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Space systems — Flight-to-ground umbilicals

AMENDMENT 1: Prevention of accidental cross-connection

Systèmes spatiaux — Ombilicaux bord-sol

AMENDEMENT 1: Prévention des croisements accidentels de connexions

Reference number
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Foreword

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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.

Amendment 1 to ISO 15389:2001 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 14, *Space systems and operations*.

Space systems — Flight-to-ground umbilicals

AMENDMENT 1: Prevention of accidental cross-connection

Page 1

Replace the full stop at the end of the second sentence with the following:

“and also prevention of accidental cross-connection.”

Insert the following paragraph at the end of Clause 1:

“Annex A establishes requirements for umbilical connectors and couplings located on the same plate to prevent an accidental service-line cross-connection. There are two groups of requirements: design and symbolic. The design requirements provide the distinctive characteristics of elements for attaching connectors (threaded connections, flanges, etc.). The symbolic requirements provide for the presence of distinctive marking of connectors and couplings (pipelines, cables) by symbols or colour.”

Pages 1, 2, and 3

Insert the following terms and definitions alphabetically in Clause 3 and renumber the existing terms appropriately:

3.4
flanged connection
connection at which halves of connectors (3.2) or couplings (3.3) are mated by means of flanges

3.11
nipple
half of a hydraulic or gas coupling with an external sealing surface

3.18
threaded connection
connection at which halves of connectors (3.2) or couplings (3.3) are mated by means of a thread on each of the halves

3.24
union
half of a hydraulic or gas coupling with an internal sealing surface

Page 4

Insert “Umbilical design shall ensure prevention of accidental cross-connection.” at the end of the third paragraph of 4.1.

Page 10

Add the following new subclause after 5.3.6:

5.4 Prevention of accidental cross-connection

The design requirements for connectors between lines and the flight plate and between lines and the ground plate preventing accidental cross-connection shall be in accordance with Annex A.

Page 11

Add the following new subclause after 6.4:

6.5 Cross-connection verification test

Correctness of connectors between lines and the flight plate and between lines and the ground plate shall be tested in accordance with Annex A.

Page 11

Add the following Annex A after 6.5:

Annex A
(normative)

Prevention of accidental cross-connection

A.1 General considerations

Due to launch vehicle and spacecraft assembly specific features, arrangement of many connectors and couplings in close proximity to each other is required. During assembly, test, and operation, connectors and couplings should not be in a zone of simultaneous service. All connectors and couplings in this zone shall have a very different design and be marked to prevent an incorrect connection.

The accidental cross-connection of service lines can result in very serious and even tragic consequences. For example:

— supplying other gas or fluids;

— supplying gas or fluid under other pressure;

— supplying the electric power with other parameters;

— supplying an error signal (command).

Therefore, differences in design of connectors and couplings that are located close to each other should be significant. Such differences can be both in design and in marking for identification.

International cooperation in space engineering assumes international cooperation in design, manufacture and operation. The application of uniform methods will increase the reliability of space systems by minimizing the accidental cross-connection of connectors and couplings. The application of unified symbols will promote mutual understanding and personnel training.

This annex applies to umbilical assemblies connected to pipelines and equipment cables at a launch complex or to the launch vehicle or spacecraft. This annex can be used by those participating in the development, renovation, modernization, and operation of launch complexes.

A.2 General requirements

Electrical and fluid couplings located on a single umbilical carrier plate (or carrier) should be designed to prevent the accidental cross-connection of incorrect coupling halves.

This requirement may be implemented in one of the following ways:

a) use of a different design;

b) application of distinctive marking.

The simultaneous use of both methods is recommended.

A.3 Design requirements

A.3.1 Threaded connections

The electrical and fluid connectors and coupling located on one plate should have different threads. Threads should be distinguished by

a) diameter - not less than by 4 mm;

b) arrangement - external, internal;

c) step - not less than by 1,5 mm;

d) number of threads per unit of measure;

e) direction – right-hand or left-hand threads.

Other features include the following:

— guide elements;

— fixing elements;

— arrangement of nipples and unions, etc.

A.3.2 Flanged connections

The electrical and fluid connectors (umbilicals) located on one plate should have different flanges. These flanges should be distinguished by one or more of the following:

a) geometrical configuration (circle, oval, square, triangle, irregular polygon, etc.);

b) flange thickness;

c) attachment (perpendicular or parallel to plate) orientation;

d) quantity of attachment features;

e) arrangement of attachment features;

f) type of fastening elements (bolt with a nut, screw, pin, lock);

g) diameter of threaded elements;

h) quantity of connectors (couplings) located on a flange;

i) location of flanges [flanges on both halves of connectors (couplings) or only on a part of the pipeline (cable)].

The following types of fastening elements are recommended:

— removable bolts or screws;

— folding bolts;

— locks with different attachment methods.

The electrical connectors (except the requirements previously specified) should differ in the following:

— pin quantity;

— geometrical configuration of pin combination;

— pin diameter;

— arrangement of “pin–socket” couple.

A.4 Marking requirements

A.4.1 General requirements

Marking by figures, letters, or symbols and colour is recommended. See A.4.2 to A.4.5.

Both halves of connectors and couplings and also pipelines and cables attached to them shall have identical marking.

Marking shall be put directly on both halves of connectors and couplings and on the pipelines and cables attached to them.

Marking may be by a mechanical method or by painting.

When it is impossible to mark both halves of connectors and couplings or pipelines and the cables directly, one half should have a label marker. In this case, places for label attachment shall be provided on halves of connectors and coupling (pipelines and cables).

On vacuum pipelines, an inscription “vacuum” is made besides marking.

A.4.2 Marking figures and letters

The marking content and location shall be indicated on the schematics, diagrams, and drawings. The size of figures and letters should be not less than 5 mm. The marking shall be clear and precise to preclude an error in reading and understanding.

A.4.3 Marking by symbols

The marking symbols shall indicate danger, which can arise with cable (pipeline) damage (for example, high voltage/pressure and poisonous substances).

The halves of the marking symbols should correspond to the International Standard guidelines or as specified on the schematics, diagrams, and drawings. In all cases, the symbols shall be explained in the operation and maintenance documentation.

The symbol size should be not less than 15 mm.

The symbol colour should be black or white depending on the background. Symbols should be placed inside an equilateral triangle with the size of the side not less than 24 mm. The colour of the triangle background should be yellow.

Symbol tracing should be clear and precise to avoid an error in understanding.

The concrete parameters can be utilized as marking, for example, voltage 25 V.

A.4.4 Marking by colour

Colour marking should indicate the following:

a) the function (application) of a connection (unit A power supply, bottles, charging control, tank fill and drain, tank pressurization, fire suppression, etc);

b) the value of dangerous characteristics (more than 250 V, more than 4 MPa, etc);

c) the fluid and gas type [combustible gases (including liquefied); noncombustible gases; inert gases; air; combustible fluids; water; fire-suppression products; mixes, etc];

d) the particular fluid or gas (oxygen, hydrogen, kerosene, helium, nitrogen, compressed air, etc).

In the case where the use of a colour symbol is required for marking bands (loops), the following will apply:

— symbol size should be not less than 15 mm;

— line thickness should be not less than 5 mm;

— colour should correspond to a function, characteristic, type, etc.;

— width of a band should be not less than 5 mm.

If it is necessary to identify several characteristics, add one or more bands. The first band should be the function, followed by additional bands with a description.

Additional bands corresponding to other characteristics may be added to the basic colour bands.

The distance between additional bands and also from an edge of a basic band is not less than 5 mm.

When using cables with colour isolation, the colour of the isolation shall correspond to a function colour.

When using painted pipes, their colour shall correspond with the function colour.

When applying additional bands, black or white lines that are 1-mm thick should be applied to the edges of colours that are similar (e.g. red/orange) or the same.

Marking colour shall be established to meet national, customer, or launch vehicle supplier requirements. The convention used shall be identified in the appropriate operations manual.