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

National foreword

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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 second edition cancels and replaces the second edition (ISO/TR 18146:2015), which has been technically revised.

The main changes compared to the previous edition are as follows:

— text has been updated to be aligned with ISO 24113:2019[1];

— information has been added that the ejection of slag debris from solid rocket motors is limited newly in low Earth orbit in addition to GEO previously;

— information relating to collision avoidance against catalogued space objects has been improved;

— information of the intention of the new requirement avoiding fragmentation caused by impact of space debris and meteoroid, and typical assessment procedure in the world space agencies has been added;

— corresponding to the new requirement limiting the total probability of successful disposal to be at least 0,9, the state of the art to confirm the compliance with that taken in the world space industries and national agencies has been added;

— other information relating to the changes in ISO 24113 has been added.

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.

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Introduction

Coping with debris is essential to preventing the deterioration of the orbital environment and ensuring the sustainability of space activities. Effective actions are also 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 is taken to prevent damage due to the impact. Collision avoidance manoeuvres are taken to avoid large debris (larger than 10 cm, for example), which can be observed from the ground. Spacecraft design protects against micro-debris (even smaller than 1 mm) that can cause critical damage to vulnerable components.

ISO 24113:2019[1] and other ISO documents, introduced in Bibliography, were developed to encourage debris mitigation activities.

In Clause 5, the major space debris mitigation requirements are informed.

In Clause 6, the information of life-cycle implementation of space debris mitigation related activities is 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.

This document provides comprehensive information on what ISO requires to do for the design and operation of the launch vehicles, and where such requirements and recommendations are registered in a set of ISO documents.

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TECHNICAL REPORT **ISO/TR 18146:2020(E)**

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

1 Scope

This document contains information on the design and operational practices for launch vehicle orbital stages for mitigating space debris.

This document provides information to engineers on what are required or recommended in the family of space debris mitigation standards to reduce the growth of space debris by ensuring that spacecraft is designed, operated, and disposed of in a manner that prevents them from generating debris throughout their orbital lifetime.

2 Normative reference

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

4 Symbols and abbreviated terms

A/M	area-to-mass
AOCS	attitude and orbit control system
CDR	critical design review
CFRP	carbon-fibre-reinforced plastic
CNES	Centre National d'Etudes Spatiales
CSpOC	Combined Space Operations Center (USA)
DAS	debris assessment software (NASA)
COTS	commercial off-the-shelf
DRAMA	debris risk assessment and mitigation analysis (ESA)
EOMDP	end-of-mission (operation) disposal plan
ESA	European Space Agency
FDIR	failure detection, isolation and recovery

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