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Space product assurance - Non-destructive testing

Táto norma obsahuje anglickú verziu európskej normy.
This standard includes the English version of the European Standard.

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English version

Space product assurance - Non-destructive testing

Assurance produit des projets spatiaux - Essais non destructifs

Raumfahrtproduktsicherung - Zerstörungsfreie Prüfung

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European Foreword

This document (EN 16602-70-15:2021) has been prepared by Technical Committee CEN-CENELEC/TC 5 “Space”, the secretariat of which is held by DIN.

This standard (EN 16602-70-15:2021) originates from ECSS-Q-ST-70-15C.

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of an identical text or by endorsement, at the latest by March 2022, and conflicting national standards shall be withdrawn at the latest by March 2022.

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 standardization request 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).

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

Introduction

This standard specifies general requirements for flight parts. It also covers specific requirements for flight metallic components, structures and composite parts used for space missions. It does not explicitly cover all the flight parts, components, structures and techniques. Consequently, some techniques as acoustic emission, shearography, IR thermography or specific guided waves techniques are not addressed in detail and are to be agreed per NDT plan, in line with the general requirements of clauses 5 and 9 (and covered by Annexes).

Non-destructive testing (NDT) covers a wide range of processes used in quality control. The generic term NDT covers several sub processes such as Dye Penetrant testing (PT), Radiographic testing (RT), Magnetic particle testing (MT), Ultrasonic testing (UT) and Eddy current testing (ET). The processes are applied at the discretion of the design authority depending on the criticality of the part or component and inherent risk of the manufacturing process to create detrimental discontinuities. It is expected that every component used in spaceflight is subjected to some level of NDT in accordance with the present standard, which complements the ECSS-Q-ST-70-39 “Welding of metallic materials for flight hardware”.

The lack of NDT control throughout the supply chain has been evident in all space projects across the Europe. As no standard was in place at that time this has resulted in inconsistency in the rationale and application for NDT selection. NDT is generally applied for quality control to ensure that components are free of unacceptable discontinuities. NDT is used in cases, in which the damage or destruction of the item under test is not desired. Examples for this are root cause analysis and quality control to ensure that components are free of discontinuities.

For some components the NDT methods used form the basis of the fracture and fatigue verification and thus the assurance of design margins. The level of NDT (testing level) is expected to be decided based on the manufacturing processes applied and the criticality of the part or component and the impact if that part fails in service.

1 Scope

This standard specifies NDT requirements for flight parts, components and structures used for space missions. It covers the NDT methods and stipulates the certification levels for personnel. The qualification of such processes are also specified for non-standard NDT techniques or where complex components are concerned. This standard also identifies the best practice across the large range of international and national standards. When international or national NDT standards are referenced within this document, alternative equivalent standards can be considered acceptable subject to customer approval.

Visual testing included in this standard is not intended to include incoming inspection of, for example, raw materials, damage during transport, storage and handling and parts procurement verification. Furthermore, the visual testing performed in the NDT (discontinuities, surface structure) does not cover the visual testing in the Cleanliness and Contamination standard.

The minimum requirements for NDT documentation are specified in the DRDs of the Annexes.

This standard does not cover the acceptance criteria of components, structures and parts submitted to this examination; it is expected that these criteria are identified on specific program application documentation.

This Standard does not apply to EEE components.

This standard may be tailored for the specific characteristic and constraints 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 16601-40	ECSS-M-ST-40	Space management – Configuration and information management
EN 16602-10	ECSS-Q-ST-10	Space product assurance – Product assurance management
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 16602-70-39	ECSS-Q-ST-70-39	Space product assurance -Welding of metallic materials for flight hardware
EN 16603-32	ECSS-E-ST-32	Space engineering – Structural general requirements
EN 16603-32-01	ECSS-E-ST-32-01	Space engineering – Fracture control
	EN 4179:2017	Aerospace series – Qualification and approval of personnel for non-destructive testing
	EN 12668-1:2010	Non-destructive testing – Characterization and verification of ultrasonic examination equipment – Part 1: Instruments
	EN 12668-2:2010	Non-destructive testing – Characterization and verification of ultrasonic examination equipment – Part 2: Probes
	EN 13068-3:2001	Non-destructive testing – Radioscopic testing – Part 3: general principles or radioscopic testing of metallic materials by x- and gamma rays
	EN 1779:1999/A1:2003	Non-destructive testing – Leak testing – Criteria for method and technique selection
	EN ISO 17637:2016	Non-destructive testing of welds – Visual testing of fusion-welded joints
	EN ISO 3452-1:2013	Non-destructive testing — Penetrant testing — Part 1: General principles

	EN ISO 3452-2:2013	Non-destructive testing – Penetrant testing – Part 2: Testing of penetrant materials
	EN ISO 3452-3:2013	Non-destructive testing – Penetrant testing – Part 3: Reference test blocks
	EN ISO 5579:2013	Non-destructive testing – Radiographic testing of metallic materials using film and X- or gamma rays – Basic rules
	EN ISO 9712:2012	Non-destructive testing – Qualification and certification of NDT personnel
	EN ISO 9934-1:2016	Non-destructive testing – Magnetic particle testing – Part 1: General principles
	EN ISO 9934-2:2015	Non-destructive testing – Magnetic particle testing – Part 2: Detection media
	EN ISO 9934-3:2015	Non-destructive testing – Magnetic particle testing – Part 3: Equipment
	EN ISO 15548-1:2013	Non-destructive testing – Equipment for eddy current examination – Part 1: Instrument characteristics and verification
	EN ISO 15548-2:2013	Non-destructive testing – Equipment for eddy current examination – Part 2: Probe characteristics and verification
	EN ISO 15548-3:2008	Non-destructive testing – Equipment for eddy current examination – Part 3: System characteristics and verification
	EN ISO 15549:2019	Non-destructive testing – Eddy current testing – General principles
	EN ISO 15708-2:2019	Non-destructive testing – Radiation methods for computed tomography – Part 2: Principles, equipment and samples
	EN ISO 15708-4:2019	Non-destructive testing – Radiation methods for computed tomography – Part 4: Qualification
	EN ISO 16810:2014	Non-destructive testing – Ultrasonic testing – General principles
	EN ISO 16811:2014	Non-destructive testing – Ultrasonic testing – Sensitivity and range setting
	EN ISO 17635:2016	Non-destructive testing of welds – General rules for metallic materials
	EN ISO 17636-1:2013	Non-destructive testing of welds – Radiographic testing – Part 1: X- and gamma-ray techniques with film
	EN ISO 17636-2:2013	Non-destructive testing of welds – Radiographic testing – Part 2: X- and gamma-ray techniques with digital detectors
	EN ISO 17640:2018	Non-destructive testing of welds – Ultrasonic testing – Techniques, testing levels and assessment

	ASTM E 127:2019	Standard Practice for Fabrication and Control of Flat Bottomed Hole Ultrasonic Standard Reference Blocks
	ASTM E 164:2019	Standard Practice for Contact Ultrasonic Testing of Weldments
	ASTM E 426:2016	Standard Practice for Electromagnetic (Eddy Current) Examination of Seamless and Welded Tubular Products, Titanium, Austenitic Stainless Steel and Similar Alloys
	ASTM B 594:2019	Standard Practice for Ultrasonic Inspection of Aluminium-Alloy Wrought Products
	ASTM E 1254:2013(2018)	Standard guide for storage of radiographs and unexposed industrial radiographic films
	ASTM E 1417/1417M-11:2016	Standard Practice for Liquid Penetrant Testing
	ASTM E 1444/ E1444M:2016	Standard Practice for Magnetic Particle Testing
	ASTM E 1734:2016	Standard Practice for Radioscopic Examination of Castings
	ASTM E 1742/ E1742M:2018	Standard Practice for Radiographic Examination
	ASTM E 1814:2014	Standard Practice for Computed Tomographic (CT) Examination of Castings
	ASTM E 2375:2016	Standard Practice for Ultrasonic Testing of Wrought Products
	ASTM E 2445/M2445M:2020	Standard Practice for Performance Evaluation and Long-Term Stability of Computed Radiography Systems
	ASTM E 2698:2018-e1	Standard Practice for Radiological Examination Using Digital Detector Arrays
	IR99: 1999	Ionizing Radiation Regulations 1999
	NAS 410:2014	NAS Certification and Qualification of Non Destructive Test Personnel
	SAE-ARP-4402:2013	Eddy Current Inspection of Open Fastener Holes in Aluminium Aircraft Structure
	SAE-AS-4787:2013	Eddy Current Inspection of Circular Holes in Nonferrous Metallic Aircraft Engine Hardware
	SAE-AMS-2154D:202020	Process for Inspection, ultrasonic, wrought metals
	SAE-AMS-2647:2009	Fluorescent Penetrant Inspection Aircraft and Engine Component Maintenance
	SAE-AMS-2644:2006	Inspection material penetrant
	QPL-AMS-2644:2016	Inspection material, penetrant