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**Space systems — Flight-to-ground  
umbilicals**

*Systèmes spatiaux — Ombilicaux bord-sol*

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Tel. + 41 22 749 01 11  
Fax + 41 22 749 09 47  
E-mail [copyright@iso.ch](mailto:copyright@iso.ch)  
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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 3.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 15389 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 14, *Space systems and operations*.

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## Introduction

This International Standard establishes the general requirements and criteria for flight-to-ground umbilical systems used by space systems. The purpose of this International Standard is to establish uniform engineering practices and methods and to ensure the inclusion of essential requirements in the design of reusable flight-to-ground umbilical systems that support the launch of space systems. This International Standard is not intended to define how to design umbilicals but to define the minimum requirements umbilicals must meet.

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# Space systems — Flight-to-ground umbilicals

## 1 Scope

This International Standard defines the general criteria for the development of flight-to-ground umbilical systems used by a space system. The criteria specified herein is limited to the service arms or equivalent mechanisms, umbilical carriers and plates, couplings, connectors, withdrawal and retract devices, handling mechanisms and control systems for mechanisms.

## 2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

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

[ISO 15389:2001](https://www.iso.org/standard/50924.html)

IEC 60364-5-54, *Electrical installations of buildings — Part 5: Selection and erection of electrical equipment — Chapter 54: Earthing arrangements and protective conductors*.

## 3 Terms and definitions

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

### 3.1

#### **carrier**

device that groups coupling and connector halves together to provide a common means for their positioning, retention, unlocking, and separation

NOTE The term is commonly used in relation to the facility ground-side of umbilical interfaces.

### 3.2

#### **connector**

device, consisting of two halves, that permits engagement and disengagement of electrical circuits at an interface

### 3.3

#### **coupling**

device, consisting of two halves, that permits transfer of fluid across and disconnection at an interface

### 3.4

#### **ground control**

equipment, fluids, or signals, provided for command or control purposes, which are neither on board nor originate on board the launch vehicle

**3.5  
handling mechanism**

device used to provide positioning, manipulation, and physical dead-weight support of an object

**3.6  
inflight**

term that denotes an occurrence or function after vehicle lift-off

**3.7  
interface**

region of mating or boundary between separating or cooperating elements established by a governing characteristic

EXAMPLES Ground-to-vehicle interface, physical interface, or responsibility interface.

**3.8  
launch processing system**

operating consoles, data handling and display equipment, and the associated transmission system configured to issue commands and analyse and display response data required in checkout and operation of ground support equipment (GSE) and flight hardware

**3.9  
lift-off**

term designating the instant of flight at which the vehicle's contact is terminated with all areas of hold-down and/or support devices

NOTE Lift-off is commonly called "first motion" of the vehicle.

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**3.10  
plate**

device that groups coupling and connector halves together to provide a common means for retention

NOTE 1 The plate is a passive device, containing cooperating but usually immobile portions of positioning, locking, and separation machinery.

NOTE 2 The term is commonly used in relation to the vehicle side of umbilical interfaces or with the carrier.

EXAMPLE Carrier plate.

**3.11  
preflight**

term that denotes an occurrence or function before vehicle lift-off

**3.12  
rise-off**

term applied to a device to denote that its actuation is solely caused by a vehicle's vertical motion

**3.13  
service arm**

retractable structure, usually attached to a tower used to provide either umbilical requirements, personnel access, or both to the flight vehicle

NOTE 1 A service arm is commonly called access arm, umbilical arm, or swing arm, depending upon whether it provides services for access only, umbilicals only, or both, respectively.

NOTE 2 The service-arm retracting motion may be along an arc or in a vertical or horizontal plane.



**3.14****T-0****time minus zero**

last moment in the launch countdown, measured in seconds, at which time the launch vehicle lifts off the ground

**3.15****tail service mast**

retractable structure used to provide umbilical requirements to the aft portion (tail) of a space vehicle

## NOTE

Movement is usually a rotation about a pivot point away from the vehicle.

**3.16****umbilical**

device that provides fluid (supply/return and purge) and electrical requirements at physical interfaces between ground facilities and various areas of a space vehicle

**3.17****umbilical assembly**

mated carrier and plate containing all couplings and connectors for a specified umbilical region of the vehicle

**3.18****umbilical service line**

any fluid line or electrical cable routed through an umbilical such as a service arm or equivalent mechanism that is to be disconnected prior to engine ignition or at T-0 or in flight

**3.19****umbilical supply device**

movable structure used to connect and/or disconnect the umbilical plates at various locations on a space vehicle

**3.20****umbilical system**

functional assembly of all items required for providing fluid and electrical servicing to a launch vehicle and/or a payload

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NOTE 1 This system usually includes the following:

- service arms or equivalent umbilical supply device mechanisms;
- umbilical carriers and plates;
- couplings and connectors, all separation, withdrawal, and retraction devices;
- control equipment;
- control fluids and electrical signals;
- all interconnecting lines across the service arms or the equivalent mechanism on the ground side.

NOTE 2 The mating-half interface for the couplings/connectors and umbilical carrier should be located on the exterior surface of the launch vehicle at an orientation compatible with the launch structure.

**4 General requirements****4.1 Umbilical system principles**

The umbilical design shall not require reconnection of disconnected umbilical service lines to abort safely on the launch pad. Passive umbilical systems disconnected at a launch vehicle's first motion during launch by gravity is the preferred system over active systems to minimize failure modes and potential damage to the flight hardware.