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Space engineering - Technology readiness level (TRL) guidelines

Ingénierie spatiale - Guide d'utilisation des Niveaux de Maturité Technologique (NMT)

Raumfahrttechnik - Richtlinien zum technischen Reifegrad (TRL)

This Technical Report was approved by CEN on 26 March 2021. It has been drawn up by the Technical Committee CEN/CLC/JTC 5.

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CEN-CENELEC Management Centre:
Rue de la Science 23, B-1040 Brussels

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European Foreword

This document (CEN/CLC/TR 17603-11:2021) 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 16603-11.

This Technical report (CEN/CLC/TR 17603-11:2021) originates from ECSS-E-HB-11A.

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).

Introduction

This Handbook supports the application of the TRL, and provides guidelines to its use in projects and its independent verification within each specific project context.

This Handbook provides guidelines for best practice for interpretation of the requirements contained in ECSS-E-AS-11 and for the implementation of the process of technology readiness assessment for technologies applied to a critical function of an element.

The ECSS-E-AS-11 - "Adoption Notice of ISO 16290 Definition of the Technology Readiness Levels (TRLs) and their criteria of assessment" adopts ISO 16290 with a minimum set of modifications, to allow for reference and for a consistent integration in ECSS system of standards.

TRL is a scale for technology maturity assessment and not a method of technology engineering nor development. TRL is used in R&T&D activities and also in project activities.

For project activities, a technology readiness assessment informs the project manager (until the end of B phase) of the risk when adopting a new technology for a critical function of an element of the system. In the C and D phases TRL is no longer used by the project and the maturity of technology is managed in the critical item list.

For other projects the information of the declared technology maturity can be reused and an assessment of the new project use conditions are considered in the assessment.

In this handbook the three main actors and the respective role of each actor are clearly identified. The three discrete actors are: technology developers, projects teams (using the technology) and the TRA participants (i.e. those who perform the technology readiness assessment).

1 Scope

The present handbook is provided to support the implementation of the requirements of ECSS-E-AS-11 to space projects.

With this purpose, this handbook provides guidelines on the way to assess the maturity of a technology of a product in a given environment, to use the TRL assessment outcome in the product development framework, and to introduce some further refinements for specific disciplines or products to which the TRL assessment methodology can be extended.

The concept of Manufacturing Readiness Level (MRL) is not addressed in this document, whilst the concept of TRL can be applied to the technology-related aspects of manufacturing.

2 References

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 16603-10-06	ECSS-E-ST-10-06	Space engineering – Technical requirements specification
EN 16603-10-24	ECSS-E-ST-10-24	Space engineering – Interface management
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 (1 October 2014)
TR 17603-10-02	ECSS-E-HB-10-02	Space engineering – Verification guidelines
EN 16603-40	ECSS-E-ST-40	Space engineering – Software
EN 16603-70	ECSS-E-ST-70	Space engineering – Ground systems and operations
EN 16601-10-10	ECSS-M-ST-10-01	Space project management – Organization and conduct of reviews
EN 16601-60	ECSS-M-ST-60	Space project management – Cost and schedule management
EN 16601-80	ECSS-M-ST-80	Space project management – Risk management
EN 16602-10	ECSS-Q-ST-10	Space product assurance – Product assurance management
EN 16602-10-04	ECSS-Q-ST-10-04	Space product assurance – Critical-item control
EN 16602-20	ECSS-Q-ST-20	Space product assurance – Quality assurance
EN 16602-20-10	ECSS-Q-ST-20-10	Space product assurance – Off-the-shelf items utilization in space systems
EN 16602-30	ECSS-Q-ST-30	Space product assurance – Dependability
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 Reference	Reference in text	Title
EN 16602-60-13	ECSS-Q-ST-60-13	Space product assurance – Commercial electrical, electronic and electromechanical (EEE) components
EN 16602-70	ECSS-Q-ST-70	Space product assurance – Materials, mechanical parts and processes
EN 16602-70-71	ECSS-Q-ST-70-71	Spaced product assurance – Materials, processes and their data selection
EN 16602-80	ECSS-Q-ST-80	Space product assurance – Software product assurance
	ISO 16290:2013	Space systems - Definition of the Technology Readiness Levels (TRLs) and their criteria of assessment
	Mankins 95 reference (M95r)	TECHNOLOGY READINESS LEVELS, A White Paper, April 6, 1995, John C. Mankins Advanced Concepts Office, Office of Space Access and Technology NASA 1 https://www.hq.nasa.gov/office/codeq/trl/trl.pdf