SLOVENSKI STANDARD
SIST EN 16603-33-11:2019

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Nadomešča:
SIST EN 14607-6:2005

Vesoljska tehnika - Eksplozivni podsistemi in naprave

Space engineering - Explosive subsystems and devices

Raumfahrttechnik - Explosive Subsysteme und Geräte

Ingénierie spatiale - Sous-systèmes et dispositifs explosifs

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ICS:

29.260.20	Električni aparati za eksplozivna ozračja	Electrical apparatus for explosive atmospheres
49.140	Vesoljski sistemi in operacije	Space systems and operations

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English version

Space engineering - Explosive subsystems and devices

Ingénierie spatiale - Sous-systèmes et dispositifs explosifs

Raumfahrttechnik - Explosive Subsysteme und Geräte

This European Standard was approved by CEN on 28 September 2018.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN and CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN and CENELEC members are the national standards bodies and national electrotechnical committees of 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 United Kingdom.

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European Foreword

This document (EN 16603-33-11:2019) has been prepared by Technical Committee CEN-CENELEC/TC 5 “Space”, the secretariat of which is held by DIN.

This standard (EN 16603-33-11:2019) originates from ECSS-E-ST-33-11C Rev.1.

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of an identical text or by endorsement, at the latest by October 2019, and conflicting national standards shall be withdrawn at the latest by October 2019.

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 supersedes EN 14607-6:2004.

Changes to EN 14607-6:2004 that was based on ECSS-E-30 Part 6A (25 April 2000) are:

- Complete edit to conform to the ECSS Drafting Rules for "ECSS Issue C standards"
- Implementation of ECSS Change Requests and harmonization the standard with ISO in ECSS Revision 1 (2017)

- Change of the title from "Space engineering - Mechanical - Part 6: Pryotechnics" to "Space engineering – Explosive subsystems and devices"
- Use of the more accurate term "explosive" rather than "pyrotechnics" in relation to the subject components and systems
- Emphasis on reliability coupled with confidence level for performance properties
- Inclusion of detailed requirements for the different types of explosive device
- Emphasis on the requirement for properties of components to be agreed with the end user before commitment to purchase.

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

As any explosive item used for flight can function only once, it can never be fully tested before its crucial mission operation. The required confidence can only be established indirectly by the testing of identical items. Test results and theoretical justification are essential for demonstration of fulfilment of the requirements. The requirement for repeatability shows that product assurance plays a crucial role in support of technical aspects.

The need for statistics requires that the explosive components used in the explosive subsystem be tested and characterized extensively. The variability in components requires that manufacturers prove to customers that delivered items are identical to those qualified.

The failure or unintentional operation of an explosive item can be catastrophic for the whole mission and life threatening. Specific requirements can exist for the items associated with it. As all explosives where ever used are treated similarly, the same requirements, regulations, practices and standards need to be applied to help avoiding human error.

1
Scope

This Standard defines the requirements for the use of explosives on all spacecraft and other space products including launch vehicles. It addresses the aspects of design, analysis, verification, manufacturing, operations and safety.

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 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 16603-10-02	ECSS-E-ST-10-02	Space engineering - Verification
EN 16603-10-03	ECSS-E-ST-10-03	Space engineering - Testing
EN 16603-20	ECSS-E-ST-20	Space engineering - Electrical and electronic
EN 16603-20-07	ECSS-E-ST-20-07	Space engineering - Electromagnetic compatibility
EN 16603-32-10	ECSS-E-ST-32-10	Space engineering - Reliability based mechanical factors of safety
EN 16603-33-01	ECSS-E-ST-33-01	Space engineering - Mechanisms
EN 16602-20	ECSS-Q-ST-20	Space product assurance - Quality assurance
EN 16602-30	ECSS-Q-ST-30	Space product assurance - Dependability
EN 16602-40	ECSS-Q-ST-40	Space product assurance - Safety
EN 16602-70-01	ECSS-Q-ST-70-01	Space product assurance - Contamination and cleanliness control
EN 16601-40	ECSS-M-ST-40	Space management - Configuration and information management
	ST/SG/AC.10/1 latest version (UNECE publication)	Recommendations on the Transport of Dangerous Goods – Model Regulations
	Commission Directive 2012/4/EU (22 February 2012)	Commission Directive 2012/4/EU of 22 February 2012 amending Directive 2008/43/EC setting up, pursuant to Council Directive 93/15/EEC, a system for the identification and traceability of explosives for civil uses

	Commission Directive 2008/43/EC (4 April 2008)	Commission Directive 2008/43/EC of 4 April 2008 setting up, pursuant to Council Directive 93/15/EEC, a system for the identification and traceability of explosives for civil uses
	Council Directive 93/15/EEC (5 April 1993)	Council Directive 93/15/EEC of 5 April 1993 on the harmonization of the provisions relating to the placing on the market and supervision of explosives for civil uses
	Dictionary of explosive related terms, 7th Edition, 2016	Groupe de Travail de Pyrotechnie, Dictionnaire de pyrotechnie

NOTE For launcher subsystems and Transfer Vehicle programmes, the specific General Specification (SG) or Design Rules (DR) documents are applicable for designing, dimensioning and testing.

3
Terms, definitions and abbreviated terms

3.1 Terms defined in 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. lifetime

3.2 Terms specific to the present standard

3.2.1 all fire

stimulus with a probability of functioning equal to or better than 0,999 at 95 % confidence level

3.2.2 arm plug receptacle

connector mounted on the skin of a spacecraft that can be connected to a Safe or Test or Arm plug

3.2.3 armed

status of an explosive subsystem when all the safety devices have been disabled and which can be triggered

[Adapted from Dictionary of explosive related terms]

3.2.4 cartridge

explosive device designed to produce pressure for performing a mechanical function

NOTE A cartridge is called an initiator if it is the first or only explosive element in an **explosive train** (see definition 3.2.14).

3.2.5 charge

explosive loaded in a cartridge, detonator, or separate container for use in an explosive device

3.2.6 component

smallest functional item in an explosive subsystem

3.2.7 deflagration

self-sustaining, exothermic decomposition reaction of an explosive substance, whose apparent velocity is less than the velocity of sound in the substance and greater than the speed of sound in air

NOTE It is generally accepted that the energy transmission takes place via a mechanical compression wave. This type of reaction is intermediary between combustion and detonation. It differs from combustion through the presence of a significant compression wave in the surrounding environment.

[Dictionary of explosive related terms]

3.2.8 detonation

exothermic decomposition reaction of an explosive substance self-sustained by a shock wave, whose velocity of propagation is greater than the velocity of sound in the substance

NOTE The velocity of propagation is of the order of several thousands of m/s.

[Dictionary of explosive related terms]

3.2.9 detonator

initiator whose function is to transform external energy directly into a shock wave strong enough to detonate a secondary high explosive

NOTE External energy can be, for example, mechanical, electrical and thermal.

[Dictionary of explosive related terms]

3.2.10 electro-explosive device

device containing some reaction mixture that is electrically initiated

NOTE 1 The output of the initiation is heat, shock or mechanical action.

NOTE 2 The reaction mixture can be explosive or pyrotechnic.

[Dictionary of explosive related terms]

3.2.11 end-user

person who or organization that actually uses a product

NOTE 1 The end-user need not to be the owner or buyer.

NOTE 2 In the context of this standard the end user is generally the first level customer.

3.2.12 energetic material

material consisting of, or containing, an explosive, oxidizer, fuel, or combination of them, that can undergo, contribute to, or cause rapid exothermic decomposition, combustion, deflagration, or detonation

3.2.13 explosively actuated device

device that converts the products of explosion into useful mechanical work

NOTE 1 The explosion can be combustion, deflagration or detonation.

NOTE 2 Pyromechanisms and linear detonating separation devices are explosively actuated devices.

3.2.14 explosive train

series of explosive components including the initiator, explosive transfer assembly and explosively actuated device

3.2.15 explosive component

discrete item containing an explosive substance

3.2.16 explosive function

function that uses energy released from explosive substances for its operation

3.2.17 explosive subsystem

collection of all the explosive trains on the spacecraft or launcher system, and the interface aspects of any on-board computers, launch operation equipment, ground support and test equipment and all software associated with explosive functions

3.2.18 fail operational

mission capable after one failure

NOTE Maintaining operational conditions after one failure and safety conditions after a second independent failure is referred to as "Fail operational – Fail safe".

3.2.19 fail safe

design property of a subsystem, or part of it, which remains safe after one failure

NOTE Maintaining safety following two independent failures is referred to as "Fail safe – Fail safe".

3.2.20 gas generators

explosive devices that produce a volume of gas or exothermic output or both

NOTE E.g. pyrotechnic igniters for solid propulsion applications, gas generator for inflatable structures.

3.2.21 initiator

basic component located upstream of an explosive train, from which originates a transformation of mechanical, electrical or optical energy, the effect produced being a combustion, deflagration or detonation.

NOTE 1 It contains a small quantity of an energetic material.

NOTE 2 Examples: hot bridge wire initiator, exploding bridge wire initiator