

**INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO):
STANDARDS AND TECHNICAL REPORTS****International mechanisms:**

The following is a list of the standards and technical reports developed by the International Organization for Standardization (ISO) for mitigating space debris:

1. ISO 24113, Space systems — Space debris mitigation requirements. Publication date: 1st edition - 2010; 2nd edition - 2011; 3rd edition - in preparation.
2. ISO 23312, Space systems — Detailed space debris mitigation requirements for spacecraft. Publication date: 1st edition - in preparation.
3. ISO 20893, Space systems — Detailed space debris mitigation requirements for launch vehicle orbital stages. Publication date: 1st edition - in preparation.
4. ISO 11227, Space systems — Test procedures to evaluate spacecraft material ejecta upon hypervelocity impact. Publication date: 1st edition - 2012; Amendment 1 - in preparation.
5. ISO 14200, Space environment (natural and artificial) — Guide to process-based implementation of meteoroid and debris environmental models (orbital altitudes below GEO+2000km). Publication date: 1st edition - 2012.
6. ISO 16126, Space systems — Assessment of survivability of unmanned spacecraft against space debris and meteoroid impacts to ensure successful post-mission disposal. Publication date: 1st edition - 2014.
7. ISO 27852, Space systems — Estimation of orbit lifetime. Publication date: 1st edition - 2011; 2nd edition - 2016.
8. ISO 27875, Space systems — Re-entry risk management for unmanned spacecraft and launch vehicle orbital stages. Publication date: 1st edition - 2010; Amendment 1 - 2016; 2nd edition - in preparation.
9. ISO/TR 16158, Space systems — Avoiding collisions among orbiting objects: Best practices, data requirements, and operational concepts. Publication date: 1st edition - 2013; 2nd edition - in preparation.
10. ISO/TR 18146, Space systems — Space debris mitigation design and operation guidelines for spacecraft. Publication date: 1st edition - 2015.
11. ISO/TR 20590, Space systems — Space debris mitigation design and operation guidelines for launch vehicle orbital stages. Publication date: 1st edition - 2017.
12. ISO 13541, Space data and information transfer systems — Attitude data messages. Publication date: 1st edition - 2010; 2nd edition - in preparation.
13. ISO 26900, Space data and information transfer systems — Orbit data messages. Publication date: 1st edition - 2012; 2nd edition - in preparation.
14. ISO 13526, Space data and information transfer systems — Tracking data message. Publication date: 1st edition - 2010; 2nd edition - in preparation.

15. ISO 19389, Space data and information transfer systems — Conjunction data message.
Publication date: 1st edition - 2014.

Description:

ISO 24113 (Document type: international standard) defines the primary space debris mitigation requirements applicable to all elements of unmanned 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. The requirements contained in ISO 24113 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 orbit lifetime. The requirements are also intended to reduce the casualty risk on ground associated with atmospheric re-entry of space objects. ISO 24113 is the top-level standard in a family of ISO standards addressing space debris mitigation.

ISO 23312 (Document type: international standard) will support compliance with those clauses in ISO 24113 that are relevant to spacecraft. ISO 23312 will define detailed space debris mitigation requirements for the design and operation of spacecraft.

ISO 20893 (Document type: international standard) will support compliance with those clauses in ISO 24113 that are relevant to launch vehicle orbital stages. ISO 20893 will define detailed space debris mitigation requirements for the design and operation of launch vehicle orbital stages.

ISO 11227 (Document type: international standard) supports compliance with those clauses in ISO 24113 that are relevant to space debris impact risk assessment. ISO 11227 describes an experimental procedure for acquiring data to characterize the ejecta released when spacecraft materials are impacted by hypervelocity projectiles representative of space debris and meteoroids. Such data contribute to informed decisions being made with regard to the selection of suitable materials for external surfaces on spacecraft.

ISO 14200 (Document type: international standard) supports compliance with those clauses in ISO 24113 that are relevant to space debris impact risk assessment. ISO 14200 specifies a process for implementing meteoroid and debris environment models in the impact risk assessment of spacecraft and launch vehicle orbital stages. Guidance is provided for selecting and using the models and ensuring their traceability throughout the design phase of a spacecraft or launch vehicle orbital stage.

ISO 16126 (Document type: international standard) supports compliance with those clauses in ISO 24113 that are relevant to space debris impact risk assessment. ISO 16126 defines requirements and a procedure for assessing the survivability of an unmanned spacecraft against space debris and meteoroid impacts to ensure the survival of critical components required to perform post-mission disposal. ISO 16126 also describes two impact risk analysis procedures that can be used to satisfy the requirements.

ISO 27852 (Document type: international standard) supports compliance with those clauses in ISO 24113 that are relevant to post-mission disposal in the LEO protected region. ISO 27852 describes a process for the estimation of orbit lifetime for spacecraft, launch vehicles, upper stages and associated debris in LEO-crossing orbits. ISO 27852 also clarifies the following: a)

modelling approaches and resources for solar and geomagnetic activity modelling; b) resources for atmosphere model selection; c) approaches for spacecraft ballistic coefficient estimation.

ISO 27875 (Document type: international standard) supports compliance with those clauses in ISO 24113 that are relevant to the re-entry of space objects. ISO 27875 provides a framework with which to assess, reduce and control the potential risks that spacecraft and launch vehicle orbital stages pose to people and the environment when those space vehicles re-enter the Earth's atmosphere and impact the Earth's surface. ISO 27875 is intended to be applied to the planning, design and review of space vehicle missions for which controlled or uncontrolled re-entry is possible.

ISO/TR 16158 (Document type: technical report) supports compliance with those clauses in ISO 24113 that are relevant to collision avoidance. ISO/TR 16158 describes some widely used techniques for perceiving close approaches, estimating collision probability, estimating the cumulative probability of survival, and manoeuvring to avoid collisions.

ISO/TR 18146 (Document type: technical report) can be used to guide engineers in the application of those ISO space debris mitigation standards that are relevant to spacecraft. ISO/TR 18146 contains non-normative information on spacecraft design and operational practices for mitigating space debris.

ISO/TR 20590 (Document type: technical report) can be used to guide engineers in the application of those ISO space debris mitigation standards that are relevant to launch vehicle orbital stages. ISO/TR 20590 contains non-normative information on launch vehicle orbital stage design and operational practices for mitigating space debris.

ISO 13541 (Document type: international standard) specifies two standard message formats for use in transferring spacecraft attitude information between space agencies/operators. Such exchanges are used in many ways, including: a) pre-flight planning and scheduling for tracking or attitude estimation support; b) carrying out attitude operations; c) performing attitude comparisons; d) carrying out attitude propagations and/or sensor predictions. These data exchanges can also be important in the assessment of collision probability.

ISO 26900 (Document type: international standard) specifies three standard message formats for use in transferring spacecraft orbit information between space agencies/operators. Such exchanges are used in many ways, including: a) pre-flight planning and scheduling for tracking or navigation support; b) carrying out tracking operations; c) performing orbit comparisons and orbit conjunction analyses; d) performing orbit propagation and orbit reconstruction; and e) designing collaborative manoeuvres. These data exchanges are the foundation of comprehensive, timely, accurate conjunction assessment, collision avoidance, SSA and Space Traffic Management.

ISO 13526 (Document type: international standard) specifies a standard message format for use in exchanging spacecraft tracking data used in orbit determination between space agencies/operators. Such exchanges are used for distributing tracking data output from routine interagency cross-supports where spacecraft missions managed by one agency are tracked from a ground station managed by a second agency. These data exchanges are critical to the development of comprehensive, timely, accurate space catalogues that are foundational to actionable SSA.

ISO 19389 (Document type: international standard) specifies a standard message format for use in exchanging spacecraft conjunction information between originators of conjunction assessments and satellite owner/operators and other authorized parties. Such exchanges provide critical information to satellite owner/operators to enable timely collision avoidance decisions. ISO 19389 is applicable to satellite operations in all environments in which close approaches and collisions among satellites are concerns.

Applicability:

Voluntary

Relation to international mechanisms:

	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 20893, 23312)	Recommendation 5	5.2.1
Disposal at end-of-operations	GEO	Re-orbit at end of operation ISO 24113, 6.3.2 (Detailed in ISO 20893, 23312) 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 20893, 23312) 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)	

	Measures	ISO Standards (or Technical Reports)	UN Guidelines	IADC Guidelines
	Options for removal from the protected region	ISO 24113, 6.3.3.2 (a) ~ (f) (Detailed in ISO 20893, 23312)	Mentioned in Recommendation 6	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) ISO/19389	Recommendation 3	5.4
	Protection from the impact of micro-debris	ISO 16126 (for assessment only)	--	5.4
	Exchange or pooling of space data for the purpose of safety-of-flight and mitigation of Radio Frequency Interference	ISO 13541, Attitude ISO 26900, Orbit ISO 13526, Tracking ISO 19389, Conjunction	Consensus LTS Guideline 11 (Share space object and orbital event information), Guideline 12 (Orbital information sharing), Guideline 13 (sharing of space debris information), Guideline 14 (Conjunction Assessment), Guideline 31 (Reentry)	5.4 "Reliable orbital information"

References:

1. <https://www.iso.org/standard/57239.html>
2. <https://www.iso.org/standard/75221.html>
3. <https://www.iso.org/standard/73023.html>
4. <https://www.iso.org/standard/57535.html>
5. <https://www.iso.org/standard/54506.html>
6. <https://www.iso.org/standard/55720.html>
7. <https://www.iso.org/standard/68572.html>
8. <https://www.iso.org/standard/44393.html>
9. <https://www.iso.org/standard/55739.html>
10. <https://www.iso.org/standard/61602.html>

11. <https://www.iso.org/standard/68467.html>
12. <https://www.iso.org/standard/53987.html>
13. <https://www.iso.org/standard/46135.html>
14. <https://www.iso.org/standard/53984.html>
15. <https://www.iso.org/standard/64784.html>