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Space systems — Estimation of orbit lifetime

Systèmes spatiaux — Estimation de la durée de vie en orbite

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 27852 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 14, *Space systems and operations*.

Introduction

A spacecraft is exposed to the risk of collision with orbital debris and operational satellites throughout its launch, early orbit and mission phases. This risk is especially high during passage through or operations within the LEO region.

To address these concerns, the Inter-Agency Space Debris Coordination Committee (IADC) recommended to the United Nations[2] (section 5.3.2 “Objects Passing Through the LEO Region”): “Whenever possible space systems that are terminating their operational phases in orbits that pass through the LEO region, or have the potential to interfere with the LEO region, should be de-orbited (direct re-entry is preferred) or where appropriate manoeuvred into an orbit with a reduced lifetime. Retrieval is also a disposal option.” and “A space system should be left in an orbit in which, using an accepted nominal projection for solar activity, atmospheric drag will limit the orbital lifetime after completion of operations. A study on the effect of post-mission orbital lifetime limitation on collision rate and debris population growth has been performed by the IADC. This IADC and some other studies and a number of existing national guidelines have found 25 years to be a reasonable and appropriate lifetime limit.”

The Scientific and Technical Subcommittee (STSC) of the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS), acknowledging the benefits of the IADC guidelines, established the Working Group on Space Debris to develop a set of recommended guidelines[3] based on the technical content and the basic definitions of the IADC space debris mitigation guidelines, taking into consideration the United Nations treaties and principles on outer space. Consistent with the IADC recommendations (listed above), STSC Guideline 6 states that space mission planners, designers, manufacturers and operators should “Limit the long-term presence of spacecraft and launch vehicle orbital stages in the low-Earth orbit (LEO) region after the end of their mission.” STSC guidelines also state, “For more in-depth descriptions and recommendations pertaining to space debris mitigation measures, Member States and international organizations can refer to the latest version of the IADC space debris mitigation guidelines and other supporting documents, which can be found on the IADC website (www.iadc-online.org).”

The purpose of this International Standard is to provide a common, consensus approach to determining orbit lifetime, one that is sufficiently precise and easily implemented for the purpose of demonstrating compliance with IADC guidelines. This International Standard offers standardized guidance and analysis methods to estimate orbital lifetime for all LEO-crossing orbit classes.

This International Standard is a supporting document to ISO 24113[1] and the GEO and LEO disposal standards that are derived from ISO 24113.

Space systems — Estimation of orbit lifetime

IMPORTANT — The electronic file of this document contains colours which are considered to be useful for the correct understanding of the document. Users should therefore consider printing this document using a colour printer.

1 Scope

This International Standard describes a process for the estimation of orbit lifetime for satellites, launch vehicles, upper stages and associated debris in LEO-crossing orbits.

It also clarifies the following:

— modelling approaches and resources for solar and geomagnetic activity modelling;

— resources for atmosphere model selection;

— approaches for satellite ballistic coefficient estimation.

2 Terms, definitions, symbols and abbreviated terms

2.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1.1
orbit lifetime
elapsed time between the orbiting satellite's initial or reference position and orbit demise/reentry

NOTE 1 An example of the orbiting satellite's reference position is the post-mission orbit.

NOTE 2 The orbit's decay is typically represented by the reduction in perigee and apogee altitudes (or radii) as shown in Figure 1.