



SLOVENSKI STANDARD SIST EN 16604-10:2019

01-september-2019

Nadomešča:

SIST EN 16604-10:2014

Vesoljska vzdržljivost - Zahteve za zmanjšanje količine vesoljskih odpadkov (ISO 24113:2011, spremenjen)

Space sustainability - Space debris mitigation requirements (ISO 24113:2011, modified)

Nachhaltigkeit im Weltraum - Anforderungen zur Eindämmung des Weltraummülls (ISO 24113:2011, modifiziert)

Développement durable de l'espace - Exigences relatives à la réduction des débris spatiaux (ISO 24113:2011, modifiée)

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<https://standards.iteh.ai/catalog/standards/sist/53525683-a254-4e33-a84e-368d5c92b509/sist-en-16604-10-2019>

Ta slovenski standard je istoveten z: EN 16604-10:2019

ICS:

13.030.99	Drugi standardi v zvezi z odpadki	Other standards related to wastes
49.140	Vesoljski sistemi in operacije	Space systems and operations

SIST EN 16604-10:2019

en,fr,de

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EUROPEAN STANDARD

EN 16604-10

NORME EUROPÉENNE

EUROPÄISCHE NORM

June 2019

ICS 49.140

Supersedes EN 16604-10:2014

English version

Space sustainability - Space debris mitigation requirements (ISO 24113:2011, modified)

Durabilité des activités spatiales - Exigences relatives à la réduction des débris (ISO 24113:2011 modifiée)

Nachhaltigkeit im Weltraum - Anforderungen zur Eindämmung des Weltraummülls (ISO 24113:2011, modifiziert)

This European Standard was approved by CEN on 4 February 2019.

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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.

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European foreword

This document (EN 16604-10:2019) has been prepared by Technical Committee CEN/CLC/JTC 5 "Space", the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by December 2019, and conflicting national standards shall be withdrawn at the latest by December 2019.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 16604-10:2014.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

This document (EN 16604-10:2019) originates from ISO 24113:2011 taking into account the specificities of the ECSS Adoption Notice ECSS-U-AS-10C "Space sustainability — Adoption Notice of ISO 24113: Space systems — Space debris mitigation requirements".

EN 16604-10:2019 is a merge of EN 16604-10:2014 and ISO 24113:2011, resulting in one European Standard containing all requirements for Space debris mitigation.

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).

Context information: <https://standards.iteh.ai/catalog/standards/sist/53525683-a254-4e33-a84e-368d5c92b509/sist-en-16604-10-2019>

The Standard ISO 24113, *Space systems — Space debris mitigation requirements*, has been developed by ISO TC20/SC 14. The key space debris mitigation requirements have been thoroughly discussed at international level, agreed by the ISO members and published as ISO 24113.

Aiming at the development of world wide implementation standards dealing with space debris mitigation, ECSS has proactively contributed to the preparation of ISO 24113.

ECSS decided to adopt and apply ISO 24133 with a minimum set of modifications, identified in the present document, to account for the reference and applicable space debris mitigation documents existing in Europe and of the needs of the ECSS members.

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, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

Space debris comprises all non-functional, man-made objects, including fragments and elements thereof, in Earth orbit or re-entering the Earth's atmosphere. The growing population of these objects poses an increasing hazard to missions. In response to this problem, there is international consensus that space activities need to be managed to minimize debris generation and risk. This consensus is embodied in space debris mitigation guidelines published by organizations such as the International Telecommunication Union (ITU)^[1], the Inter-Agency Space Debris Coordination Committee (IADC)^{[2][3]} and the United Nations (UN)^[4]. The transformation of debris mitigation guidelines into engineering practice is a key purpose of this Standard.

The importance of this Standard can be seen within the context of four UN treaties^[5] that were established under the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS) to govern the involvement of nations in space activities. These are the *Outer Space Treaty*, the *Liability Convention*, the *Registration Convention* and the *Rescue Agreement*. Through some of these treaties, a Launching State has total liability for damage caused by its spacecraft or launch vehicle orbital stages (or any parts thereof) on the surface of the Earth or to aircraft in flight, as well as in outer space where fault can be proven.

All countries are encouraged to abide by these international agreements in order not to endanger or constrain existing and future space missions. A Launching State can choose to appoint licensing or regulatory authorities to administer its approach for complying with the above-mentioned UN treaties. In several Launching States, these authorities have implemented national legislation to enforce the UN treaties. Such legislation can include the mitigation of space debris. Some Launching States meet their obligations by appointing non-regulatory government bodies, such as national space agencies, to provide the necessary guidelines or requirements, including those for space debris mitigation.

The general aim of space debris mitigation is to reduce the growth of space debris by ensuring that spacecraft and launch vehicle orbital stages are designed, operated and disposed of in a manner that prevents them from generating debris throughout their orbital lifetime. This is achieved by the following actions:

- a) avoiding the intentional release of space debris into Earth orbit during normal operations;
- b) avoiding break-ups in Earth orbit;
- c) removing spacecraft and launch vehicle orbital stages from protected orbital regions after end of mission;
- d) performing the necessary actions to minimize the risk of collision with other space objects.

Such actions are especially important for a spacecraft or launch vehicle orbital stage that has one or more of the following characteristics:

- a large collision cross-section;
- remains in orbit for many years;
- operates near manned mission orbital regions;
- operates in highly utilized regions, such as protected regions;
- operates in regions of high debris population.

This Standard transforms these objectives into a set of high-level debris mitigation requirements. Methods and processes to enable compliance with these requirements are provided in a series of lower-level implementation standards.

1 Scope

This document defines the primary space debris mitigation requirements applicable to all elements of systems launched into, or passing through, near-Earth space, including launch vehicle orbital stages, operating spacecraft and any objects released as part of normal operations or disposal actions.

The requirements contained in this document are intended to reduce the growth of space debris by ensuring that spacecraft and launch vehicle orbital stages are designed, operated and disposed of in a manner that prevents them from generating debris throughout their orbital lifetime.

This document is the top-level standard in a family of standards addressing debris mitigation. It will be the main interface for the user, bridging between the primary debris mitigation requirements and the lower-level implementation standards that will ensure compliance.

This document does not cover launch phase safety for which specific rules are defined elsewhere.

This document identifies the clauses and requirements modified with respect to ISO 24113, *Space systems — Space debris mitigation requirements*, Second edition 2011-05-15 for application in ECSS.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 ISO 9000:2005, *Quality management systems — Fundamentals and vocabulary (ISO 9000:2005)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 9000:2005 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1

approving agent

entity from whom approval is sought for the implementation of space debris mitigation requirements with respect to the procurement of a spacecraft, or its launch, or its operations in space, or a combination of those activities

EXAMPLE Regulatory or licensing authorities; national or international space agencies.

3.2

break-up

event that destroys an object and generates fragments that are released into space

3.3

casualty risk

probability that a person is killed or seriously injured

EN 16604-10:2019 (E)**3.4****disposal**

actions performed by a spacecraft or launch vehicle orbital stage to permanently reduce its chance of accidental break-up and to achieve its required long-term clearance of the protected regions

3.5**disposal phase**

interval during which a spacecraft or launch vehicle orbital stage completes its disposal actions

3.6**end of life**

instant when a spacecraft or launch vehicle orbital stage is permanently turned off, nominally as it completes its disposal phase, or when it re-enters, or when the operator can no longer control it

3.7**end of mission**

instant when a spacecraft or launch vehicle orbital stage completes the tasks or functions for which it has been designed, or when it becomes non-functional or permanently halted because of a failure or because of a voluntary decision

3.8**geostationary Earth orbit****GEO**

Earth orbit having zero inclination and zero eccentricity, whose orbital period is equal to the Earth's sidereal rotation period

3.9**launch vehicle orbital stage**

stage of a launch vehicle that is designed to achieve orbit

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3.10**Launching State**

State that launches or procures the launching of a spacecraft, or a State from whose territory or facility a spacecraft is launched

Note 1 to entry: This definition is consistent with the definition in the UN Liability Convention^[5] and Resolution 59/115^[6] of 10 December 2004 on the notion of the Launching State.

3.11**normal operations**

planned tasks or functions performed by a spacecraft or launch vehicle orbital stage prior to its disposal

3.12**orbital lifetime**

period of time from when a spacecraft or launch vehicle orbital stage achieves Earth orbit to when it commences re-entry

3.13**probability of successful disposal**

probability of successfully disposing of a spacecraft or launch vehicle orbital stage, evaluated as a conditional probability weighted on the mission success at the time disposal is executed

Note 1 to entry: See Annex A.

3.14**protected region**

region in space that is protected with regard to the generation of space debris to ensure its safe and sustainable use in the future

3.15**re-entry**

process in which atmospheric drag cascades deceleration of a spacecraft or launch vehicle orbital stage (or any part thereof), leading to its destruction or return to Earth

3.16**regulatory authority**

governmental entity, national or international, that bears responsibility for implementing space debris mitigation policy or law with respect to the procurement of a spacecraft, or its launch, or its operations in space, or a combination of those activities

3.17**space debris**

orbital debris

man-made objects, including fragments and elements thereof, in Earth orbit or re-entering the atmosphere, that are non-functional

3.18**spacecraft**

system designed to perform specific tasks or functions in space

Note 1 to entry: A spacecraft that can no longer fulfil its intended mission is considered non-functional. Spacecraft in reserve or standby modes awaiting possible reactivation are considered functional.

4 Symbols and abbreviated terms**4.1 Symbols**

A/m aspect area to dry mass ratio (m^2kg^{-1})

C_R solar radiation pressure coefficient ($0 < C_R < 2$)

$P(D|M)$ probability that disposal, D , will be successful given that the nominal mission, M , has been completed

Z altitude measured with respect to a spherical Earth whose radius is 6 378 km

Z_{GEO} altitude of the geostationary orbit with respect to a spherical Earth whose radius is 6 378 km

ΔH change in altitude

4.2 Abbreviated terms

GEO geostationary earth orbit

LEO low earth orbit

LV launch vehicle

S/C spacecraft

SDMP space debris mitigation plan