



**International
Standard**

ISO 14620-4

**Space systems — Safety
requirements —**

Part 4:

**Spacecraft assembly, integration
and test**

Systèmes spatiaux — Exigences de sécurité —

Partie 4: Assemblage, intégration et test d'engins spatiaux

**First edition
2025-02**

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Published in Switzerland

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Foreword

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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 document 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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This document was prepared by Technical Committee 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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Space systems — Safety requirements —

Part 4: Spacecraft assembly, integration and test

1 Scope

This document provides requirements for the safety management and operation of assembly, integration and test (AIT) activities related to spacecraft projects and applications including the responsibilities of the organization involved in the AIT operations for spacecraft products.

This document provides a method to identify hazards, control and reduce safety risk to acceptable levels in the activities of spacecraft assembly, integration, testing, hoisting, logistics and handling.

This document is applicable to space test centres and entities providing operating infrastructure and facilities for spacecraft AIT. It can serve as a reference for the AIT of the spacecraft system, its subsystems and equipment.

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 10795, *Space systems — Programme management and quality — Vocabulary*

ISO 14620-1, *Space systems — Safety requirements — Part 1: System safety*

ISO 14620-2, *Space systems — Safety requirements — Part 2: Launch site operations*

ISO 14625, *Space systems — Ground support equipment for use at launch, landing or retrieval sites — General requirements*

ISO 17666, *Space systems — Risk management*

ISO 18322, *Space systems — General management requirements for space test centres*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 10795 and the following 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

logistics

science and practice of interconnecting, and finding the best way of goal attainment, for bringing material objects or living beings in sufficient quantity to the right place in the right time.

[SOURCE: ISO 5127:2017, 3.1.2.26]

3.2

operator

governmental or non-governmental entities, international organization, or natural person carrying out a space operation independently and under its responsibility.

[SOURCE: ISO 14620-2:2019, 3.15]

3.3

risk

undesirable situation or circumstance that has both a likelihood of occurring and a potential negative consequence on a project

Note 1 to entry: Risks arise from uncertainty due to lack of predictability or control of events. Risks are inherent to any project and can arise at any time during the project life cycle; reducing these uncertainties reduces the risks.

[SOURCE: ISO 17666:2016, 3.1.12]

3.4

space test centre

complete entity including the organization which provides, maintains, develops and operates test facilities for space project and applications including accompanied services

[SOURCE: ISO 18322:2017, 3.7]

3.5

safety risk

measure of the potential consequences of a hazard considering the probability of the associated mishap, the harm caused to people and the damage caused to public and private property and the environment

Note 1 to entry: The safety risk is defined to be differentiated from political, financial, industrial, project, and other risks (3.3).

Note 2 to entry: An example of a safety risk is the expected number of casualties.

[SOURCE: ISO 14620-2:2019, 3.19]

3.6

safety representative

representative from the *space test centre* (3.4) management with designated responsibility for safety

[SOURCE: ISO 18322:2017, 3.5, modified — Note 1 to entry has been removed.]

4 Abbreviated terms

AIT assembly, integration and test

GSE ground support equipment

5 Safety organization

5.1 General

The safety organization shall be established to organize, inspect and implement safety activities in the AIT process.

5.2 Requirements for the safety organization

The following requirements apply to the safety organization.

a) The safety organization shall be established in accordance with ISO 14620-1.

ISO 14620-4:2025(en)

- b) Operations at the launch site shall conform to the safety requirements specified in ISO 14620-2.
- c) Ground support equipment used for launch, landing or retrieval operations shall meet the general requirements specified in ISO 14625.
- d) Space test centres shall meet the general management requirements specified in ISO 18322.
- e) The safety organization shall ensure that safety requirements and related AIT tasks are appropriately integrated into all project plans and procedures.
- f) The implementation of safety requirements shall be verified at defined intervals.

5.3 Safety representative

The following requirements apply to the safety representative.

- a) The safety representatives shall coordinate with all relevant bodies, including the safety launcher authority, medical boards, radiation protection committees, industrial safety organizations and environmental protection agencies.
- b) The safety representative:
 - 1) shall have the right to obtain all safety-related information;
 - 2) shall report to the project manager;
 - 3) shall have access to top management;
 - 4) shall have the authority to report safety issues independently;
 - 5) shall not be restricted by any organization in any aspect of safety.

5.4 Personnel

The following requirements apply to operating personnel involved in spacecraft AIT.

- a) Personnel shall be qualified in fundamental safety skills related to inspection, testing, maintenance and operation in the AIT process.
- b) Personnel performing or controlling hazardous operations, or handling, using or transporting hazardous materials, shall be trained and qualified with the necessary knowledge, skills and, if specified in the job description, abilities to perform the job safely.

NOTE This rule applies to tasks that pose an immediate danger to the operator (death or injury) if not performed correctly, or that can endanger others nearby (death or injury) or cause damage to surrounding equipment or facilities.

- c) Personnel shall have successfully completed safety and technical training and shall be familiar with the safety measures, safety plans and responsibilities associated with the operations they perform.
- d) All contractor personnel engaged in potentially hazardous operations or the handling of hazardous materials shall be qualified through similar training as described in item c).
- e) Operators shall wear dust resistant and anti-static work clothes, safety helmets and safety belts.
- f) During spacecraft integration, operators shall wear:
 - 1) split suit anti-static work clothes with tight cuffs and without pockets and buttons;
 - 2) anti-static wristbands according to the needs of work.
- g) When handling thermal control materials or other sensitive spacecraft products, operators shall wear masks and anti-static gloves or finger covers.

- h) Operators shall wear protective equipment in the work area.
- i) Unauthorized personnel shall not enter the work area.

6 Safety programme

6.1 General

- a) The safety programme:
 - 1) shall be established in accordance with ISO 14620-1:2018, Clause 4, to ensure that during AIT activities, the safety of spacecraft products, personnel (including customers and visitors), ground support equipment, facilities and the environment is fully addressed, taking full responsibility for safety performance during products testing;
 - 2) shall take into account the applicable safety requirements of either the spacecraft or the project, or both;

NOTE The objective of the safety programme is to ensure that all safety risks associated with the AIT, handling and logistics of spacecraft products are adequately identified, assessed, minimized, controlled and finally accepted. The safety programme includes the identification of hazards, assessment of safety risks, implementation of control measures for unacceptable risks, reassessment of risks following control measures and the reduction of risks to an acceptable level.
 - 3) shall ensure that all hazards related to spacecraft AIT are systematically identified, risks are assessed, and where risks are unacceptable, control measures are recommended to eliminate or mitigate the hazards.
- b) Information, data and analysis results obtained during hazard analysis and safety risk assessment shall be communicated to design, operations and management teams in a timely manner to implement early measures for effectively ensuring safety.
- c) Interfaces shall be established between the safety programme and other plans and programmes (e.g. AIT, handling, reliability, quality assurance) to integrate relevant data and information into hazard analysis and safety risk assessment.

6.2 Hazard analysis

The purpose of the hazard analysis is to identify, at an early stage, hazards related to spacecraft AIT that can pose a threat to the safety of personnel, spacecraft products and facilities.

The AIT phase hazard analysis shall cover at least the following aspects:

- a) hazardous materials (e.g. propellants, gunpowder, explosive devices, toxic substances, power supplies, radioactive materials, and high-pressure gas sources);
- b) the environment in which the system operates, including the natural environment and induced environments (e.g. vibration, shock, extreme temperatures, vacuum, electromagnetic interference);
- c) system functional faults or abnormal operating conditions;
- d) defects in safety-critical instructions and control software;
- e) risks that may arise or be introduced during AIT, handling or logistics;
- f) incorrect operation;
- g) the storage, handling and transportation of hazardous materials;
- h) safety-related equipment, safety protection devices and other safety assurance measures;
- i) analysis of safety requirements and lessons learned from similar previous operations.

6.3 Safety risk assessment

The purpose of the safety risk assessment is to analyse the identified hazards related to spacecraft AIT by evaluating the risk level based on severity and occurrence probability and to determine the need for risk reduction measures.

The following requirements apply for safety risk assessment.

- a) The safety risk assessment shall be performed for each identified hazard in accordance with ISO 17666.
- b) The safety risk assessment shall determine the risk level for each identified hazard based on severity and occurrence probability.
- c) Hazard severity shall be classified as catastrophic, critical, marginal and negligible in accordance with the definitions in ISO 14620-1.
- d) The safety risk assessment shall determine the acceptability of each risk based on the safety policy and accordingly, identify the need for control measures.
- e) A safety risk assessment report shall be prepared; and the results of the assessment shall be considered a key element in the special safety review to ensure that any remaining risks are acceptable.

6.4 Safety risk control

6.4.1 Purpose of safety risk control

The purpose of safety risk control is to reduce unacceptable safety risks or safety-critical items to an acceptable level.

6.4.2 Safety risk control measures

For the selection and implementation of safety risk control measures the following order applies.

- a) Elimination of hazards: hazards should be eliminated from the operational scheme by aligning task objectives with the selection of assembly and test operations.
- b) Minimum risk design: for hazards that cannot be eliminated, sufficient safety margins shall be ensured to control the risk to a minimum acceptable level.
- c) Safety measures: automatic or other operational measures may be implemented to reduce risks to an acceptable level.
- d) Warning design: warning devices should be established to alert personnel if safety measures cannot fully eliminate the hazard or reduce its associate risk to an acceptable level.
- e) Safety operation procedures and training: specific safety operation procedures should be developed and necessary trainings provided for risks that cannot be eliminated through design, safety measures or warning devices.

6.4.3 Safety critical items

The following requirements apply to the definition of control measures for safety-critical items.

- a) The production and test documents of safety-critical parts shall be appropriately identified (e.g. safety-critical characteristics, critical processes, critical parts).
- b) The AIT and handling of items with potential hazards to personnel or hardware shall be optimized for operational safety; and traceability shall be maintained.
- c) Safety-critical items (including safety-critical operation procedures), control methods and test requirements of safety-critical items shall be tracked.

6.5 Verification of safety risk control measures

The following requirements apply to the verification of safety risk control measures.

- a) The implementation of process control measures and safety improvement measures for safety-critical items shall be verified.
- b) When safety control measures require verification at a mandatory inspection point, the safety inspection shall be conducted during the AIT phase accordingly.
- c) After verification of implementation, the safety risk assessment shall be repeated to update the product AIT and process operation risks, and to re-evaluate whether the control measures effectively meet the safety requirements.
- d) The documentation shall be updated to consider system configuration modifications, and updates to safety-critical items and corresponding control requirements.
- e) Unresolved residual risks shall be comprehensively documented and prepared for management review to support decisions regarding their acceptance.

6.6 Safety documentation

6.6.1 General

The following requirements apply to the safety documentation.

- a) Contingency plans for the spacecraft, its subsystems, test equipment and infrastructure shall be documented.
- b) Safety-related documents or forms shall be developed to ensure the traceability of safety activities.
- c) Hazardous materials and risk factors involved in the spacecraft AIT process shall be identified; and the related documentation shall be approved by the safety representative.
- d) Clear signboards for hazardous materials, protective measures and the emergency response plan shall be established and maintained at all times.

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6.6.2 Safety summary records

The following requirements apply to safety summary records.

- a) The safety status shall be reported and documented at the end of each test phase.
- b) If an emergency occurs during AIT, the outcome of the emergency response shall be recorded.
- c) If a safety incident occurs during AIT, the treatment process, rescue efforts, accident losses and post-incident actions shall be investigated and clarified.
- d) Lessons learned from safety events shall be made public and used to continuously improve the safety management system, safety programme and safety requirements.

6.6.3 Safety inspection records

The following requirements apply to safety inspection records.

- a) All safety reviews, inspections and checks shall be recorded.
- b) Records shall be stored for at least the lifetime of the corresponding spacecraft to ensure traceability of the AIT process.
- c) Records shall be available for review at any time.