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Second edition
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Space systems — Interface control documents between ground systems, ground support equipment and launch vehicle with payload

Systèmes spatiaux — Documents de contrôle d'interface entre les systèmes au sol, l'équipement de soutien au sol et le véhicule de lancement de charge utile

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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*.

This second edition cancels and replaces the first edition (ISO 17689:2015), which has been technically revised.

The main changes are as follows:

— terms were updated.

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

This document is intended for application at realization of interstate, intergovernmental or non-governmental space activities, between operators of different countries and organizations on the basis of their space activity contracts.

Interfaced (connected) devices development by two and more designers (commands, organizations, developers of other specializations, etc.) creates a need for coordination between them to prevent interfaces incompatibility, taking into account unlimited possibilities for design (structure) improvement in the course of space systems development.

Interface control documents (ICDs) make it possible to systematically create (develop), operate and manage interfaces (see Clause 1) at all stages of the life cycle of a launch system. They are necessary in order to ensure the normal functioning of a launch system, prevent accidents and reduce acceptable risks when implementing joint space projects and providing spacecraft launch services. ICD between payload and a launch vehicle is defined in ISO 15863.

Application of this document at design and development stages improves control and compatibility of interfaces (see Clause 1).

Application of this document at operation stage improves a launch system safety and facilitates control of interfaces.

Interface control documents format defined in this document does not contain the descriptions regarding various properties of ground support equipment (i.e. performance, functions or endurance to launch mechanical environment or quality assurance provisions), which are defined in technical specifications.

Control of interfaces, independently of its frequency or depth, cannot replace stages of parameters definition of high-quality production and development of technical requirements of project, design and development. Interfaces control is used as a control process that can provide necessary verification of successful finishing of design at a stated in contract period.

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Space systems — Interface control documents between ground systems, ground support equipment and launch vehicle with payload

1 Scope

This document establishes basic requirements for interface control documents (ICD) writing and interface control procedures for the following items included in the launch system: payload, launch vehicle, ground support equipment (according to ISO 14625) and launch site (buildings with utility systems), specifically:

a) ICD between the ground support equipment and the payload;

b) ICD between the ground support equipment and the launch vehicle;

c) ICD between items of the ground support equipment;

d) ICD between the ground support equipment and the launch site.

This document is applicable to organizations developing ground support equipment and to operators performing space activity.

2 Normative references

There are no normative references in this document.

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
acceptable risk
safety risk the severity and the probability of which can be reasonably accepted by humanity, without durable or irreversible foreseeable consequence on health, Earth, and the environment, at the present time and in the future

EXAMPLE A safety risk can be acceptable for crew members of a manned space vehicle when it is comparable to that of test pilots, for the personnel participating in hazardous activities when it is comparable to that of industrial workers, for people, public and private property, and the environment when it is comparable to that of other hazardous human activities (e.g. high-speed surface travel).

3.2
accident
undesired event arising from operation of any project-specific items which results in:

a) human death or injury;

b) loss of, or damage to, project hardware, software or facilities that can then affect the accomplishment of the mission;

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c) loss of, or damage to, public or private property; or

d) detrimental effects on the environment

[SOURCE: ISO 14620-1:2018, 3.1.1, modified — "and" has been changed to "or" at the end of item c); note 1 to entry has been removed.]

3.3
ground support equipment
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

[SOURCE: ISO 14625:2023, 3.1.5, modified — The abbreviated term "GSE" has been removed.]

3.4
hazard
existing or potential condition that can result in an *accident* (3.2)

[SOURCE: ISO 14623:2003, 2.30]

3.5
ICD for ground support equipment
interface control document for ground support equipment
document which describes mechanical, hydraulic, pneumatic, thermal, electric and other parameters of interfaces between the *ground support equipment* (3.3) and the *launch vehicle* (3.10), items of the ground support equipment, the ground support equipment and *launch site* (3.8) objects (building constructions with technical systems), and which is used to control these parameters

3.6
interfaces controller
specialist in the scope of *launch complexes* (3.7) or organization of space activity which controls interface control document (ICD) observance by organization-executor at realization of contract of space technics creation

Note 1 to entry: Interfaces controllers may be indicated in the contract between the space technics leading developers and executors. The leading developer can let a contract with the interfaces controller.

3.7
launch complex
site assigned to or owned by a *launch vehicle* (3.10) operator to operate a launch vehicle

[SOURCE: ISO 14620-2:2019, 3.9]

3.8
launch site
site necessary for the prelaunch and launch operations of a space vehicle and for the in-flight operations during the launch phase

[SOURCE: ISO 14620-2:2019, 3.11]

3.9
launch system
system made up of a *launch vehicle* (3.10), the associated *launch complex* (3.7), *launch site* (3.8), *payload* (3.11), *ground support equipment* (3.3) and associated airborne equipment (including software), control systems, navigation system, trajectories, procedures, necessary personnel, and any other associated items

[SOURCE: ISO 14620-2:2019, 3.13]

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3.10
launch vehicle
vehicle designed to transport *payloads* (3.11) to space

[SOURCE: EN 16601-00-01:2015, 2.3.127]

3.11
payload
set of space segment elements (parts of a space system, placed in space, to fulfil the space mission objectives)

Note 1 to entry: A spacecraft payload is a set of instruments or equipment that performs the user mission.

Note 2 to entry: A launcher payload is a set of space segment elements carried into space in accordance with agreed position, time and environmental conditions.

[SOURCE: ISO 10795:2019, 3.165, modified — The abbreviated term "P/L" has been removed.]

4 General

4.1 An ICD for ground support equipment is developed as a separate document for each part included in the launch system: payload, launch vehicle, items of ground support equipment, launch site (building constructions with technical systems):

a) ICD between the ground support equipment and the payload;

b) ICD between the ground support equipment and the launch vehicle;

c) ICD between items of the ground support equipment;

d) ICD between the ground support equipment and the launch site.

The leading enterprise-developer of the ground support equipment is responsible for the development of a list of ICD for this equipment.

The leading enterprise-developer of a launch site supervises types, quantity, and location of interfaces of ground support equipment items, which are developed by the enterprises according to ICD for the items.

The developers of components of a launch site develop ICD and coordinate them with other enterprises, which are developers of the interface elements.

4.2 When a joint project is implemented by several participants, it is an enterprise, which owns a finished (existing) part or an element of a system, that has an advantage in making a decision about interface structures over participants, which have yet to develop an interface part of a system.

The organization, which provides spacecraft launch services, gives the full information about interfaces of the launch pad to the customer.

An organization, which is responsible for the payload, shall provide the interface status information to the operator.

4.3 The technical specification shall include a record that ICD for an element is available.

Each interface shall have the code, which contains the main information about it.

EXAMPLE 1 ICD XXXX-YYYY-000-AAA – interface code, where:

— XXXX is the source item code;

— YYYY is the consumer item code;

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— 000 is the interface number;

— AAA is the code of place where the interface is located.

The interface number is followed by a reference number or code (in brackets), which may indicate the drawing (sheet) where this interface is demonstrated.

EXAMPLE 2 A110-B010-001-005 (A110.08.03.01).

The number of symbols and use of figures and letters in the index should correspond to approved codes in technical specifications.

4.4 ICD may be presented as a text, a picture (drawing), or as a combination (a text and a picture).

A special indicator, like the letter "G", may be added to the picture (drawing) code (e.g. ICD XXXX-YYYY-000-AAA-G).

The internal ICD is developed when there are many interfaces between elements of the ground support equipment, which need to be controlled.

For simple search, items of the ground support equipment, to which the interface belongs, may be indicated.

4.5 The procedure of ICD preparation is as follows.

Launch site developers shall initiate the process of ICD preparation. The general requirements for an ICD are as follows:

— the ICD provides distribution of work and responsibility between developers;

— the ICD has a hierarchical structure (see Figure 2);

— the ICD directs the control of works of developers during the creation of interfaces.

The scheme of division of the launch site's components is presented in Figure 1. The responsible developers are defined for working out and handing over to codevelopers requirements to interfaces of launch system components.

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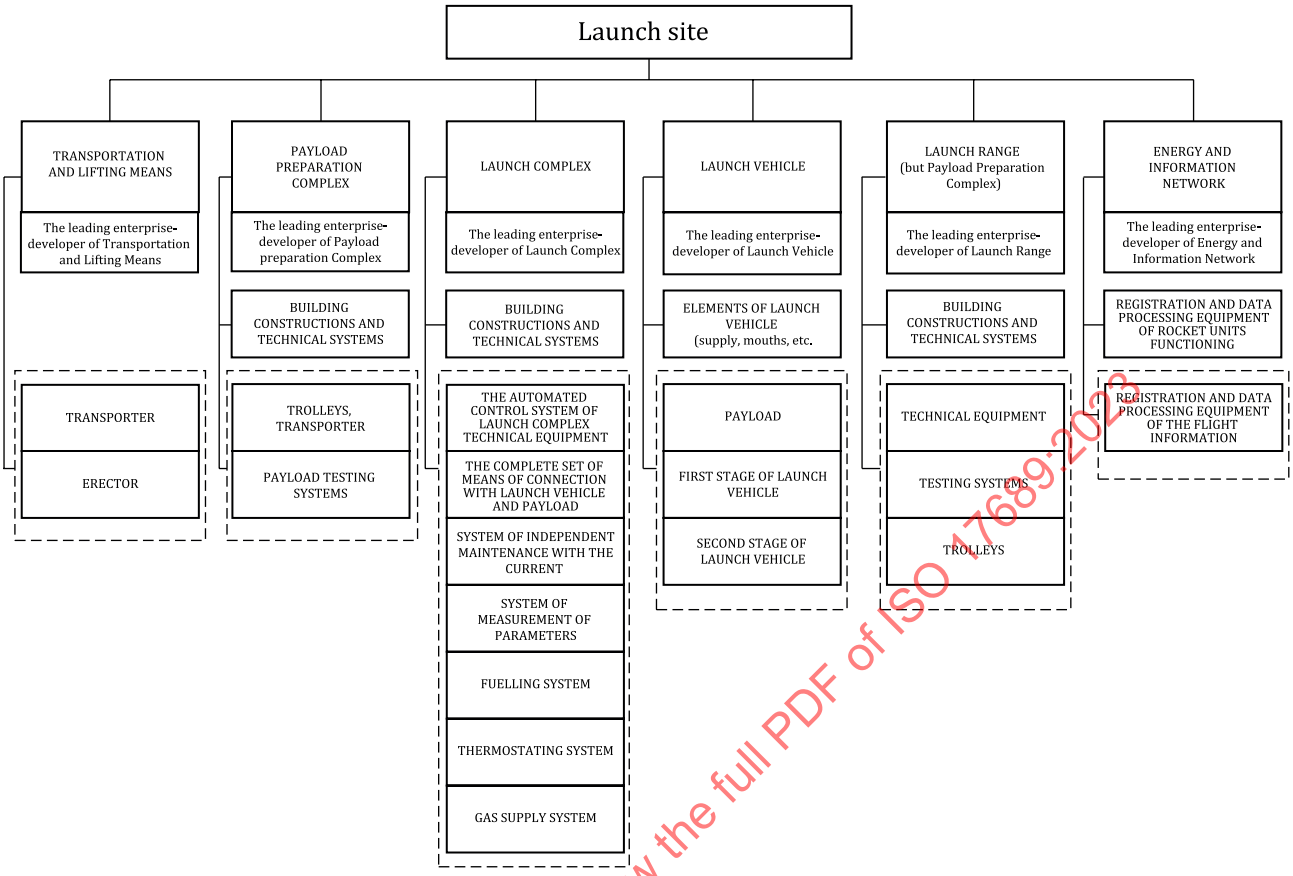

Figure 1 — Example structure of a launch site

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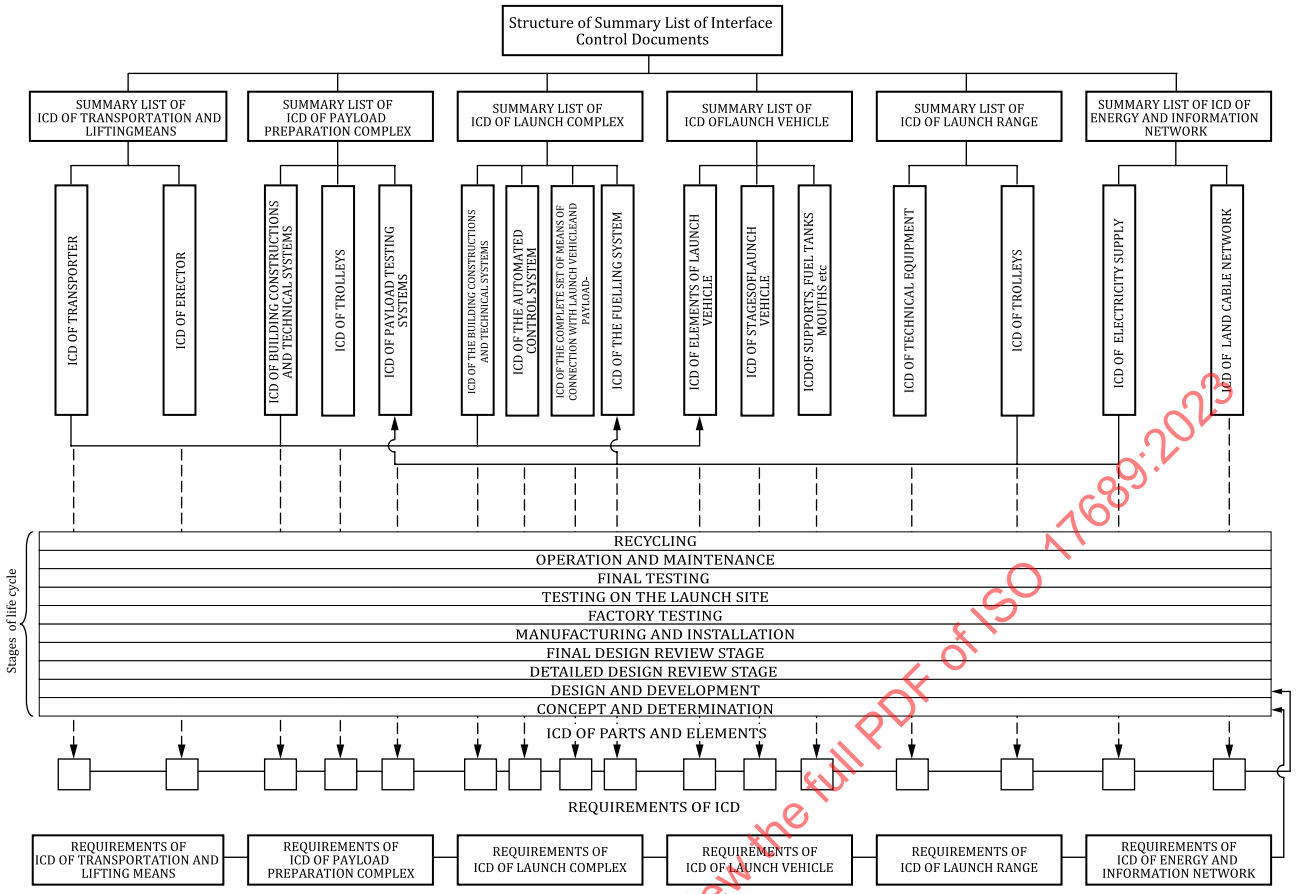

Figure 2 — Example structures of interface control documents of the launch site

The leading developer of the components of the launch system hands over requirements to interfaces to the codevelopers of the components of a launch vehicle, to developers of the complexes of the launch system, and to developers of the components of the complexes.

Developers of the complexes and developers of the components of the complexes give proposals to leading developers of the launch system in the process of coordination of the requirements:

— about the specification of the requirements to interfaces;

— about ICD formats;

— about the interface development works breakdown;

— about ICD execution time schedule;

— about stages and duration of progress monitoring for interface implementation (development), etc.

Developers of the components make the launch system according to ICD and according to the approved requirements.

5 Requirements to ICD execution

5.1 Requirements to item ICD execution

5.1.1 ICD should include the following:

— cover sheet;

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— revision record;

— applicability;

— description of the interface;

— verification requirements.

5.1.2 The cover sheet of ICD should contain the following items:

— ICD title;

— ICD designation.

An ICD formal reference number shall identify a document and may comprise several blocks of numbers and letters.

This reference number comprises six blocks, which include letters/numbers, separated by hyphens.

Block 1 identifies a project.

Block 2 identifies a document type (in this case, ICD).

Block 3 identifies a document according to a product tree (or according to a tree of elements, if applied to an interface).

Block 4 defines differences between documents of the same type, which, however, correspond to different versions of the same item.

Block 5 consists of one or several numbers, which correspond to the index number of a particular document. These numbers define the type of a document, which is used for a single item in accordance with a component diagram. Digits of a reference number are determined by a party (participant), which has a document numbering system of its own.

Block 6 consists of two to four letters which identify an entity, which issues a document.

Project parties may use other variants of ICD reference, which provide reliable identification of a document:

— issue date;

— organization, which issues a document.

5.1.3 The revision record should contain the following description:

— revision number;

— revision date;

— summary of revision contents;

— approval.

5.1.4 The applicability record should contain the following information:

— applicable documents;

— definitions;

— units of measurement.

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5.1.5 The description of an interface should specify the title and number of units, associated with interfaces, types of interfaces (mechanical, electric, pneumatic, hydraulic, thermal, electromagnetic, radiofrequency, etc.), location (coordinates), parameters, identification of hazards, and description of the interface structure.

Information about an interface should be stated clearly and unambiguously.

Information should be arranged in tables, with interface breakdown by type. Interface parameters, included in tables, are defined by the developer based on the need to provide maximum of information about the interface.

EXAMPLE See Tables 1 and 2.

Table 1 — Pneumatic interfaces of gas-supply system A110

Interface reference number	Working medium	Location	Parameters			Interface drawing number
			P, MPa	*T*, °C	*Q*, m^3/c	
A110-B010-001	Liquid nitrogen (LIN)	Room 10	20,0 ±1	25,0 ±5	0,04 ±0,01	A110-B010-001-G

Table 2 — Electric interfaces of gas-supply system A110

Interface number	Current type	Location	Parameters			Interface drawing number
			I (A)	*U* (M)	*R* (Ω)	
A110-E020-001	AC\DC	Build 2 room 5	1 to 15	12 ± 1	≤0,005	A110-E020-001-G

The table should include all the ranges of parameter values, registered when performing setup, tests and operations. In case of value deviations, conditions should be noted, which correspond to a particular parameter value.

For more information, it is necessary to provide pictures (drawings) of premises, indicating the interface location and coordinates, and pictures (drawings) of the interface structure, which may be included in ICD or may be registered separately as an annex.

Examples of interface drawing formats are shown in Figures 3 to 6.

Examples of interfaces location between a launch vehicle, ground support equipment and a launch site (building structures with utility systems) are shown in Figure 7.

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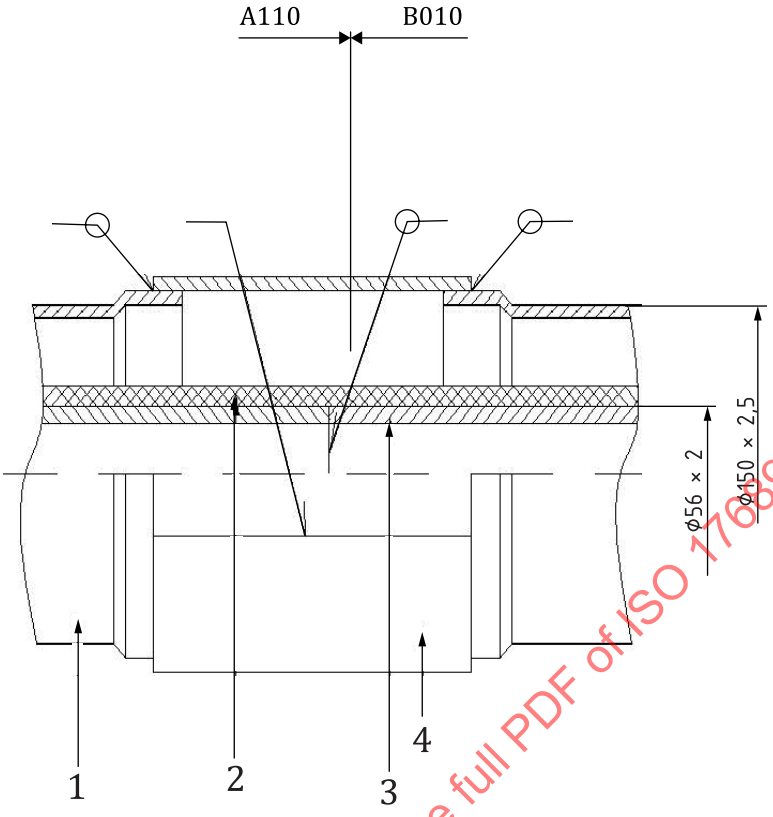

Key

1 case
2 insulation
3 inner pipe
4 half-coupling

Figure 3 — Interface A110-B010-001 (A110.08.03.01)

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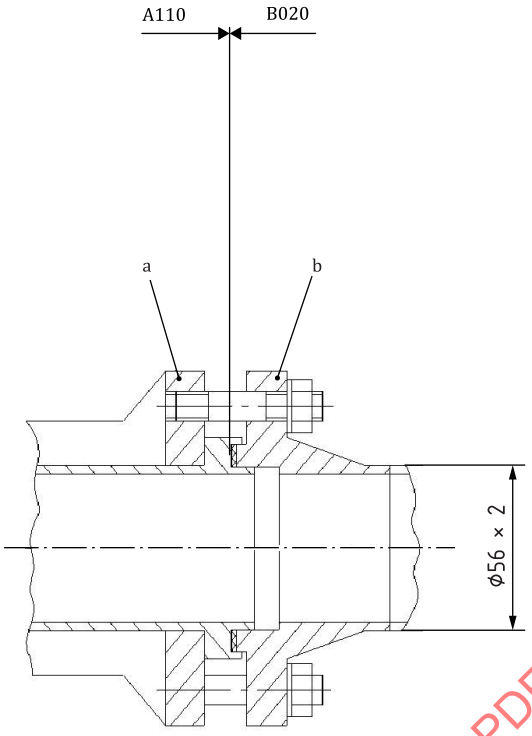

a Flange "O" of control system 1.

b Flange of liquid oxygen filling system.

Figure 4 — Interface A110-B020-002 (A110.08.04.01)

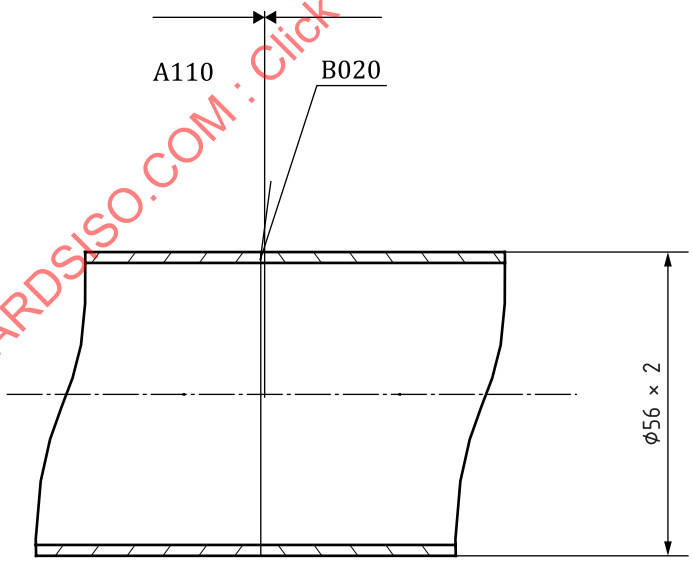

Figure 5 — Interface A110-B020-005 (A110.08.05.01)

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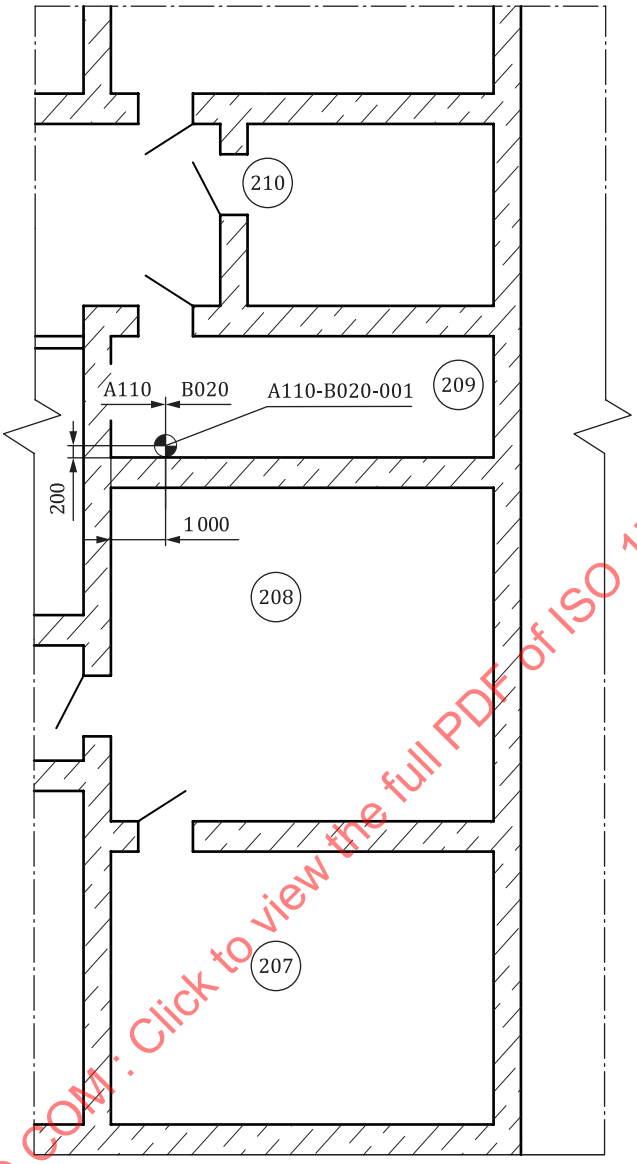

Figure 6 — Interface coordinates A110-B020-001 (A110.08.03.01)

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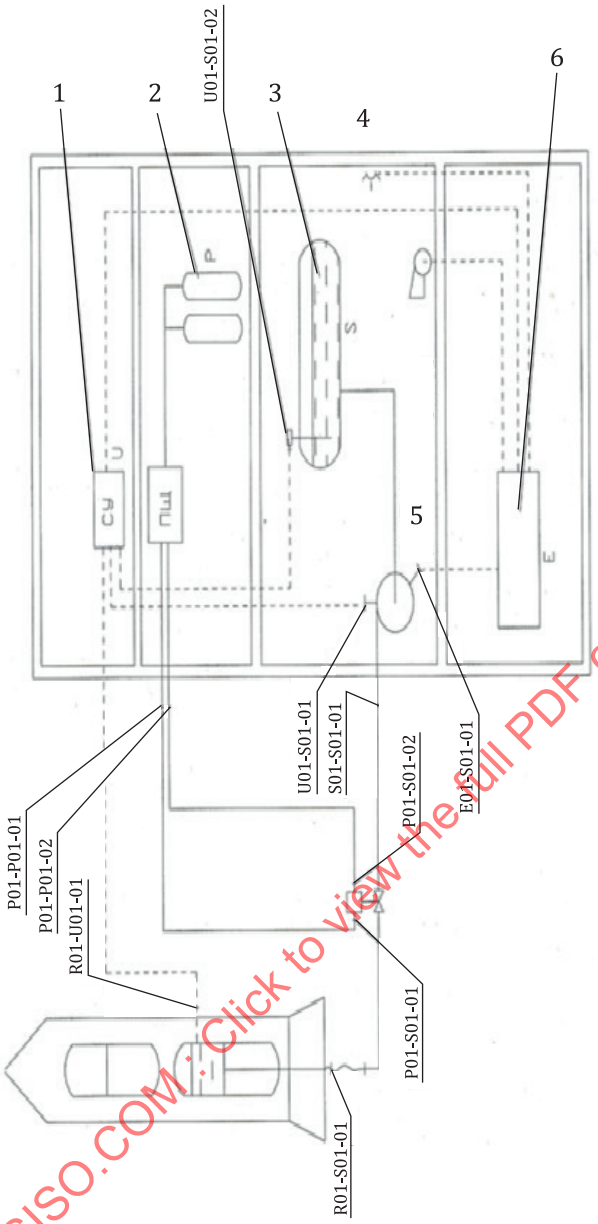

Key

1 control system (support equipment)
2 gas supply system (support equipment)
3 refuelling system (support equipment)
4 lighting (utility system)
5 ventilation (utility system)
6 power supply system (support equipment)

Figure 7 — Examples of interfaces arrangement between a launch vehicle, facilities of a launch site, and elements of ground support equipment

Information about interfaces may be provided in the format that is most suitable for organizations, but it has to be unified for the entire project and it must be applied by all the participants. The format, which is used to provide information about interfaces, has to be approved at the concept and definition stages during preliminary design review (PDR).

5.2 Requirements to execution of summary list of launch site ICD

5.2.1 A summary list of launch site ICD is developed based on ICD for ground support equipment items, launch vehicle ICD and other ICDs.

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5.2.2 A summary list of ICD is provided in a table. All launch site facilities, ground support equipment items and launch vehicle are listed in rows and columns of this table.

EXAMPLE See Table 3.

Table 3 — Summary list of launch site ICD

	LV	FS	OFS	GSS	TCS	CS	TE
Launch vehicle (LV)	x	R010-A110-001					
Fuelling system (FS)	A110-R010-001	x	No	A110-B020-001			
Oxidant filling system (OFS)		No	x				F002-G001-001
Gas supply system (GSS)		B020-A110-001		x			
Temperature control system (TCS)					x		
Control system (CS)						x	
Transporter erector (TE)			G001-F002-001				x

If there is an interface between elements, interface numbers are inserted in cells. If there is no interface, then “No” is inserted.

6 ICD development, validation and verification stages

6.1 Working stages

Development, verification and validation of interfaces for the launch vehicle, payload, launch site systems (building structures with utility systems), and for the ground support equipment should be provided by the organization-developer and the operator of space services, with participation of the interfaces controller, based on ICD of these objects.

These procedures, along with the project analysis, should be carried out according to the stages specified in IEC 61160.

EXAMPLE See Table 4.

Table 4 — ICD - interface conformity for stages of life cycle

Stage of life cycle	Type of project analysis	Abbreviation	Period of life cycle stages analysis	Check of ICD - interface conformity
Concept and determination	Preliminary design review	PDR	— At proposed requirements receiving — At contract or order receiving	Determination of interfaced units and preparation of ICD structure
Design and development	Detailed design review	DDR	— During design stage — After design stage — During development stage	— ICD writing — ICD improvement — Final ICD approval
	Final design review	FDR	— After manufacturing of pre-production models — After test of pre-production models	Interface verification of ICD compliance

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