



DPC: 25/30482403 DC

BSI Group Headquarters

389 Chiswick High Road London W4 4AL

Tel: +44 (0)20 8996 9000

Fax: +44 (0)20 8996 7400

www.bsigroup.com

Date: 05 March 2025

Origin: International

Latest date for receipt of comments: 28 April 2025

Project No. 2023/02622

Responsible committee: ACE/68 Space systems and operations

Interested committees:

Title: Draft BS ISO 23705 Space systems — Identifying, evaluating, and avoiding collisions between orbiting objects.

Please notify admin.start@bsigroup.com if you are aware of any keywords that might assist in clarifying or identifying the standard or of the content of this standard:

- i) has any issues related to 3rd party IPR, patent or copyright
- ii) affects other national standard(s)
- iii) requires additional national guidance or information

WARNING: THIS IS A DRAFT AND MUST NOT BE REGARDED OR USED AS A BRITISH STANDARD. THIS DRAFT IS NOT CURRENT BEYOND 28 April 2025

This draft is issued to allow comments from interested parties; all comments will be given consideration prior to publication. No acknowledgement will normally be sent. **See overleaf for information on the submission of comments.**

No copying is allowed, in any form, without prior written permission from BSI except as permitted under the Copyright, Designs and Patent Act 1988 or for circulation within a nominating organization for briefing purposes. Electronic circulation is limited to dissemination by e-mail within such an organization by committee members.

Further copies of this draft may be purchased from BSI Shop <http://shop.bsigroup.com> or from BSI Customer Services, Tel: +44(0) 20 8996 9001 or email cservices@bsigroup.com. British, International and foreign standards are also available from BSI Customer Services.

Information on the co-operating organizations represented on the committees referenced above may be obtained from <https://standardsdevelopment.bsigroup.com/>.

E-mail: admin.start@bsigroup.com

Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

- **Annotated drafts are not acceptable and will be rejected.**
- All comments should be submitted online at <https://standardsdevelopment.bsigroup.com/>. You will need to register in order to comment.

Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
------------------	------------------------

1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



DRAFT International Standard

ISO/DIS 23705

Space systems — Identifying, evaluating, and avoiding collisions between orbiting objects

ICS: 49.140

ISO/TC 20/SC 14

Secretariat: **ANSI**

Voting begins on:
2025-03-05

Voting terminates on:
2025-05-28

This document is circulated as received from the committee secretariat.

THIS DOCUMENT IS A DRAFT CIRCULATED FOR COMMENTS AND APPROVAL. IT IS THEREFORE SUBJECT TO CHANGE AND MAY NOT BE REFERRED TO AS AN INTERNATIONAL STANDARD UNTIL PUBLISHED AS SUCH.

IN ADDITION TO THEIR EVALUATION AS BEING ACCEPTABLE FOR INDUSTRIAL, TECHNOLOGICAL, COMMERCIAL AND USER PURPOSES, DRAFT INTERNATIONAL STANDARDS MAY ON OCCASION HAVE TO BE CONSIDERED IN THE LIGHT OF THEIR POTENTIAL TO BECOME STANDARDS TO WHICH REFERENCE MAY BE MADE IN NATIONAL REGULATIONS.

RECIPIENTS OF THIS DRAFT ARE INVITED TO SUBMIT, WITH THEIR COMMENTS, NOTIFICATION OF ANY RELEVANT PATENT RIGHTS OF WHICH THEY ARE AWARE AND TO PROVIDE SUPPORTING DOCUMENTATION.

Reference number
ISO/DIS 23705:2025(en)

Full document details: 25/30482403 DC

© ISO 2025  **Documents**
Document Sharing Hub



COPYRIGHT PROTECTED DOCUMENT

© ISO 2025

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword	v
Introduction	vi
1 Scope	1
1.1 Breakdown of space safety constituents across ISO standards	1
2 Normative references	1
3 Terms and definitions	2
4 Symbols and abbreviated terms	3
4.1 Symbols	3
4.2 Abbreviated terms	3
5 CA Requirements for SSA systems and organizations	4
5.1 General Requirements	4
5.1.1 Documentation describing conjunction assessment methodology	4
5.1.2 Conjunction assessment operational concept	4
5.2 SSA systems and organizations responsibilities	4
5.2.1 Data exchange with SSA systems and organizations	4
5.2.2 Interface with S/C operators	4
5.2.3 Establishment of service conditions between S/C operators and SSA organisations	4
5.2.4 Update of the space object catalog for debris and non-cooperating operators	4
5.2.5 Update of the space object catalog for cooperating operators	4
5.2.6 Quality Assessment of the data used	5
5.2.7 Coordination with third parties	5
5.3 Risk assessment methodology	5
5.3.1 Screening threshold	5
5.3.2 CDM computation	5
5.3.3 Adopted spacecraft or debris equivalent cross-sectional area	5
5.3.4 Adopted spacecraft or debris mass	5
5.3.5 Spacecraft activity status	5
5.3.6 Notification and reporting of upcoming conjunctions	6
6 CA Requirements for Spacecraft Operators	6
6.1 General Requirements	6
6.1.1 Documentation describing collision avoidance methodology	6
6.1.2 Collision avoidance operational concept	6
6.2 Spacecraft operator collision risk mitigation and notification responsibilities	8
6.2.1 General	8
6.2.2 Spacecraft collision avoidance metrics and thresholds	8
6.2.3 Data exchange with relevant stakeholders	8
6.2.4 Spacecraft attitude reorientation to minimize collision risk	9
6.2.5 Collision avoidance manoeuvre coordination	9
6.2.6 Spacecraft manoeuvrability categories	10
6.2.7 Communication of operator interpretation of manoeuvre rules, planned avoidance manoeuvres, and spacecraft status	10
6.2.8 Collision avoidance manoeuvre Go/No-Go thresholds	10
6.2.9 Post-CAM collision probability targets	10
6.2.10 Obtaining sufficiently accurate STC	11
6.2.11 Avoiding introduction of new collisions	11
6.2.12 Timeline of collision avoidance manoeuvres	11
Annex A (informative) Collision probability estimation methods	12
Annex B (informative) Covariance realism and relationship between sigma span and probability density percentage	20
Annex C (informative) Perceiving close approaches	23

Annex D (informative) Notification of potential collisions for warning and further action	26
Annex E (informative) Relationship between combined object size, combined positional error, and maximum probability	30
Annex F (informative) Probability contour visualization	32
Bibliography	42

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).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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*.

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.

Introduction

This document specifies the workflow for perceiving, evaluating, and avoiding collisions among orbiting objects, data requirements for these tasks, techniques that can be used to estimate the probability of collision and guidance for executing avoidance manoeuvres.

The process begins with obtaining orbital data from observations provided by spacecraft operators or sensor systems developed for this purpose. Spacecraft orbits can be compared with each other to discern physically feasible approaches that could result in collisions. The trajectories so revealed can then be examined more closely to estimate the probability of collision. Where the possibility of a collision has been identified within the criteria established by each spacecraft operator, the spectrum of feasible maneuvers is examined.

The avoidance process begins with obtaining the best possible positional information on all potentially conjuncting objects obtained from a combination of spacecraft operator and/or STC^[1] systems. The content of which is specified in ISO 26900.^[2] The data can be provided by collaborating spacecraft operators and from observers who are capable of viewing spacecraft. It is also important to know the nature of each object if possible. This information includes size, mass, geometry, and the operational state (e.g., active or inactive). Collision probability estimates consider the inevitable imprecision associated with orbit determination and other hypotheses and measurements. This information then allows decision makers to take an effective course of action as shown in the top-level workflow contained in [Figure 1](#).

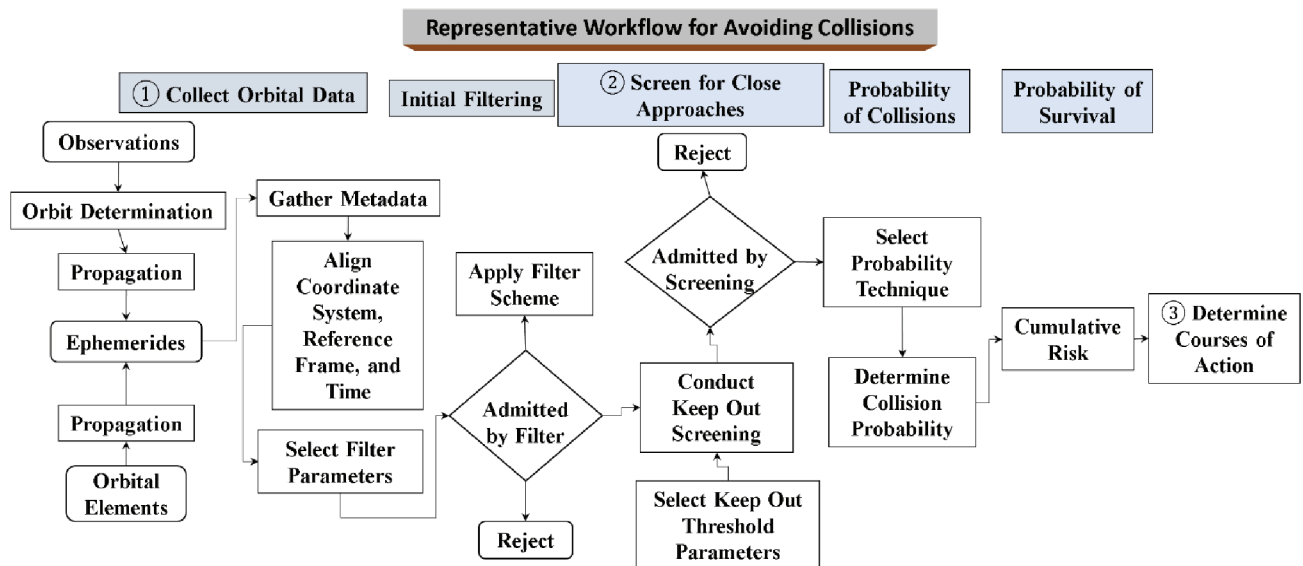


Figure 1 — Top-level collision avoidance workflow

There are several different approaches to conjunction assessment. All have merits and deficiencies. Many focus on how closely spacecraft approach each other. This is often very uncertain since spacecraft orbits generally change more rapidly under the influence of non-conservative forces than observations of spacecrafts in orbit can be acquired and employed to improve orbit estimates. Spacecraft operators require the fullness of orbit data to judge the credibility and quality of conjunction perception. This information includes the moment of time of the last elaboration of orbit (the epoch) and the standard time scale employed, positional ephemerides or orbit state vector values or elements at that moment in time, the coordinate system description that presents the orbital data, the forces model description that was used for orbital predictions, and information about the estimated positional errors associated with those predictions. Essential elements of information for this purpose are specified in ISO 26900^[2].

There are also diverse approaches to estimating the probability that a close approach might really result in a collision. This is a statistical process very similar to weather forecasting. Meteorologists no longer make definitive predictions. They provide the probability of precipitation, not whether it will rain. All

conjunction assessment approaches are in some way founded in probabilities. Probability of collision is also a highly desirable element of data. It can be accompanied by metadata that allows operators to interpret the information within their own operational procedures.

How near two spacecraft might be to each other and the probability they might collide if they were that close are only two discriminants of potentially catastrophic events. Since the objective is that the spacecraft survives despite many potential close approaches, cumulative probability of survival is also important information. Responding precipitously to the close approach nearest at hand might only delay the demise of the spacecraft or even contribute to a subsequent more serious event. The evolution of close approaches is thus also important.

Finally, the state of each of the conjunction partners, their ability to maneuver or otherwise avoid contact, and the outcomes of past events that are similar guide courses of action.

Space systems — Identifying, evaluating, and avoiding collisions between orbiting objects

1 Scope

This document provides the workflow and technical requirements for perceiving, evaluating, and avoiding collisions among orbiting objects, data requirements for these tasks, identifies techniques that can be used to estimate the probability and/or consequence of collision, and provides guidance and requirements for executing collision avoidance maneuvers.

1.1 Breakdown of space safety constituents across ISO standards

The space flight safety-relevant topics of Space Traffic Coordination, on-orbit collision avoidance, and launch collision avoidance are closely related. To minimize duplication and maximize document consistency, the various content that serve as the basis for these three disciplines has been divided up as shown in [Figure 2](#).

• ISO 9490: STC

- STC terminology
- STC system, QC, IS, reliability
- STC roles/responsibilities for launch providers, S/C operators, and SSA providers
- STC & SSA services
- Orbit determination, required accuracy, timeliness
- Maneuverability RotR/
- Maneuver recommendations
- Data exchange and launch, maneuver, anomaly, and fragmentations notifications
- STC mathematical techniques

• ISO 23705: Avoid collision

- Conjunction assessment and collision avoidance terminology
- Risk mitigation strategies
- Suggested collision miss distance and probability/risk metrics and associated minimum thresholds
- Mathematical techniques:
 - Conjunction assessment
 - Collision probability
 - Linear, Non-linear,
 - Asymmetric, Max Prob
 - CAM planning, optimize
 - CA nomograms

• ISO 21740: LCOLA

- LCOLA terminology: Safety LCOLA and Mission Assurance LCOLA
- LCOLA launch window screening process
- LCOLA products
- Launch range coordination
- LCOLA data exchange (LDM)
- LCOLA mathematical techniques

Figure 2 — Division of space safety operations content spanning several ISO standards.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their 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/TR 11233, *Space systems — Orbit determination and estimation — Process for describing techniques*

ISO 26900, *Space data and information transfer systems — Orbit data messages*

ANSI/AIAA S-131-2010, *Best Practices in Astronautics: Propagation*

AIAA G-043-1992, *Guide to Developing Operational Concepts*

3 Terms and definitions

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

ISO and IEC maintain 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 collision

act of colliding; an instance of one object striking another

3.2 collision probability

A quantification of the likelihood of two objects impacting each other during a specific encounter

3.3 conjunction

apparent meeting or passing of two or more objects in space

3.4 covariance

measure of how much variables change together

Note 1 to entry: For multiple dependent variables, a square, symmetric, positive definite matrix of dimensionality $N \times N$, where N is the number of variables.

3.5 encounter plane

plane normal to the relative velocity at the time of closest approach.

3.6 ephemeris

A time history of positional and velocity (and optionally acceleration and covariance) state information.

3.7 false alarm

statistical error, when a statistical test fails to reject a false null hypothesis.

3.8 interface control document

specification that describes the characteristics that must be controlled at the boundaries between systems, subsystems, and other elements.

3.9 mission operations concept

description, in operator and user terms, of the operational attributes of a mission's flight and ground elements

3.10 orbital elements

parameters that describe the evolution of the trajectory and which can be used to estimate the trajectory in the future.

3.11 scaled Pc

Scaled collision probability, where the collision probability is estimated using covariance matrices that have been numerically adjusted by the square of a scaling factor.

4 Symbols and abbreviated terms

4.1 Symbols

(TBD)

4.2 Abbreviated terms

ANSI	American National Standards Institute
AIAA	American Institute of Aeronautics and Astronautics
CA	Conjunction Assessment
CAM	Collision avoidance manoeuvre
CCSDS	Consultative Committee for Space Data Systems
CDM	Conjunction Data Message
COLA	COLLision Avoidance
ESA	European Space Agency
FDS	Flight Dynamics Staff
GEO	Geostationary earth orbit
HEO	High earth orbit
JCA	Just-in-time Collision Avoidance
LCOLA	"Launch COLLision Avoidance" or "Launch COLA"
LEO	Low earth orbit
LTS	Long-Term Sustainability
MEO	Medium earth orbit
O/O	Owner/Operator
NASA	National Aeronautics and Space Administration
PDF	Probability Distribution Function
RCS	Radar Cross Section
SANA	Space Assigned Numbers Authority
S/C	Spacecraft
SSA	Space situational awareness
SST	Space Surveillance and Tracking
STM	Space traffic management
STC	Space traffic coordination

TCA	Time of Closest Approach
UTC	Coordinated Universal Time

5 CA Requirements for SSA systems and organizations

5.1 General Requirements

5.1.1 Documentation describing conjunction assessment methodology

SSA systems and organizations shall create **and** maintain documentation describing their own catalogue update strategies (including detection of new objects), update of external orbits (ephemerides from spacecraft operators, catalog maintained by other SSA entities), assessment of the quality of the data used, conjunctions detection, risks assessment and mitigation strategy provision.

NOTE These data requirements enable a well-understood workflow and interactions among the potentially several organizations that can interact to mitigate the potential consequences of conjunctions and collisions.

5.1.2 Conjunction assessment operational concept

SSA systems and organizations shall develop and maintain an operational concept that describes the roles, relationships, tasks, processes, and information flows amongst stakeholders and the way systems and processes will be used to provide conjunction assessment to spacecraft operators.

5.2 SSA systems and organizations responsibilities

5.2.1 Data exchange with SSA systems and organizations

SSA systems and organizations shall have the capability to exchange orbits and measurements with other SSA systems and organizations, and with SST data providers.

NOTE The use of machine-to-machine interfaces as well as CCSDS standards is recommended when applicable.

5.2.2 Interface with S/C operators

Organizations conducting conjunction assessments shall provide an interface to operators to receive input data (such as ephemerides) and generate CDMs.

5.2.3 Establishment of service conditions between S/C operators and SSA organisations

Exact service conditions shall be achieved between the satellite operator and the SSA organization(s) before the start of the service and clarify the liability of the SSA systems and organizations; and unless specified otherwise, the owners and operators are responsible for deciding mitigating courses of action.

NOTE Such conditions may already be established for all participants in a common definition of services, adopted data exchange formats, and definition of liability. In cases where these are not established by default or if not well-suited for a particular spacecraft operator, an interface document may be required to delineate such terms as agreed between SSA organizations and spacecraft operators (cf [6.2.3.3](#)).

5.2.4 Update of the space object catalog for debris and non-cooperating operators

Organizations conducting conjunction assessments shall obtain or maintain the most current, complete, timely, and accurate SSA catalog data on debris and non-cooperating actively maneuvering spacecraft, by building their own catalog and/or by acquiring data from an external entity.

5.2.5 Update of the space object catalog for cooperating operators

SSA system or organization shall keep up to date their database of orbits shared by spacecraft operators.

5.2.6 Quality Assessment of the data used

Organizations conducting conjunction assessments shall check the consistency of external data before use, by performing comparisons with statistical analysis, with measurements or with other orbits sources.

NOTE Organizations conducting conjunction assessments should notify S/C operators if the ephemerides or covariances provided does not pass the quality checks.

5.2.7 Coordination with third parties

In case of a conjunction between two or more active S/C, organizations shall have the capability to describe their risk assessment process, methodology, and analysis results to any parties unfamiliar with them.

5.3 Risk assessment methodology

5.3.1 Screening threshold

Organizations conducting conjunction assessments shall use the risk assessment methodology, screening metrics, and associated thresholds as specified by their decision authority.

NOTE 1 Suggested minimum metrics and thresholds are provided in informative C.

NOTE 2 See [3] for representative metrics and thresholds used by commercial spacecraft operators.

5.3.2 CDM computation

Organizations conducting conjunction assessments shall consider all information available to compute CDM and provide an easy mean to enable the user to differentiate the data source (O/O ephemerides, own catalog, external catalogs) used for the primary and secondary objects.

NOTE Organizations conducting conjunction assessments should be able to identify which orbit source is the most adequate for a given conjunction at a given time.

5.3.3 Adopted spacecraft or debris equivalent cross-sectional area

Organizations conducting conjunction assessments shall obtain or define the estimated “Equivalent Cross-Sectional Area” for the spacecraft and/or debris object involved in the conjunction based on the following priority order: data provided by Spacecraft operator or debris originator, computed from geometry available on open-source information, default values derived from RCS or optical magnitude information, or a default value when no information is available.

5.3.4 Adopted spacecraft or debris mass

Organizations conducting conjunction assessments shall obtain or define the estimated mass of the spacecraft and/or debris object involved in the conjunction based on the following priority order: data provided by spacecraft operator or debris originator, open-source information available, default values derived from RCS or optical magnitude information, or a default value when no information is available.

5.3.5 Spacecraft activity status

Organizations conducting conjunction assessments shall obtain the operational status of any spacecraft involved in a conjunction.

5.3.6 Notification and reporting of upcoming conjunctions

Organizations conducting conjunction assessments shall alert operators of conjunctions that exceed predefined metric thresholds as specified by their respective decision authority.

NOTE 1 Examples of conjunction metrics and thresholds are provided in informative [Annex D](#). Such thresholds typically support the identification of three separate phases of the analysis: (1) initial screening; (2) warning associated with the adopted reporting criteria; and (3) exceedance of the Go/No-Go avoidance maneuver threshold.

NOTE 2 Organizations conducting conjunction assessments should be able to provide mitigation actions recommendation for a few standard cases (such as a chemical maneuver performed 0,5 orbits before TCA) and help the Spacecraft operator to define its mitigation strategy.

6 CA Requirements for Spacecraft Operators

6.1 General Requirements

6.1.1 Documentation describing collision avoidance methodology

Spacecraft operators shall create and maintain documentation describing their collision avoidance detection, evaluation, and mitigation strategies.

NOTE These data requirements enable a well-understood workflow and interactions among the potentially several organizations that can interact to mitigate the potential consequences of conjunctions and collisions.

6.1.2 Collision avoidance operational concept.

Spacecraft operators shall develop and maintain an operational concept that describes the roles, relationships, tasks, processes, and information flows amongst stakeholders and the way systems and processes will be used to perform collision avoidance actions.

NOTE 1 Since conjunction and collision assessment involves multiple stakeholders, providers, and action recipients, a commonly understood, normative operational concept is essential. [Figure 3](#) and [Figure 4](#) provide a representative operational concept depicting each of the elements in the collision avoidance workflow.

NOTE 2 There are several guides for developing and maintaining operational concepts (e.g. see ISO 14950, ISO 17666 and ISO 19971).