

Space systems — Design, testing and operation of a **spacecraft**
large constellation of spacecraft

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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).

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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*.

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

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Introduction

There are more than a dozen ~~spacecraft~~ large ~~constellation programs~~ constellations of spacecraft are planned to be launched in the next several years. While large ~~constellation programs (defined in sub-clause 3.1) can~~ constellations can provide societal benefits to humanity, ~~such constellation~~ they can also ~~stressput pressure on~~ the orbital and electro-magnetic environments, introducing mission design, hardware design, launch, operations and disposal challenges to other operating space assets and the long-term sustainability of space activities.

This ~~technical specification document~~ provides a set of standard practices throughout the large constellation life cycle to promote safety on the ground from re-entry hazard and long-term sustainability of space operations.

In developing this ~~technical specification document~~, the practices of the existing large constellation programs, consensus in the Space Safety Coalition, “Best Practices for the Sustainability of Space Operations,”^{[1],[11]} the “Statement on Large Constellations”^{[2]-[21]} of the “Inter-Agency Space Debris Coordination Committee (IADC)”, ISO 24113—“~~Space, which specifies space~~ debris mitigation requirements”^[3], the “Guidelines for the Long-term Sustainability of Outer Space Activities” COPUOOS June 2021^{[3],[4]} and other effective documents were consulted.

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Space systems — Design, testing and operation of a ~~spacecraft~~ large constellation of spacecraft

1 Scope

This document provides requirements that are either unique or particularly relevant to large constellations of spacecraft (particularly when operating in the LEO protected region) throughout ~~its~~their life cycle, including planning, designing, testing, operating and disposal activities.

~~Basically, the~~ The requirements in this document are ~~imposed on the~~applicable to large constellation owners. While some are ~~imposed directly on them~~applicable to the constellation owners, others are allocated to the manufactures or operators under the responsibility of the constellation owners.

2 Normative reference

The following documents are referred to in the text in such a way that some or all of their ~~contents constitute~~content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 19389¹, Space data and information transfer systems — Conjunction data message

ISO 24113¹³, Space systems — Space debris mitigation requirements

ISO 26900², Space data and information transfer systems — Orbit data messages

3 Terms and definitions

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

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

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

— ~~—~~IEC Electropedia: available at <https://www.electropedia.org/>

~~3.1~~

~~(spacecraft)~~ 3.1

large constellation of spacecraft

large constellation

system of a hundred or more spacecraft working together ~~as a system.~~

~~NOTE—~~ Note 1 to entry: While providing a specific quantity of spacecraft, the size, mass, complexity and function of the spacecraft also have a bearing.

3.2

latitude range

band of geocentric latitude that spacecraft in two constellations may simultaneously occupy.

3.3

radial separation

distance between constellation orbits in the radial direction within a common latitude range (3.2), irrespective of ~~Right Ascension~~right ascension of ~~Ascending Node~~ascending node and timing (nodal regression and in-track motion).

¹ Adoption from CCSDS 508.0-B-1.

² Adoption from CCSDS 502.0-B-2.

3.4

useful life

operating duration in which a product is claimed to remain suitable and safe for its intended use when used as designed.

4 Abbreviated terms

CCSDS Consultative Committee for Space Data System

~~DoA Dead-on-Arrival~~

~~Ee Expected number of casualties~~

~~ITU International Telecommunication Union~~ ~~light emitting diode~~

~~LED low earth orbit~~

~~LEO reaction control system~~ ~~radio frequency interference~~

~~RCS Space Situational Awareness~~

~~RFI~~

~~SSA~~

DoA dead-on-arrival

ITU International Telecommunication Union

LED light emitting diode

LEO low Earth orbit

RCS reaction control system

RFI radio frequency interference

SSA space situational awareness

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5 Requirements

5.1 Mission design

5.1.1 Orbit selection of constellation and maintenance to minimise collision risk

5.1.1.1 Selection of orbit of constellation considering collision risk

The orbit of constellation shall be selected to minimise the probability of collision with other space objects.

5.1.1.2 Maintenance of radial separation from other constellations

The constellations shall be designed to maintain adequate radial separation from other large constellations to assure safe operations under both nominal and anomalous vehicle operating conditions.

5.1.2 Intra-constellation collision avoidance

5.1.2.1 Allocation of orbit of member spacecraft to minimise collision risk

Constellations shall be configured to mitigate collision risk between constellation spacecraft according to the threshold defined by approving agent.

5.1.2.2 ~~5.1.2.2~~ Allocation of orbit considering the contingencies

Constellations shall be configured such that constituent failures do not significantly elevate intra-constellation collision risk (e.g. by separating the orbit planes and radial profiles to avoid intersection points).