chain for the remainder of the mission lifetime

3.2.2.7 permanent mission degradation

situation where space segment functions or performances affecting mission product generation or primary mission objectives cannot be achieved either on the nominal or on any redundant chain for the remainder of the mission lifetime

3.2.2.8 temporary degradation of space segment function

situation where a given on-board function cannot be achieved either on the nominal or on any redundant chain for a limited period of time

3.2.2.9 temporary mission degradation

situation where space segment functions or performance affecting mission product generation or primary mission objectives cannot be achieved either on the nominal or on any redundant chain for a limited period of time

NOTE For example, a mission outage following transition to survival mode.

3.2.2.10 vital function

function that is essential to mission success and that can cause permanent mission degradation if not executed when it should be, or wrongly executed, or executed in the wrong context

3.2.2.11 vital telecommand

telecommand that activates a commandable vital function

3.2.3 Other terms

3.2.3.1 application process

on-board entity capable of generating telemetry source data and receiving telecommand data

3.2.3.2 authorization

right of an authenticated entity to perform a function or access a data item or data stream

3.2.3.3 chain

set of hardware or software units that operate together to achieve a given function

NOTE For example, an attitude and orbit control subsystem (AOCS) processor and its software and a set of AOCS sensors and actuators together constitute an AOCS chain.

3.2.3.4 confidentiality

property that information is not made available or disclosed to unauthorized individuals, entities or processes

3.2.3.5 control function

mechanism to maintain a parameter or a set of parameters within specified limits

NOTE A control function normally consists of a set of measurements and responses (commands) related according to a function, algorithm, or set of rules.

3.2.3.6 data integrity

property that the data has not been altered or destroyed in an unauthorized manner

3.2.3.7 data origin authentication

corroboration that the source of the data received is as claimed

3.2.3.8 datation

attachment of time information to telemetry data

NOTE This includes payload measurement data.

3.2.3.9 device telecommand

telecommand that is routed to and executed by on-board hardware

NOTE For example, a relay switching telecommand, a telecommand to load an on-board register.

3.2.3.10 housekeeping telemetry

telemetry provided for the purposes of monitoring the health and functioning of the space segment

3.2.3.11 loss of mission

state where the ground segment can no longer control the space segment (e.g. due to loss of contact), or where the space segment can no longer achieve the mission goals (e.g. due to anomalies)

3.2.3.12 memory

on-board data storage area

NOTE 1 This includes main memory and storage memory.

NOTE 2 Examples of memory are disk, tape, and bubble-memory.

3.2.3.13 mode

operational state of a spacecraft, subsystem or payload in which certain functions can be performed

3.2.3.14 mode transition

transition between two operational modes

3.2.3.15 on-board autonomy

capability of the space segment to manage nominal or contingency operations without ground segment intervention for a given period of time

3.2.3.16 on-board monitoring

on-board application of checking functions to a set of on-board parameters in conformance with predefined criteria

NOTE Monitoring functions include limit-checking, expected-value-checking and delta-checking.

3.2.3.17 on-board operations procedure

monitoring and control procedure that is stored on-board and whose activation is under ground segment control

3.2.3.18 on-board operations schedule

on-board facility for storing and releasing telecommands that were loaded in advance from the ground

NOTE In its simplest form, the on-board operations schedule stores time-tagged telecommands loaded from the ground and releases them to the destination application process when their on-board time is reached.

3.2.3.19 operability

capability of the space segment to be operated by the ground segment during the complete mission lifetime, whilst optimizing the use of resources and maximizing the quality, quantity, and availability (or timeliness of delivery) of mission products, without compromising space segment safety

3.2.3.20 operations

activities undertaken by the ground and space segments in order to ensure the timely provision of mission products or services, recover from on-board contingencies, carry out routine maintenance activities and manage on-board resources in order to maximize the provision of mission products or services and the mission lifetime

3.2.3.21 parameter

lowest level of elementary data item on-board

3.2.3.22 parameter validity

condition that defines whether the interpretation of a telemetry parameter is reliable and meaningful

NOTE The angular output of a gyro only has a valid engineering meaning if the power to the gyro is "on", while at other times the output is random. Such a parameter is deemed conditionally valid, with its validity determined from the power status.

3.2.3.23 peer-entity authentication

corroboration that a peer entity in an association is the one claimed

3.2.3.24 safe state

safe condition for a system, subsystem or payload

3.2.3.25 space segment status

information from which the operational status of the space segment is assessed and the criteria driving operational decisions are determined

3.2.3.26 survival mode

configuration of a spacecraft in which it can remain safely without ground segment intervention for a specified period

3.2.3.27 telecommand function

operationally self-contained control action initiated by telecommand that can comprise or invoke one or more lower level control actions