
**Space systems — Space debris
mitigation design and operation
guidelines for spacecraft**

*Systèmes spatiaux — Conception de mitigation des débris spatiaux et
lignes directrices de manoeuvre de la navette*



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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. www.iso.org/directives

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committee responsible for this document is ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 14, *Space systems and operations*.

Introduction

Coping with debris is essential to preventing the deterioration of the orbital environment and ensuring the sustainability of space activities. Effective actions must also be taken to ensure the safety of those on the ground from re-entering objects that were disposed of from low-Earth orbit.

Recently, the orbital environment has become so deteriorated by debris that action must be taken to prevent damage due to the impact. Collision avoidance manoeuvres should be taken to avoid large debris (larger than 10 cm, for example), which can be observed from the ground. Spacecraft design should protect against micro-debris (even smaller than 1 mm) that can cause critical damage to vulnerable components.

The following ISO standards and technical reports cover these issues: ISO 24113, *Space systems — Space debris mitigation requirements*; ISO/TR 16158, *Space systems — Avoiding collisions with orbiting objects*; ISO 16126, *Space systems — Assessment of the survivability of unmanned spacecraft against space debris and meteoroid impacts to ensure successful post-mission disposal*. Other ISO documents, introduced in [Clause 2](#), are currently being developed to encourage debris mitigation and protection from debris impact. [Table 1](#) shows those requirements together with the recommendations in the United Nations Space Debris Mitigation Guidelines and the Inter-Agency Space Debris Coordination Committee (IADC) space debris guidelines referred to in the UN guidelines.

Reliability and quality shortfalls have resulted in fragmentation events that generated thousands of fragments. ISO 24113 and other debris-mitigation guidelines make the assumption that space hardware quality and reliability issues have been addressed by other management programs. But for low-cost or low-criticality missions, spacecraft of reduced quality have been developed. The failure of such spacecraft may not pose critical damage to their owners but they may adversely affect the environment and impair the sustainability of space activities. This Technical Report suggests activities that can improve reliability and quality sufficiently to avoid this problem. This aspect of space-debris mitigation is particularly important for micro-satellites developed by universities and newcomers to space activities.

Space systems — Space debris mitigation design and operation guidelines for spacecraft

1 Scope

This Technical Report contains non-normative information on spacecraft design and operational practices for mitigating space debris.

This Technical Report is a supporting document to the family of international standards addressing space debris mitigation (see [2.2](#)). The purpose of these standards is to minimize the creation of additional 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 Technical Report can be used to guide spacecraft engineers in the application of these space debris mitigation standards. [Table 1](#) lists the main debris mitigation requirements defined in the standards and compares them to equivalent recommendations published by the United Nations and the Inter-Agency Space Debris Coordination Committee.

In [Clause 3](#), the main space debris mitigation requirements are reported and discussed. [Clause 4](#) provides guidance for life-cycle implementation of space debris mitigation related activities.

In [Clause 5](#), the system level aspects stemming from the space debris mitigation requirements are highlighted, while in [Clause 6](#), the impacts at subsystem and component levels are detailed.

Where it is not directly required by existing ISO standards but considered relevant to spacecraft operations, design and debris mitigation, content in this Technical Report is labelled as such with “[information]”.

Table 1 — Comparison of ISO debris-related documents with UN and IADC space debris mitigation Guidelines

	Measures	ISO International Standards (or Technical Reports)	UN Guidelines	IADC Guidelines
Released objects	General measures for avoiding the release of objects	ISO 24113, 6.1.1	Recommendation-1	5.1
	Operational debris	Included in above	Included in above	5.1
	Slag from solid motors	ISO 24113, 6.1.2.2, 6.1.2.3	--	--
	Combustion products from pyrotechnics	ISO 24113, 6.1.2.1 (Combustion Products < 1 mm)	--	--
On-orbital break-ups	Intentional destruction	ISO 24113, 6.2.1	Recommendation-4	5.2.3
	Accident during operation	ISO 24113, 6.2.2 (Probability < 10 ⁻³)	Recommendation-2	5.2.2 (Monitoring)
	Post-mission break-up (Passivation, etc.)	ISO 24113, 6.2.2.3 (Detailed in ISO 16127)	Recommendation-5	5.2.1
Disposal at end of operation GEO	Reorbit at EOL	ISO 24113, 6.3.2 (Detailed in ISO 26872) 6.3.2.1: General Requirement. 6.3.2.2: 235 km+ (1000·Cr·A/m), e < 0,003 6.3.1: Success Probability > 0,9	Recommendation-7 (No quantitative requirements) Note: ITU-R S.1003-1 recommends; 235 km + 1000 Cr·A/M Here, A[m ²], M[kg], Cr[-]	5.3.1 235 km+ (1000·Cr·A/m), e < 0,003
	Reduction of orbital lifetime	ISO 24113, 6.3.3 (Detailed in ISO 16164) 6.3.3.1: EOL Lifetime < 25 years 6.3.1: Success Probability > 0,9	Recommendation-6 (No quantitative requirements)	5.3.2 (Recommend 25 years)
Disposal at end of operation LEO	Transfer to graveyard	ISO 24113, 6.3.3.2 (f) (guarantee 100 years' non-interference)	Mentioned in recommendation-6	5.3.2
	Other options	ISO 24113, 6.3.3.2 (a) ~ (e)	--	5.3.2
	Avoidance of ground casualties	ISO 24113, 6.3.4 (Detailed in ISO 27875)	Included in Recommendation-6	5.3.2
Re-entry	Collision avoidance for large debris	ISO/TR 16158 (for assessment)	Recommendation-3	5.4
	Protection from the impact of micro-debris	ISO 16126 (for assessment)	--	5.4