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

*Systèmes spatiaux — Équipements de soutien au sol utilisés sur les
sites de lancement, d'atterrissage ou de récupération — Exigences
générales*

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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 14625 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 first edition (ISO 14625:1999), which has been technically revised.

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Introduction

This International Standard is intended to be used when designing new ground support equipment (GSE) that support space system (launch vehicle or payload) programmes or projects. Existing programmes and projects may utilize this International Standard as far as is practical in accordance with sound management and engineering practices.

The edition of this International Standard applicable at the time the decision is taken to design, construct, manufacture or procure a given GSE remains applicable for the useful life of the hardware. However, if modifications are made to existing hardware, these can be done in accordance with the edition of this International Standard applicable at the time the modification is decided.

When this International Standard is used in procurement, it is advisable that it be reviewed by the programme/project office for applicability, and that only the clauses that apply to the project or programme be included in the procurement documentation.

This International Standard can also be used as a template for the development of specific programme or project GSE specifications or standards.

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

1 Scope

This International Standard specifies the general characteristics, performance, design, test, safety, reliability, maintainability and quality requirements for ground support equipment (GSE) and systems intended for use at launch, landing or retrieval-site installations, or other locations that are the responsibility of the launch, landing and retrieval site. This International Standard does not specify how to design GSE, but establishes the minimum requirements to provide simple, robust, safe, reliable, maintainable and cost-effective GSE.

This International Standard is applicable to the design of non-flight hardware and software used to support the operations of transporting, receiving, handling, assembly, inspection, test, checkout, service, launch and recovery of space vehicles and payloads at the launch, landing or retrieval sites. As such, the requirements of this International Standard are optional for hardware used only at the manufacturing, development or test sites prior to arrival at the launch, landing or retrieval sites. However, if such GSE is temporarily used at a launch, landing or retrieval site, for whatever reason, conformity with all the safety-related requirements of this International Standard is a minimum requirement for the GSE.

NOTE In the event of conflict between the documents listed in Clause 2 and the contents of this International Standard, the contents of this International Standard supersede except where otherwise noted. The applicable contract or purchase/procurement order takes precedence over the contents of this International Standard in the event of conflicting requirements. No part of this International Standard is deemed or otherwise used to supersede any locally applicable law or regulation, unless a specific exemption has been obtained for this purpose from the appropriate Authority.

2 Normative references

The following referenced documents are indispensable for the application 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 898-7, *Mechanical properties of fasteners — Part 7: Torsional test and minimum torques for bolts and screws with nominal diameters 1 mm to 10 mm*

ISO 1000, *SI units and recommendations for the use of their multiples and of certain other units*

ISO 1949, *Aircraft — Electrical connectors — Design requirements*

ISO 1966, *Crimped joints for aircraft electrical cables*

ISO 2635, *Aircraft — Conductors for general purpose aircraft electrical cables and aerospace applications — Dimensions and characteristics*

ISO 2964, *Aerospace — Tubing — Outside diameters and thicknesses — Metric dimensions*

ISO 6346, *Freight containers — Coding, identification and marking*

ISO 14625:2007(E)

- ISO 14620-1, *Space systems — Safety requirements — Part 1: System safety*
- ISO 14621 (all parts), *Space systems — Electrical, electronic and electromechanical (EEE) parts*
- ISO 14624 (all parts), *Space systems — Safety and compatibility of materials*
- ISO 14952 (all parts), *Space systems — Surface cleanliness of fluid systems*
- ISO 15389, *Space systems — Flight-to-ground umbilicals*
- ISO 15859 (all parts), *Space systems — Fluid characteristics, sampling and test methods*
- ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*
- ISO 22538 (all parts), *Space systems — Oxygen safety*
- IEC 60034 (all parts), *Rotating electrical machines*
- IEC 60038, *IEC standard voltages*
- IEC 60079 (all parts), *Electrical apparatus for explosive gas atmospheres*
- IEC 60096 (all parts), *Radio-frequency cables*
- IEC 60169 (all parts), *Radio-frequency connectors*
- IEC 60189 (all parts), *Low-frequency cables and wires with PVC insulation and PVC sheath*
- IEC 60227 (all parts), *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V*
- IEC 60245 (all parts), *Rubber insulated cables — Rated voltages up to and including 450/750 V*
- IEC 60297 (all parts), *Dimensions of mechanical structures of the 482,6 mm (19 in) series*
- IEC 60309 (all parts), *Plugs, socket-outlets and couplers for industrial purposes*
- IEC 60364 (all parts), *Electrical installations of buildings*
- IEC 60794 (all parts), *Optical fibre cables*
- IEC 60874 (all parts), *Connectors for optical fibres and cables*
- IEC 60884 (all parts), *Plugs and socket-outlets for household and similar purposes*
- IEC 60947 (all parts), *Low-voltage switchgear and controlgear*
- IEC 61000 (all parts), *Electromagnetic compatibility (EMC)*
- IEC 61086 (all parts), *Coatings for loaded printed wire boards (conformal coatings)*
- IEC 62305 (all parts), *Protection against lightning*
- IEC 62326 (all parts), *Printed boards*

3 Terms and definitions, symbols and abbreviated terms

3.1 Terms and definitions

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

3.1.1

cognizant authority

organization that is recognized as having expertise in one or more technical disciplines

EXAMPLE ISO, IEC.

3.1.2

commercial-off-the-shelf

COTS

equipment, including hardware and associated software/procedures, that is commercially available from current industry inventory

3.1.3

critical weld

weld whose single failure during any operating condition could result in injury to personnel or damage to property or flight hardware

3.1.4

flight hardware lifting device

structural or mechanical items between the crane hook and the flight vehicle interface that are used to lift the flight hardware

EXAMPLE Sling, cable, shackle, beam.

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3.1.5

ground support equipment

GSE

non-flight systems, equipment or devices necessary to support the operations of transporting, receiving, handling, assembly, inspection, test, checkout, servicing, launch and recovery of a space system at launch, landing or retrieval sites

3.1.6

safety critical

any condition, event, operation, process, equipment or system with a potential for personnel injury, fatality or damage to, or loss of, equipment or property

3.1.7

safety factor

ratio of ultimate strength, breaking strength or yield strength to the material design limit stress

3.1.8

safe working load

assigned load, as shown on the identification tag, which is the maximum load the device or equipment is permitted to handle and maintain in operation

3.1.9

sneak circuit

unexpected path or logic flow within a system that, under certain conditions, can initiate an undesired function or inhibit a desired function

NOTE Sneak circuits are not the result of hardware failure, but are latent conditions inadvertently designed into the hardware, or coded into the software, and triggered by timing or human error.

3.2 Symbols and abbreviated terms

A-50	aerazine-50
CFC	chlorofluorocarbon
CIL	critical items list
COTS	commercial off-the-shelf
ECS	environmental control system
EEE	electrical, electronic and electromechanical
EMC	electromagnetic compatibility
EMI	electromagnetic interference
FMECA	failure mode, effects and criticality analysis
GSE	ground support equipment
ICD	interface control document
LH ₂	liquid hydrogen
LHe	liquid helium
LN ₂	liquid nitrogen
LOX or LO ₂	liquid oxygen
MMH	monomethylhydrazine
NDT	non-destructive test
NH ₃	ammonia
N ₂ H ₄	hydrazine
N ₂ O ₄	nitrogen tetroxide
OMD	operations and maintenance documentation
PCB	polychlorobiphenyl
PHE	propellant handlers ensemble
PVC	polyvinyl chloride
RF	radio frequency
SCAPE	self-contained atmospheric protective ensemble
SCC	stress corrosion cracking
SI	international system of units
UDMH	unsymmetrical dimethylhydrazine

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4 General

The general design requirements and criteria described in this International Standard are the minimum requirements necessary to meet the needs and expectations of internal customers (e.g. safety, reliability, maintainability, quality, supportability) in a cost-effective manner. In order to meet customer expectations, GSE may need requirements that are more stringent than those specified herein. In such cases, requirements that exceed the provisions described in this International Standard shall be determined by the responsible design organization in consultation with its customers (e.g. users, operators).

5 Functional designations

5.1 General

GSE covered by this International Standard shall be classified according to one of the functional designations given in 5.2 to 5.6. Under each functional designation, GSE can be classified by criticality, whereby the GSE

- a) either physically or functionally interfaces with flight hardware/software,
- b) is classified as safety critical, and/or
- c) generates data used in determining flight worthiness/certification.

The GSE is assessed as safety critical if loss of the GSE or improper performance could result in loss of life, loss of flight hardware or damage to flight hardware. The GSE defined herein shall be subject to the configuration control requirements specified in the approved programme configuration management plan.

5.2 Servicing GSE

Servicing GSE is equipment used to supply electrical power or fluids to the flight hardware and/or associated GSE. Typical functions of servicing GSE are those functions of storage, transfer, flushing, purging, pressurizing, conditioning, vapour disposal and decontamination of propellants and other fluids required by the flight hardware up to and including the launch terminal count and/or lift-off.

5.3 Checkout and test GSE

Checkout and test GSE is equipment used in the test and checkout of flight hardware and/or associated GSE. Typical functions of checkout and test GSE are the functions of stimuli monitoring and evaluation.

5.4 Handling and transportation GSE

Handling and transportation GSE is equipment used for the movement and support of flight hardware and/or associated GSE. Typical types of equipment used in the handling and transportation category are slings, dollies, trailers, shipping containers, support stands, jacks, hoists, strongbacks and special handling mechanisms.

5.5 Auxiliary GSE

Auxiliary GSE is equipment used to align, access, protect and calibrate flight hardware. Auxiliary GSE includes, but is not limited to, protective devices, access stands and platforms, and alignment or calibration hardware.

5.6 Umbilical GSE

Umbilical GSE is equipment used to interface directly with flight hardware for transfer of fluids, electrical power or electronic signals to and from the flight vehicle element intended for use up to and including launch terminal count and/or lift-off.

6 Characteristics

6.1 Performance characteristics

6.1.1 Operability

GSE shall support the flight hardware operational requirements and shall be designed to ensure that it does not degrade or contaminate associated flight or ground systems, subsystems or experiments during use, checkout, servicing or handling.

6.1.2 Interfaces

GSE shall meet the requirements of all interfaces with new or existing flight and facility hardware or software. Future system compatibility shall be in accordance with identified interfaces. GSE hardware shall meet the requirements of the applicable interface control document (ICD).

6.1.3 Producibility

GSE hardware shall provide for ease of production, manufacture, construction and inspection. Special care shall be taken to avoid imposing close manufacturing tolerances, unless required by design and performance.

6.2 Physical characteristics

6.2.1 Limited life

Use of items with a life of less than the useful life of the system or equipment for which the items are intended, shall be avoided whenever possible. Items with limited life shall be identified. Identified limited-life items shall be controlled from the date of manufacture through operational use, including storage. Provisions will be made for replacement or refurbishment of these items after a specified age or operating time/cycle. Status of limited-life cycle items and waivers on limited-life items shall be maintained. Elapsed time or cycle indicators shall be employed to accumulate operational time or cycles if critical.

6.2.2 Useful life

GSE shall be designed for a useful life appropriate to its mission. When a useful life is not identified by programme or mission requirements, a goal of 10 years may be used. During this period, normal preventive maintenance, repair, modification or calibration may be accomplished to maintain specified performance.

6.2.3 Protective coating

Protective coating of hardware shall be appropriate to the condition, use and environment to which the GSE will be exposed during its life cycle. The coating shall minimize corrosion and should indicate its use (see 6.2.4).

6.2.4 Colours

The colours given in Table 1 should be used for the type of GSE indicated.