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Space systems - Debris mitigation design and operation manual for launch vehicle orbital stages

Systèmes spatiaux - Conception pour l'attenuation des débris et manuel d'utilisation à étages orbitaux pour les véhicules de lancement

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Foreword

The International Organization for Standardization (ISO) is a worldwide federation of national standards bodies (ISO member bodies). International Standards are generally prepared by ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to represent that committee. International organizations, both 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 the conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT).

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 can also be taken to ensure the safety of those on the ground from re-entering objects that were disposed of from Earth orbit.

ISO 24113 “Space debris mitigation requirements,” and other ISO documents, introduced in Clause 4, were developed to encourage debris mitigation. 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 United Nations (UN) guidelines.

Table 1 lists the main debris mitigation requirements defined in the standards and compares them to equivalent recommendations published by the UN and the IADC.

In Clause 5, the main space debris mitigation requirements are reported and analyzed.

In Clause 6, the guidance for life-cycle implementation of space debris mitigation related activities are provided.

In Clause 7, the system level aspects stemming from the space debris mitigation requirements are highlighted; while in Clause 8, the impacts at subsystem and component levels are detailed.

In this document, where the content is not directly required by existing ISO Standards but considered relevant to launch vehicle orbital stages operations or design and debris mitigation, it is labelled as “[Information].”

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

	Measures		ISO Standards (or Technical Reports)	UN Guidelines	IADC Guidelines
Limiting debris generation	**Released objects**	General measures for avoiding the release of objects	**ISO 24113, 6.1.1**	Recommendation-1	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
		Accidental break-ups 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-operations	**GEO**	Reorbit at end of operation	**ISO 24113, 6.3.2** (Detailed in ISO 26872) 6.3.2.1: General Requirement 6.3.2.2: 235 km+ (1 000•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 + 1,000 *Cr*A/M* Here, A[m^2], M[kg], Cr[-]	5.3.1 235 km+ (1 000•Cr•A/m), e < 0,003
	LEO	Reduction of orbital lifetime	**ISO 24113, 6.3.3** (Detailed in ISO 16164, 16699) 6.3.3.1: Orbital lifetime after end of operation < 25 years 6.3.1: Success Probability > 0,9	Recommendation-6 (No quantitative requirements)	5.3.2 (Recommend 25 years)
		Transfer to out of protected region	**ISO 24113, 6.3.3.2 (f)** (Guarantee 100 years of non-interference)	Mentioned in Recommendation-6	5.3.2
		Other options	**ISO 24113, 6.3.3.2 (a) ~ (e)**	--	5.3.2
Re-entry		Avoidance of ground casualties	**ISO 24113, 6.3.4** (Detailed in ISO 27875)	Included in Recommendation-6	5.3.2
Collision avoidance for large debris			**ISO/TR-16158** (for assessment only)	Recommendation-3	5.4
Protection from the impact of micro-debris			**ISO 16126** (for assessment only)	--	5.4