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SIST EN 14607-6:2005

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Vesoljska tehnika – Mehanika – 6. del: Pirotehnika

Space engineering - Mechnical - Part 6: Pryotechnics

Raumfahrttechnik - Mechanik - Teil 6: Pyrotechnik

Ingénierie spatiale - Mécanique - Partie 6: Pyrotechnie

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Space engineering - Mechnical - Part 6: Pryotechnics

Ingénierie spatiale - Mécanique - Partie 6: Pyrotechnie

Raumfahrttechnik - Mechanik - Teil 6: Pyrotechnik

This European Standard was approved by CEN on 27 June 2003.

CEN 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. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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 member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

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Foreword

This document (EN 14607-6:2004) has been prepared by CMC.

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of an identical text or by endorsement, at the latest by February 2005, and conflicting national standards shall be withdrawn at the latest by February 2005.

It is based on a previous version[1)] originally prepared by the ECSS Mechanical Engineering Standard Working Group, reviewed by the ECSS Technical Panel and approved by the ECSS Steering Board. The European Cooperation for Space Standardization (ECSS) is a cooperative effort of the European Space Agency, National Space Agencies and European industry associations for the purpose of developing and maintaining common standards.

This document is one of the series of space standards intended to be applied together for the management, engineering and product assurance in space projects and applications.

Requirements in this document are defined in terms of what shall be accomplished, rather than in terms of how to organize and perform the necessary work. This allows existing organizational structures and methods to be applied where they are effective, and for the structures and methods to evolve as necessary without rewriting the standards.

EN 14607 Space engineering - Mechanical is published in 8 Parts:

- Part 1: Thermal control
- Part 2: Structural
- Part 3: Mechanisms

- Part 4: ECLS
- Part 5: Propulsion
  - Part 5.1: Liquid and electric propulsion for spacecraft
  - Part 5.2: Solid propulsion for spacecraft, solid and liquid propulsion for launchers
- Part 6: Pyrotechnics
- Part 7: Mechanical parts
- Part 8: Materials

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

[1)] ECSS-E-30 Part 6A

1 Scope

EN 14607 Part 6 of Space engineering - Mechanical defines the requirements for the discipline of pyrotechnics engineering.

This part defines the standards to be applied for the use of pyrotechnics on all spacecraft and other space products including launch vehicles. It addresses the aspects of design, analysis, verification, manufacturing, operations and safety.

As any pyrotechnic 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 failure or unintentional operation of a pyrotechnic item can be catastrophic for the whole mission and life threatening. Specific requirements can exist for the items associated with it. As all pyrotechnic functions are to be treated similarly, collective control needs to be applied in the manner of a subsystem.

When viewed from the perspective of a specific project context, the requirements defined in this document should be tailored to match the genuine requirements of a particular profile and circumstances of a project.

NOTE Tailoring is a process by which individual requirements of specifications, standards and related documents are evaluated, and made applicable to a specific project by selection, and in some exceptional cases, modification of existing or addition of new requirements.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 13290-1:1999, *Space project management — General requirements — Part 1: Policy and principles.*

EN 13290-5:2001, *Space project management — General requirements — Part 5: Configuration management*

EN 13291-1:1999, *Space product assurance — General requirements — Part 1: Policy and principles.*

EN 13291-2:2003, *Space product assurance — General requirements — Part 2: Quality assurance.*

EN 13291-3:2003, *Space product assurance — General requirements — Part 3: Materials, mechanical parts and processes.*

EN 13701:2001, *Space systems — Glossary of terms.*

EN 14093:2002, *Space project management — Organization and conduct of reviews.*

EN 14160:2001, *Space engineering — Software.*

EN 14607-2:2004, *Space engineering — Mechanical — Part 2: Structural.*

EN 14724:2003, *Space project management — Tailoring of space standards.*

EN 14824:2003, *Space engineering — Testing.*

EN ISO 14620-1:2002, *Space systems — Safety requirements — Part 1: System safety (ISO 14620-1:2002).*

ECSS-E-10A, *Space engineering — System engineering.*

ECSS-E-20A, *Space engineering — Electrical and electronic.*

ECSS-Q-30, *Space product assurance — Dependability.*

ESA SCC 3401/052, *Connectors, electrical, circular, bayonet coupling, scoop-proof, removable crimp contacts.*

ESA SCC 3401/056, *Connectors, electrical, circular, triple-start sel-locking coupling, scoop-proof, removable crimp contacts.*

MIL-STD-1576 Issue 31/7/84, *Electro-explosive Sub-system Safety Requirements.*

ST/SG/AC 10/1 Rev. 7, *UNO Transport of Dangerous Goods.*

References to sources of approved lists, procedures and processes can be found in the bibliography.

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 13701:2001 and the following apply.

3.1.1
cartridge
explosive device designed to produce pressure for performing a mechanical function, i.e. operating a cartridge actuated device such as a pin-puller or cable cutter

NOTE 1 A cartridge is called an initiator if it is the first or only explosive element in an explosive chain.

NOTE 2 Electrically actuated cartridges are EEDs.

3.1.2
charge
quantity of explosive loaded in a cartridge, detonator, or separate container for use in a pyrotechnic device

3.1.3
detonator
initiator for high order detonating explosives

NOTE Detonators used in space vehicles are generally EEDs, i.e. electrically actuated.

3.1.4
electro-explosive device (EED)
explosive initiator that is electrically actuated

NOTE 1 The EED is the explosive element used to operate a cartridge actuated device, to initiate an explosive charge, or to ignite a deflagrating material.

NOTE 2 Detonators, initiators and cartridges when electrically actuated are EEDs.

3.1.5
initiator
first element in an explosive chain that, upon receipt of the proper mechanical or electrical impulse, produces a deflagrating or detonating action

NOTE 1 The deflagrating or detonating action is transmitted to the following elements in the chain.

NOTE 2 Initiators can be mechanically actuated, percussion primers, or electrically actuated (EEDs).

3.1.6
lifetime
period over which any of the subsystem properties are required to be within defined limits

3.1.7
pyrotechnic actuator
mechanism that converts the products of explosion into useful mechanical work

3.1.8
pyrotechnic chain
all the elements necessary to supply, operate, support, protect and monitor a pyrotechnic function

NOTE 1 Software, support equipment, integration, test and launch site facilities and procedures are included in the pyrotechnic chain.

NOTE 2 The schematic of a typical pyrotechnic chain is shown in Figure 1.

3.1.9
pyrotechnic component
any discrete item containing explosive substance, that is permanently changed as a result of operation

3.1.10
pyrotechnic function
any function that uses energy released from explosive substances for its mechanical operation

3.1.11
pyrotechnic subsystem
collection of all the pyrotechnic chains on the spacecraft or launcher system, and any on-board computers, launch operation equipment, ground support and test equipment and all software associated with pyrotechnic functions

NOTE Pyrotechnic subsystem is referred to as "the subsystem" throughout this document.

3.1.12
secondary characteristic
any characteristic, other than its primary function, affecting the capability of an item to meet requirements

3.1.13
sequential firing
application of the firing pulses to redundant initiators separated in time

3.1.14
simultaneous firing
application of the firing pulse to both redundant initiators at the same instant

3.1.15
sympathetic firing
firing of the second of two redundant pyrotechnic devices due to the output of the first

3.2 Abbreviated terms

The following abbreviated terms are defined and used within this document.

Abbreviation	Meaning
AIV	assembly integration verification
DPA	destructive physical analysis
EED	electro-explosive device
EGSE	electrical ground support equipment

EMC	electromagnetic compatibility
ESD	electrostatic discharge
MGSE	mechanical ground support equipment
UNO	United Nations Organisation
TBI	through-bulkhead initiator
RF	radio frequency
SRD	system requirements document

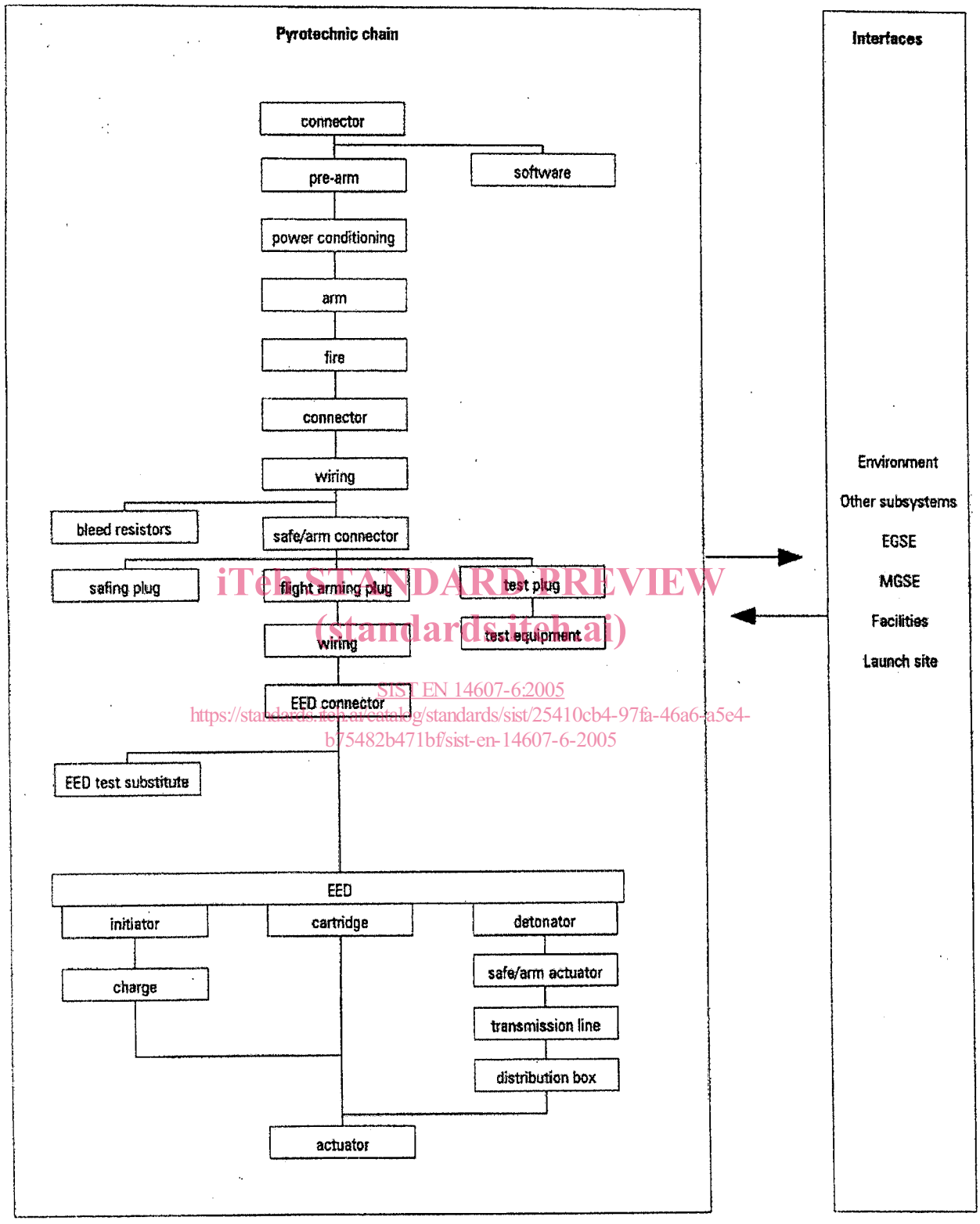

Figure 1 — Typical pyrotechnic chain and associated items

4 Requirements

4.1 General

4.1.1 Overview

This document shall be used in addition to any existing standards applicable to spacecraft or launchers and shall be applied in addition to their requirements.

This document covers the pyrotechnic subsystem and calls up requirement documents for the subsystem elements.

The properties of the electro-explosive device (EED) govern the major part of the behaviour of the whole subsystem. EEDs and their derivatives, such as cartridges and detonators, are treated in more detail in other standards. The requirements for these standard elements are defined in specific requirements documents related to the specific types.

Actuator properties, which cannot be covered by requirements for the EED alone, are defined in specific requirement documents relating to the types of actuator.

Other elements of the pyrotechnic subsystem which can be fully tested and do not need specific requirements are subject to the general technical and product assurance requirements. Detailed aspects of these elements are included for these elements where they have a significant influence on the success of the pyrotechnic functions.

4.1.2 Application

The requirements in this document cover the interaction of pyrotechnic engineering with project management, processes, parts and components, product assurance, and the related requirements affecting the conceptual definition, design, sizing, analysis, development, and hardware production of pyrotechnic devices.

4.1.3 Stability of properties

a) The properties of the subsystem shall remain stable before and after firing, even when subject to external loads or environmental conditions, except if these external conditions exceed the defined values.

b) The functional requirements shall be met within the limits of environmental and loading conditions required by the user programme.

4.1.4 Subsystem performance

The specific functions and performance to be delivered by the subsystem shall be compatible with those defined by the user.

NOTE The subsystem performance requirement is the sum of the requirements related to all the pyrotechnic functions on board.

4.1.5 Response time

Each pyrotechnic function shall respond to its electrical firing command within the time interval defined by the user.

4.2 Mission

a) The use of pyrotechnic functions during all phases of the mission shall be identified.

b) The nature of the orbit, mission purpose and duration, functions being activated shall be described (e.g. launcher ignition, staging and safety functions, payload separation, apogee motor ignition, solar array, antenna, boom or cover release, and propulsion system branch opening or closing).

c) Specific mission-related requirements placed on the subsystem shall be identified.