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Vesoljska tehnika - Sistemskotehnične splošne zahteve

Space engineering - System engineering general requirements

Raumfahrttechnik - Grundsätze und Verfahrensweise

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English version

Space engineering - System engineering general requirements

Raumfahrttechnik - Grundsätze und Verfahrensweise

This draft European Standard is submitted to CEN members for unique acceptance procedure. It has been drawn up by the Technical Committee CEN/CLC/TC 5.

If this draft becomes a European Standard, CEN and CENELEC 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.

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Table of contents

Forew	ord		5
1 Sco	pe		6
2 Norr	native r	references	7
3 Tern	ns, defi	nitions and abbreviated terms	8
3.1	Terms	from other standards	8
3.2	Terms	specific to the present standard	8
3.3	Abbrev	viated terms	9
4 Ove	rview o	f system engineering	12
4.1	The sy	stem engineering discipline	12
4.2		stem engineering process	
4.3	Overvi	ew of system engineering tasks per project phase	17
	4.3.1	Overview	17
	4.3.2	General	
	4.3.3	Phase 0 Overview: Mission analysis-need identification	17
	4.3.4	Phase A Overview: Feasibility	sist-en-166018 ¹⁰ -
	4.3.5	Phase B Overview: Preliminary definition	18
	4.3.6	Phase C Overview: Detailed definition	18
	4.3.7	Phase D Overview : Qualification and production	19
	4.3.8	Phase E Overview: Operations / utilization	19
	4.3.9	Phase F Overview: Disposal	19
5 Gen	eral req	quirements	20
5.1	Systen	n engineering plan	20
5.2	Requir	rement engineering	21
	5.2.1	General	21
	5.2.2	Requirement traceability	21
	5.2.3	Requirement engineering process	22
5.3	Analysis		24
	5.3.1	System analysis	24
	5.3.2	System environments and design and test factors	25

	5.3.3	Trade-off analyses	25
	5.3.4	Analysis methods, tools and models	26
5.4	Design	and configuration	27
	5.4.1	Design	27
	5.4.2	Configuration	28
5.5	Verifica	ation	29
	5.5.1	General	29
	5.5.2	Product verification	29
5.6	Systen	n engineering integration and control	30
	5.6.1	Management of system engineering activities	30
	5.6.2	Planning	30
	5.6.3	Engineering data	30
	5.6.4	Interface control	31
	5.6.5	Coordinate systems and units	31
	5.6.6	Technical budgets and margin policy	31
	5.6.7	Technology	31
	5.6.8	Risk management	32
	5.6.9	Changes and nonconformances control	
6 Ovei	rview o	f system engineering tasks per project phase	33
6.1		f system engineering tasks per project phase	
	Overvi		33
6.1	Overvi Genera	ew Document Preview	33
6.1 6.2	Overvi Genera Phase	ew Document Preview	33 33 33 t-en-16003-
6.1 6.2 6.3 andards	Overvi Genera Phase Phase	ewal	33 33 33 t-en-16003-
6.1 6.2 6.3 and ards 6.4	Overvior General Phase Phase Phase	ew	33 33 t-en-1000 - 33
6.1 6.2 6.3 6.4 6.5	Overvious General Phase Phase Phase Phase	ew	33 33 t-en-10005 33 33
6.1 6.2 6.3 and ards 6.4 6.5 6.6	Overvious General Phase Phase Phase Phase Phase	ew	33 33 33 t-en-1600 33 34 34
6.1 6.2 6.3 6.4 6.5 6.6 6.7	Overvious General Phase	ew	33333333
6.1 6.2 6.3 6.4 6.5 6.6 6.7 6.8 6.9	Overvious General Phase	ew	33333333
6.1 6.2 6.3 and ards 6.4 6.5 6.6 6.7 6.8 6.9	Overvious General Phase	ew	333333333334343434
6.1 6.2 6.3 and and a 6.4 6.5 6.6 6.7 6.8 6.9 7 Pre-4	Overvious General Phase Phase Phase Phase Phase Phase Phase A (info	ew	33333333343434343434
6.1 6.2 6.3 and and a 6.4 6.5 6.6 6.7 6.8 6.9 7 Pre-f	Overvious General Phase	ew	33333333
6.1 6.2 6.3 and and a 6.4 6.5 6.6 6.7 6.8 6.9 7 Pre-f Annex Annex	Overvious General Phase Phase Phase Phase Phase Phase A (information of C (normatical contents)	ew	333333333434343435 view4953

Annex F (normative) Technology matrix - DRD	71
Annex G (normative) Design definition file (DDF) - DRD	73
Annex H (normative) Function tree - DRD	78
Annex I (normative) Technical budget - DRD	80
Annex J (normative) Specification tree - DRD	82
Annex K (normative) Design justification file (DJF) - DRD	84
Annex L (normative) Trade-off report - DRD	91
Annex M (normative) < <deleted>></deleted>	94
Annex N (normative) Requirements traceability matrix (RTM) - DRD	95
Annex O (normative) Requirements justification file (RJF) - DRD	97
Annex P (normative) Product user manual (PUM or UM) - DRD	100
Annex Q (informative) Guideline content of Analysis Report	108
Annex R (informative) Mapping of typical DDP to ECSS documents	110
Bibliography(https://standards.iteh.ai)	112
Figures	
Figure 4-1: System engineering, sub-functions and boundaries	
Figure 4-2: System engineering sub-functions inter-relationships	en-16603 15
Figure B-1 : Relationship between documents	54
Figure E-1 : TRSL template	70
Tables	
Table A-1 : System engineering deliverable documents	50

Foreword

This document (FprEN 16603-10:2016) has been prepared by Technical Committee CEN/CLC/TC 5 "Space", the secretariat of which is held by DIN (Germany).

This document (FprEN 16603-10:2016) originates from ECSS-E-ST-10C Rev.1 DIR1.

This document is currently submitted to the UAP.

This document will supersede EN 13292:1999, EN 14514:2004 and EN 14607-7:2004.

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

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1 Scope

This standard specifies the system engineering implementation requirements for space systems and space products development.

Specific objectives of this standard are:

- to implement the system engineering requirements to establish a firm technical basis and to minimize technical risk and cost for space systems and space products development;
- to specify the essential system engineering tasks, their objectives and outputs;
- to implement integration and control of engineering disciplines and lower level system engineering work;
- to implement the "customer-system-supplier model" through the development of systems and products for space applications.

Generally, System Engineering is a discipline that can find beneficial application to the development and production of a wide variety of systems and throughout the product decomposition hierarchy. However the requirements in this Standard were developed to be appropriate for application as they are to complex space systems and products only; for lower level elements tailoring is necessary. The pre-tailoring table in Section 7 contains the applicability of the requirements of this document and its annexes according to product type. Specific requirements related to system engineering, like technical specification, verification, and testing are specified in dedicated documents and standards within the set of ECSS system engineering standards ECSS-E-ST-10-XX.

Discipline or element specific engineering implementation requirements are covered in dedicated ECSS standards. These standards are based on the same principles, process and documentation model. The applicability of each these standards can therefore not be considered in isolation from the others.

NOTE 1 The term "Discipline" is defined in ECSS-M-ST-10, as "a specific area of expertise within a general subject". The name of the discipline normally indicates the type of expertise, e.g. in the ECSS system mechanical engineering, software and communications are disciplines within the engineering domain.

NOTE 2 The requirements on the system engineering process are gathered in this standard; specific aspects of the SE process are further elaborated in dedicated standards.

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

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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 revision 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 more 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 16603-11	ECSS-E-AS-11	Adoption Notice of ISO 16290, Space systems - Definition of the Technology Readiness Levels (TRLs) and their criteria of assessment
EN 16603-10-02	ECSS-E-ST-10-02	Space engineering – Verification
EN 16603-10-06	ECSS-E-ST-10-06	Space engineering – Technical requirements specification
EN 16603-10-09	ECSS-E-ST-10-09	Space engineering – Reference coordinate system
EN 16603-10-24	ECSS-E-ST-10-24	Space engineering – Interface control
EN 16601-10	ECSS-M-ST-10	Space project management – Project planning and implementation
EN 16601-40	ECSS-M-ST-40	Space project management – Configuration and information management
EN 16602-20-10	ECSS-Q-ST-20-10	Off-the-shelf items utilization in space systems

3

Terms, definitions and abbreviated terms

3.1 Terms from other standards

- a. For the purpose of this Standard, the terms and definitions from ECSS-S-ST-00-01 apply, in particular for the following terms:
 - 1. acceptance
 - 2. approval
 - 3. configuration baseline
 - 4. critical
 - 5. development
 - 6. equipment
 - htz.psinspection ndards.iteh.ai)
 - 8. integration Previous
 - 9. product tree
 - 10. requirement 16603-10:2018
 - 11. specification
 - 12. subsystem
 - 13. system
 - 14. test
 - 15. verification
- b. For the purpose of this Standard, the terms and definitions from ECSS-E-AS-11C apply, in particular for the following terms:
 - 1. technology readiness level

3.2 Terms specific to the present standard

3.2.1 requirement traceability

requirement attribute that links each single requirement to its higher level requirements inside the requirement set

Note 1 to entry: This enables the derivation of a requirement tree, which demonstrates the coherent flow-down of the requirements.

3.2.2 recurring product

product which conforms to a qualified design and is produced according to the corresponding production master file

3.2.3 system engineering

interdisciplinary approach governing the total technical effort required to transform a requirement into a system solution

Note 1 to entry: From IEEE P1220.

3.2.4 verification matrix

initial issue of the VCD which contains for each requirement to be verified the methods, levels and stages of product verification

Note 1 to entry: See ECSS-E-ST-10-02 for a more detailed definition of the VCD.

3.3 Abbreviated terms Standard

For the purpose of this Standard, the abbreviated terms from ECSS-S-ST-00-01 and the following apply:

Abbreviation			
AIT SI	assembly, integration and test		
AIV plan sist	assembly, integration and verification plan 9/sist-en-16603		
AOCS	attitude and orbit control sub-system		
AR	acceptance review		
CDR	critical design review		
COTS	commercial off-the-shelf		
CRR	commissioning results review		
	NOTE For space vehicles (e.g. launcher, transfer vehicle, crew transport vehicle) the CRR can be replaced or complemented by a flight qualification review (FQR).		
DDF	design definition file		
DDP	design development plan		
DJF	design justification file		
DRD	document requirements definition		
ECSS	European Cooperation for Space Standardization		
ELR	end-of-life review		

FDIR failure, detection, isolation, recovery

FM flight model

FMECA failure modes, effects, and criticality analysis

FRR flight readiness review

FTA fault tree analysis

GSE ground support equipment
ICD interface control document
ILS integrated logistic support

IRD interface requirement document

LRR launch readiness review

MCR mission closed-out review

MDD mission description document

MDR mission definition review
MOP mission operations plan

MS mission statement

ORR operational readiness review
PDR preliminary design review

PMP project management plan

PRR preliminary requirement review

PUM product user manual

OR qualification review

RAMS reliability, availability, maintainability, safety

RF radio frequency

RJF requirement justification file

ROD review of design

ROM/RAM read only memory / random access memory

RTM requirement traceability matrix

R&D research and development

SE system engineering

SEP system engineering plan
SFT system functional test

SRR system requirement review

SVT system validation test

TP technology plan

TRL technology readiness level

TS technical requirements specification

UM user manual

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VCD verification control document

VP verification plan
w.r.t. with respect to

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4

Overview of system engineering

4.1 The system engineering discipline

System engineering is defined as an interdisciplinary approach governing the total technical effort to transform requirements into a system solution.

A system is defined as an integrated set of elements to accomplish a defined objective. These elements include hardware, software, firmware, human resources, information, techniques, facilities services, and other support elements.

In this standard the concept of "system" is used in a wide sense. The highest level, often called "mission level" or "space system", consists usually of one (or more) space segment(s), of a ground segment, and of a user segment. Elements of system decomposition are also considered a system. For the purpose of this standard the system can be any element at any level of decomposition as defined by the function tree (see Annex H) or the product tree (see ECSS-M-ST-10 Annex B). The scope of an element can include hardware, software, procedures, man-in-the-loop, facilities and services.

From the perspective of the considered system, requirements originate from the next upper level (the customer) and elements are procured from the next lower | 0-20 | 8 level (the suppliers).

NOTE 1 The customer-supplier model is described in ECSS-S-ST-00.

NOTE 2 Through this standard the notion of customer refers to several actors ,in relation to the project phase. In fact a customer can be e.g. a scientific community in phase 0, a commercial user in phase A or an Agency in phase B. A supplier can on the other hand be an Agency in both phase 0 and phase A.

Figure 4-1 shows the boundaries of system engineering, its relationship with production, operations, product assurance and management disciplines and its internal partition into the following system engineering sub-functions:

- requirement engineering, which consist on requirement analysis and validation, requirement allocation, and requirement maintenance;
- analysis, which is performed for the purpose of resolving requirements conflicts, decomposing and allocating requirements during functional analysis, assessing system effectiveness (including analysing risk factors);

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