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Space systems — Space debris mitigation requirements

Systèmes spatiaux — Exigences de mitigation des débris spatiaux



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 14, *Space systems and operations*.

This fourth edition cancels and replaces the third edition (ISO 24113:2019), which has been technically revised.

The main changes are as follows:

- the addition of a term and definition for "expected number of casualties per re-entry" to replace the term "casualty risk";
- the modification of definitions for the terms "disposal phase", "Earth orbit", "end of life", "end of mission", "passivate" and "probability of successful disposal";
- the applicability of requirements in this document with respect to a space object that enters an unbound Keplerian orbit or leaves Earth orbit;
- the modification of a requirement relating to space debris left in Earth orbit by a launch vehicle after normal operations;
- minor changes to two of the requirements relating to accidental break-up caused by an on-board source of energy;
- changes to a requirement and NOTE concerning the assessment of the probability of impact-induced break-up of a spacecraft;
- the modification of a requirement and addition of a NOTE relating to the assessment of the probability that an impact will prevent the successful disposal of a spacecraft;
- the modification of a requirement and addition of a NOTE relating to the need for disposal capability/probability reassessment before extending the mission lifetime of a spacecraft;

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- the addition of NOTES pointing out the need for and potential benefit of reducing orbital lifetime significantly below 25 years in the LEO protected region;
- the addition of a NOTE concerning the collision probability associated with a deployable device that augments the orbital decay of a spacecraft or launch vehicle orbital stage in the LEO protected region;
- the modification of a requirement relating to the assessment of the hazard caused by ground impact of any objects that are expected to survive re-entry;
- the specification of a threshold for the expected number of casualties during the re-entry of a spacecraft or launch vehicle orbital stage, and the addition of supplementary NOTES;
- the addition of a NOTE concerning the listed contents of the space debris mitigation plan;
- minor modifications to the two figures in [Annex A](#);
- updates to the Bibliography.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Space debris comprises all objects of human origin in Earth orbit or re-entering the atmosphere, including fragments and elements thereof, that no longer serve a useful purpose. The growing population of these objects poses an increasing hazard to mankind's use of space. In response to this problem, there is international consensus that space activities need to be managed to minimize collision risks among space objects and casualty risks associated with atmospheric re-entry of such objects. 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 document.

The importance of this document 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 activities in space. 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 orbit lifetime. Another aim of space debris mitigation is to ensure that space objects re-entering the Earth's atmosphere cause no harm. These aims are 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 the end of mission;
- d) performing the necessary actions to minimize the risk of collision with other space objects;
- e) reducing the risks associated with re-entry, e.g. to people, property and the Earth's environment.

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

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