



SLOVENSKI STANDARD
SIST-TP CEN/CLC/TR 17603-10-02:2021
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Vesoljska tehnika - Smernice za preverjanje

Space engineering - Verification guidelines

Raumfahrttechnik - Leitfaden zur Verifikation

Ingénierie spatiale - Lignes directrices pour la vérification

Ta slovenski standard je istoveten z: CEN/CLC/TR 17603-10-02:2021

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CEN-CENELEC Management Centre:
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European Foreword

This document (CEN/CLC/TR 17603-10-02:2021) has been prepared by Technical Committee CEN/CLC/JTC 5 "Space", the secretariat of which is held by DIN.

It is highlighted that this technical report does not contain any requirement but only collection of data or descriptions and guidelines about how to organize and perform the work in support of EN 16603-10-02.

This Technical report CEN/CLC/(TR 17603-10-02:2021) originates from ECSS-E-HB-10-02A.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

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 TR covering the same scope but with a wider domain of applicability (e.g.: aerospace).

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1 Scope

This handbook provides additional information for the application of the verification standard EN 16603-10-02 to a space system product.

This handbook does not contain requirements and therefore cannot be made applicable. In case of conflict between the standard and this handbook, the standard prevails.

This handbook is relevant for both the customer and the supplier of the product during all project phases.

To facilitate the cross-reference, this handbook follows as much as is practical, the structure of the standard and quotes the requirements, to make it self standing and easier to read (*the text from the standard is in italic*).

As the Standard applies to different products at different product levels from single equipment to the overall system (including space segment hardware and software, launchers and Transportation Systems, ground segment, Verification tools, and GSE) several examples of tailoring, to match the specificity of each application, are proposed in Annex B.

Specific discipline related verification aspects are covered in other dedicated standards and handbooks. In particular the detailed aspects for Testing are covered in the EN 16603-10-03 and in its corresponding handbook TR 17603-10-03.

The application of the requirements of the standard to a particular project is intended to result in effective product verification and consequently to a high confidence in achieving successful product operations for the intended use, in this respect this handbook has the goal to help reaching these objectives.

2 References

This document is the handbook corresponding to the Verification standard ECSS-E-ST-10-02C.

The following documents are referenced in this text or provide additional information useful for the reader.

EN Reference	Reference in text	Title
EN 16601-00-01	ECSS-S-ST-00-01	ECSS system - Glossary of terms
EN 16603-10	ECSS-E-ST-10	Space engineering - System engineering general requirements
EN 16603-10-02	ECSS-E-ST-10-02	Space engineering - Verification
EN 16603-10-03	ECSS-E-ST-10-03	Space engineering - Testing
EN 16603-40	ECSS-E-ST-40	Space engineering - Software
EN 16603-50	ECSS-E-ST-50	Space engineering - Communications
EN 16603-70	ECSS-E-ST-70	Space engineering - Ground systems and operations
TR 16703-10-03	ECSS-E-HB-10-03	Space engineering - Testing guidelines
-	ECSS-E-TM-10-21	Space engineering - System modelling and simulation
EN 16601-10	ECSS-M-ST-10	Space project management - Project planning and implementation.
EN 16602-10-09	ECSS-Q-ST-10-09	Space product assurance - Nonconformance control system.
EN 16602-20	ECSS-Q-ST-20	Space product assurance - Quality assurance.
EN 16602-20-07	ECSS-Q-20-07	Space product assurance - Quality assurance for test centres.
EN 16602-40	ECSS-Q-ST-40	Space product assurance - Safety.
EN 16602-60	ECSS-Q-ST-60	Space product assurance - Electrical, electronic and electromechanical (EEE) components.
EN 16602-70	ECSS-Q-ST-70	Space product assurance - Materials, mechanical parts and processes.

Terms, definitions and abbreviated terms

3.1 Terms from other documents

For the purpose of this document, the terms and definitions from ECSS-ST-00-01 apply, in particular for the following terms:

validation

verification

3.2 Terms specific to the present handbook

3.2.1 acceptance stage

verification stage with the objective of demonstrating that the product is free of workmanship defects, is in accordance with the qualified design and is ready for its intended use

3.2.2 analysis

verification method performing a theoretical or empirical evaluation using techniques agreed with the customer

NOTE The selected techniques can typically include statistics, qualitative design analysis, modelling and computer simulation.

3.2.3 commissioning

verification and validation activities conducted after the launch and before the entry in operational service either on the space elements only or on the overall system (including the ground elements)

3.2.4 in-orbit stage

verification stage valid for projects for which in-orbit verification is performed, including the commissioning and verification activities which are delayed because the activation of a space element is performed later during the mission (e.g. for Interplanetary mission, lander).

3.2.5 inspection

verification method by visual determination of physical characteristics

NOTE 1 Product characteristics include constructional features, hardware conformance to document drawing or workmanship requirements, physical conditions, software source code conformance with coding standards

NOTE 2 See also ECSS-ST-00-01.

3.2.6 model philosophy

definition of the optimum number and the characteristics of physical models required to achieve confidence in the product verification with the shortest planning and a suitable weighing of costs and risks

3.2.7 post-landing stage

verification stage valid for projects for which post-landing verification is performed (e.g. for Multimission projects)

3.2.8 pre-launch stage

verification stage with the objective to verify that the flight article is properly configured for launch and capable of functioning as planned for launch

3.2.9 qualification stage

verification stage with the objective to demonstrate that the design fulfils the applicable requirements including proper margins

3.2.10 review-of-design

verification method using approved records or evidence that unambiguously show that the requirement is met (e.g. using design documents, design reports, technical descriptions, engineering drawings)

3.2.11 test

verification method by measurement of product performance and functions under representative simulated environments

NOTE See also ECSS-ST-00-01.
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3.2.12 Verification Control Board (VCB)

a board composed of customer and supplier representatives that monitors the verification process and formally assesses the requirements verification close-out.

3.2.13 verification level

product architectural level at which the relevant verification is performed

3.3 Abbreviated terms

The following abbreviated terms are used within this document:

Abbreviation	Meaning
AIT	assembly, integration and test
AITP	assembly, integration and test plan
AIV	assembly, integration and verification
AIVP	assembly, integration and verification plan
AOCS	attitude and orbit control system

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Abbreviation	Meaning
AR	acceptance review
ARPT	analysis report
BB	Breadboard
CDR	critical design review
CRR	commissioning result review
CP	commissioning plan
DM	development model
DRD	document requirements definition
ECSS	European Cooperation for Space Standardization
EEE	electronic electrical and electromechanical
EIDP	end item data package
ELR	End of Life Review
EM	engineering model
EMC	electromagnetic compatibility
EOL	end-of-life
EQM	engineering qualification model
FM	flight model
FMECA	failure mode effects and criticality analysis
FRR	flight readiness review
FS	flight spare
GPS	global positioning system
GSE	ground support equipment
H/W	Hardware
HFE	human factors engineering
I/F	Interface
IM	integration model
IRPT	inspection report
ISO	International Organisation for Standardisation
LRR	launch readiness review
LTM	Life Test Model
MU	mock-up
NCR	Non conformance report
NRB	Non conformance review board
OBDH	on-board data handling

Abbreviation	Meaning
ORR	Operations Readiness Review
P/L	Payload
PDR	preliminary design review
PFM	protoflight model
PRR	preliminary requirement review
PTR	post test review
QA	quality assurance
QM	qualification model
QR	qualification review
RCS	reaction control system
RF	radio frequency
RFW	request for waiver
ROD	review of design
RRPT	review of design report
S/C	spacecraft
S/W	software
SM	structural model
SRR	system requirements review
SS	subsystem
STM	structural-thermal model
SVF	software validation facility
TCL	test configuration list
ThM	thermal model
TPRO	Test Procedure
TRR	test readiness review
TRPT	test report
TSPE	Test Specification
TT&C	telemetry, tracking and command
VCB	verification control board
VCD	verification control document
VP	verification plan
VRPT	verification report

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Verification principles

4.1 Introduction

ECSS-E-ST-10 states that verification demonstrates, through a dedicated process, that the deliverable system meets the specified requirements and is capable of sustaining its operational role during the project life cycle.

ECSS-E-ST-10-02 establishes the requirements for the verification of a space system product. It specifies the fundamental concepts of the verification process, the criteria for defining the verification strategy and the requirements for the implementation of the verification programme. It is intended to apply to different products at different levels, from single equipment to the overall system (including space segment hardware and software, ground segment, launchers and transportation systems, Verification tools and GSE).

Concerning the scope of the standard, it is useful to address at this point some frequently asked questions posed by users, in order to emphasize certain concepts and definitions imposed by higher level standards and by the accepted European practices enshrined within the standard.

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4.2 Verification versus Validation

A question often posed is why, within European space projects, we mandate a “verification” programme as opposed to a “verification and validation” programme, as practiced in other engineering disciplines (e.g. software, ground segment).

In general terms verification addresses whether a product satisfies the requirements placed upon it, whilst validation addresses whether a product will satisfy the needs of its users, or as is often more simply said,

Verification proves the product is right.

Validation proves it is the right product.

The Verification Standard does not mandate the need for a separate programme of validation of space products, since product verification is performed against a set of requirements that also address the suitability of the product to fulfil the needs of its intended use. However, the standard does not prevent the execution of a separate validation activity if this is considered appropriate, as is practiced for example, in the operation or ground segment domains. Essentially the process to be followed is the same, although it addresses mainly the use of the product.

4.3 Applicability to all engineering domains

The verification standard is applicable to all engineering domains where space products are developed and as such it is viewed as an “umbrella” under which all domains are covered.

In order to use the standard in a specific engineering domain it is necessary to tailor the standard for that domain and where necessary, to make applicable the standards that define the verification requirements of that domain. A clear example is the verification of the ground segment and operations, whereby its verification is addressed specifically in ECSS-E-ST-70 (Ground systems and operations), by mandating specific verification (and validation) requirements and processes for the ground segment. The fact that ECSS-E-ST-10-02C addresses in detail the space segment does not preclude the use of the standard in other domains, subject to correct tailoring.

4.4 Development

The ECSS glossary defines development as the process by which the capability to adequately implement a technology or design is established before manufacture and that this process can include the building of various partial or complete models of the products in order to assess amongst other things, their performance.

Whilst it is obvious that testing and analysis activities occur during the product development process, they are not addressed by the standard because they are not formal requirement verification activities in the sense of the customer-supplier relationship and consequently do not fall within the mandate of ECSS verification standard.

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