International Standard

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# Space systems — Launch-vehicle-to-spacecraft interfaces

*Systèmes spatiaux — Interfaces entre le lanceur spatial et le véhicule spatial*

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# Foreword

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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 14303:2002), which has been technically revised.

The main changes are as follows:

— revision of terms and abbreviated terms (Clauses 3 and 4);

— revision of usable volume definition in Clause 5;

— revision of mission performances in Clause 8;

— revision of Figures A2, B1, B2, C5, C6, D1, D3, D6, and D7.

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, ISO 15863 and ISO 17401 form a set of International Standards that fully describe the process for communicating information about launch vehicle (LV) to spacecraft (SC) interfaces.

Clauses 4 to 7 identify the parameters of an LV–SC interface, Clause 8 is related to mission performances, while Clauses 9 to 11 define the methodology for verification of the interface by analyses, testing or both. Clause 12 defines the operations performed on the SC to prepare it for launch and the joint operations performed until it is installed on the LV.

Annexes A to E give examples of the typical presentation format of the various interface parameters, as appropriate.

# Space systems — Launch-vehicle-to-spacecraft interfaces

## 1 Scope

This document specifies the interfaces between a launch vehicle (LV) and the spacecraft (SC) being launched, to provide LV and SC organizations with the necessary format for presenting the required technical data on existing and future interfaces.

Its intended purpose is to minimize costs and reduce the risks from errors resulting from miscommunication. It does not limit the ability of LV or SC organizations to specify unique requirements.

## 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**
**SC system**
spacecraft system
spacecraft bus, payload and all items supplied by the SC contractor in support of the launch effort

**3.2**
**LV system**
launch vehicle system
launch vehicle and associated launch services supplied by the launch services contractor or subcontractors, or both

**3.3**
**separation plane**
plane where launch vehicle and spacecraft separation occurs

**3.4**
**mating plane**
interface between the spacecraft, or the spacecraft-provided *payload adapter* (3.5), and the launch vehicle

**3.5**
**payload adapter**
**PLA**
structure that mates the spacecraft to the launch vehicle, including the SC–LV separation system

Note 1 to entry: The PLA can be part of the LV and, when the spacecraft and the launch vehicle are separated, stays with the launch vehicle.

Note 2 to entry: Some PLA are such that they are bolted to the spacecraft and that the separation plane is inside the PLA. In that case, after separation the upper part of the PLA stays onto the spacecraft, the lower part of the PLA stays with the launch vehicle.

**3.6**
**usable volume**
volume available to the payload within the LV fairing or carrying structure that the static envelope of the SC cannot exceed in order to ensure that there is no physical contact between the SC and the LV in a dynamic environment

Note 1 to entry: See Figures A.1 to A.4.

## 4 Abbreviated terms

| | |
|---|---|
| ACS | attitude control system |
| CG | centre of gravity |
| EMC | electromagnetic compatibility |
| GSE | ground support equipment |
| GTO | geosynchronous transfer orbit |
| ICD | interface control document |
| IRD | interface requirements document |
| LEO | low Earth orbit |
| LV | launch vehicle |
| PLA | payload adapter |
| PLF | payload fairing |
| RF | radio frequency |
| SC | spacecraft |
| SPF | spacecraft processing facility |
| SPM | solid propellant motor |
| SSO | sun synchronous orbit |
| TM | telecommand |



## 5 Mechanical interfaces

### 5.1 General

This clause identifies the mechanical interfaces between the SC and the LV. The methodology for verifying these interfaces is discussed in Clauses 9 to 11.

### 5.2 Mechanical configurations

The SC shall be mated to the LV by a PLA. If the LV provides the PLA, it may include a pyrotechnically activated or other adequate separation system. If the SC provides its own separation system, then a static bolted interface to the LV in accordance with 5.4 shall be used. During final launch processing and launch ascent, the SC shall be contained in a structure provided by the LV contractor.

## 5.3 Spacecraft (SC) characteristics

### 5.3.1 Spacecraft (SC) fundamental natural frequency

The SC's fundamental natural frequency in the longitudinal and lateral axes shall not be less than a value specified by the LV with the SC cantilevered from the mating plane.

### 5.3.2 Spacecraft (SC) mass properties

The SC-CG location (CG coordinates referenced in the SC coordinate system; origin of the SC coordinate is usually the geometrical centre of separation plane); and the inertia properties for the *x*, *y* and *z* axes (moments of inertia with regard to the SC axis or CG), shall be defined.

It shall include the SC propellant-tanking characteristics to be used for the LV provider's sloshing analysis (mass of propellant, centre of gravity of propellant loaded tank, pendulum mass, pendulum length, pendulum attachment point, damping factor, sloshing mode natural frequency).

## 5.4 Usable volume

The SC shall be accommodated in the LV's usable volume, as characterized in Annex A, without interference. The static envelope of the SC (including manufacturing tolerance, thermal protection installation, appendices) shall not exceed the usable volume, in order to ensure that there is no physical contact between the SC and the LV in a dynamic environment (dynamic environment in flight leading to relative motion between LV structure such as fairing and the SC itself).

Protrusions outside this usable volume may be permitted by mutual agreement between SC and LV contractors.



## 5.5 Payload adapter (PLA) interface

### 5.5.1 General

The LV–SC interface shall be characterized by the elements listed in 5.5.2 to 5.5.4, for each PLA type as shown in Annex B, Figures B.1 and B.2.

### 5.5.2 Launch vehicle (LV)-supplied payload adapter (PLA)

The SC–LV mating surface for LV-supplied PLA shall be defined by the following:

a) LV and PLA coordinate systems and relative angular orientation;

b) physical configuration (including keyway location):

   1) material;

   2) coating;

   3) roughness;

   4) flatness and perpendicularity;

   5) stiffness of interface frame:

      i) section area ($mm^2$);

      ii) applicable length (mm);

iii) inertia (mm$^4$);

c) clampband:

1) geometry;

2) material;

3) roughness;

4) allowable tension (N);

d) other mating systems.

#### 5.5.3 Spacecraft (SC)-supplied payload adapter (PLA)

The SC–LV mating surface for SC-provided PLA shall be defined by the following:

a) LV and PLA coordinate systems and relative angular orientation;

b) physical configuration:

1) description of bolted interfaces (number, size, location of holes, type of bolts and torque value);

2) material;

3) coating;

4) roughness;

5) flatness and perpendicularity;

6) stiffness of interface frame :

i) section area (mm$^2$);

ii) applicable length (mm);

iii) inertia (mm$^4$).

#### 5.5.4 Separation actuators

Separation actuators (springs or pushrods) shall be characterized by:

— number;

— location;

— nominal stroke (mm);

— reduced stroke (mm);

— maximum force (N);

— energy per unit (J).

### 5.6 Umbilical connectors and microswitches

The LV side of the interface shall have electrical connectors for electrical power and signals in accordance with Clause 6. The LV connectors shall be adjustable in two planes to provide for alignment of the connectors during SC–LV mating. The SC shall have compatible connector halves. All connectors shall be characterized by:

— supplier;

- number;
- location and mechanical interface;
- push-on load per connector (N);
- push-off load per connector (N);
- energy released by each plug (J);
- keying index.

### 5.7 Fluid connections

Fluid connections shall be defined to indicate:

- location;
- size;
- fluid (gas or liquid) and flowrate;
- material;
- definition of interface;
- functional usage.

### 5.8 Encapsulated spacecraft (SC) access



The LV shall provide access through the fairing or the carrying structure to the SC after encapsulation if physical access is required by the SC contractor.

A drawing shall be made with developed views of fairings and dual launch structures indicating authorized areas for access doors. The maximum number of doors authorized per SC with their corresponding size shall be defined.



## 6 Electrical interfaces

### 6.1 General

This clause identifies the parameters required to define electrical interfaces (power and signal) between the SC and LV.

### 6.2 Umbilical connectors

Umbilical connectors shall be defined by the following characteristics for the LV and SC sides:

- type and reference designator of connectors;
- number of pins available to the user;
- number of connectors;
- segregation between SC power and pyro-firing circuits;
- location;
- shielding;
- keying index.

## 6.3 Umbilical links

Umbilical links between the SC mated with the LV and the SC's electrical ground support equipment (GSE) shall be described as follows:

a) number and type of links;

b) limitations:

  1) maximum voltage (V);

  2) maximum current (A);

  3) power (W);

  4) maximum one-way resistance (Ω) or voltage drop (V);

c) operating constraints:

  1) number of functions activated on ground after connection to LV;

  2) types of function;

d) current at umbilical plug extraction;

e) conformance certification:

  1) end-to-end resistance (Ω);

  2) line to ground insulation;

  3) line-to-line insulation;

f) insertion of components.



## 6.4 Electrical commands dedicated to spacecraft (SC)

### 6.4.1 General

Standard and optional commands generated by the LV and dedicated to the SC shall be listed with a description of the related characteristics.

### 6.4.2 Pyrotechnic commands

A general description of the electrical circuit associated with pyrotechnic commands shall be made. Optionally, a schematic drawing of the corresponding electrical circuits may be included. The following characteristics shall be indicated:

— type and characteristics of the initiators used in the SC;

— time and number of commands;

— voltage (V);

— pulse width (s);

— output insulation (Ω);

— characteristics of current delivered to pyro-charges (A);

— interval between two commands (s);

— insulation between wires and structure (Ω);

— protection of SC equipment;

— utilization constraints (inhibits) on the SC side.

#### 6.4.3 Dry loop command

A general description of electrical circuits associated with dry loop commands shall be made. Optionally, a schematic drawing of the corresponding electrical circuits may be included. The following main electrical characteristics shall be indicated:

— number of commands available on-ground or in-flight;

— voltage (V);

— resistance (Ω) or reference of the input circuit components;

— insulation of the onboard circuit;

— protection on the SC side;

— utilization constraints on the SC side;

— maximum voltage (V) and current (A).

#### 6.4.4 launch vehicle (LV)-generated spacecraft (SC) electrical commands

A general description of the electrical circuits associated with LV-generated SC electrical commands shall be made. Optionally, a schematic drawing of the corresponding electrical circuits may be included. The following main electrical characteristics shall be indicated:



— number of commands available on-ground or in-flight;

— output voltage (V);

— current (A);

— protection on the SC side;

— insulation between circuit and structure;

— Electromagnetic compatibility (EMC)

— compliance with international specifications;

— utilization constraints on the SC side.

### 6.5 Separation status transmission

The separation status shall be indicated through the LV telemetry (TM) system modes of transmission available for separation status transmission as determined by:

— microswitch or microswitches;

— break wires;

— dry loop;

— others.