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**Rubber hoses and hose assemblies  
for aircraft ground fuelling and  
defuelling — Specification**

*Tuyaux et flexibles en caoutchouc pour le ravitaillement carburant et  
la vidange des avions au sol — Spécifications*

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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](http://www.iso.org/directives)).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on 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 the following URL: [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 1, *Rubber and plastics hoses and hose assemblies*.

This fourth edition cancels and replaces the third edition (ISO 1825:2010), which has been technically revised.

The main changes compared to the previous edition are as follows:

- the normative references have been updated;
- fuel discoloration test has been added to bring the document in line with EI 1529.

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# Rubber hoses and hose assemblies for aircraft ground fuelling and defuelling — Specification

## 1 Scope

This document specifies the dimensions and construction of, and requirements for, four types of hose and hose assembly for use in all operations associated with the ground fuelling and defuelling of aircraft.

All four types are designed for:

- a) use with petroleum fuels having an aromatic-hydrocarbon content not exceeding 30 % by volume;
- b) operation within the temperature range of  $-30\text{ °C}$  to  $+65\text{ °C}$  and such that they will be undamaged by climatic conditions of  $-40\text{ °C}$  to  $+70\text{ °C}$  when stored in static conditions;
- c) operation at up to 2,0 MPa (20 bar) maximum working pressure, including surges of pressure which the hose can be subjected to in service.

NOTE 1 Type C hoses are intended for general pressure applications on all vehicles used for plane fuelling. They can also be used for vehicle/rail car loading and discharge where excessive vacuum does not occur.

NOTE 2 Type F hoses can be used for plane delivery applications on vehicles that are also used for defuelling at high flow rates where type C hoses are not suitable.

NOTE 3 Type E and F hoses can also be used for vehicle/rail car loading and discharge, for trailer to fueller transfer and for elevation platform supply (riser) to provide greater kink resistance.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 37, *Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties*

ISO 188, *Rubber, vulcanized or thermoplastic — Accelerated ageing and heat resistance tests*

ISO 1382, *Rubber — Vocabulary*

ISO 1402, *Rubber and plastics hoses and hose assemblies — Hydrostatic testing*

ISO 1817:2015, *Rubber, vulcanized or thermoplastic — Determination of the effect of liquids*

ISO 4649:2010, *Rubber, vulcanized or thermoplastic — Determination of abrasion resistance using a rotating cylindrical drum device*

ISO 4671, *Rubber and plastics hoses and hose assemblies — Methods of measurement of the dimensions of hoses and the lengths of hose assemblies*

ISO 6246, *Petroleum products — Gum content of fuels — Jet evaporation method*

ISO 7326, *Rubber and plastics hoses — Assessment of ozone resistance under static conditions*

ISO 7989-1, *Steel wire and wire products — Non-ferrous metallic coatings on steel wire — Part 1: General principles*

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ISO 7989-2, *Steel wire and wire products — Non-ferrous metallic coatings on steel wire — Part 2: Zinc or zinc-alloy coating*

ISO 8031, *Rubber and plastics hoses and hose assemblies — Determination of electrical resistance and conductivity*

ISO 8033, *Rubber and plastics hoses — Determination of adhesion between components*

ISO 8330, *Rubber and plastics hoses and hose assemblies — Vocabulary*

ISO 10619-2:2011, *Rubber and plastics hoses and tubing — Measurement of flexibility and stiffness — Part 2: Bending tests at sub-ambient temperatures*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1382 and ISO 8330 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

### 3.1 hose assembly

hose with either permanent or reusable end fittings attached

### 3.2 electrically bonded hose/hose assembly

hose/hose assembly (3.1) that uses a metallic wire connection to conduct static electricity

### 3.3 electrically conductive hose/hose assembly

hose/hose assembly (3.1) that is capable of conducting static electrical charges, using a conductive rubber layer, without the use of a metallic wire

## 4 Classification

Hoses for this application are classified into four types and two grades according to their construction and electrical properties.

Type	Grade	Construction
B	M	Electrically bonded, incorporating at least two low-resistance electrically conductive wires and a conductive cover compound
C	Ω	Electrically conductive, incorporating a conductive cover compound
E	M	Electrically bonded, incorporating at least one metallic wire helix, at least two low-resistance electrically conductive wires and a conductive cover compound. Has an enhanced defuelling capability
F	Ω	Electrically conductive, incorporating at least one non-electrically conductive non-metallic helix and a conductive cover compound

## 5 Service reeling diameter

Hoses shall be designed for operation on equipment fitted with hose reels of the diameters given in [Table 1](#).



These hoses remain substantially circular in cross-section when reeled on drums and should not be confused with hoses of the collapsible type that are intended to be reeled flat.

**Table 1 — Service reeling diameters**

Nominal internal diameter of hose	Minimum external diameter of reeling drum used in service mm
19,0	225
25,0	300
31,5	375
38,0	450
50,0	550
63,0	600
76,0	600
100,0	900
101,5	900

## 6 Material and construction

### 6.1 Hoses

If the hose is mandrel-built and vulcanized on a mandrel, particulate-type release agents shall not be used. The hose shall be uniform in quality and be free from porosity, air holes, foreign inclusions and other defects when inspected visually.

The hose shall comprise the following components:

- a lining of synthetic rubber resistant to petroleum fuel;
- a reinforcement consisting of layers of woven, braided or spirally wound textile material;
- an outer cover made of synthetic rubber which shall be conductive and resistant to abrasion, outdoor exposure and petroleum fuel.

For types E and F hoses only, an embedded helix reinforcement shall be included in the construction. For type E hoses, the wire reinforcement used shall be a hard steel and shall have a galvanized finish in accordance with ISO 7989-1 and ISO 7989-2.

Types B and E shall also incorporate low-resistance electrically conductive wires to ensure that the hoses are electrically conductive.

The cover may have a shallow cloth-marked finish.

### 6.2 Hose assemblies

In order to produce the required electrical properties, the method of attachment of the couplings shall be in accordance with [Clause 9](#).

## 7 Dimensions and tolerances

### 7.1 Internal diameters

When measured in accordance with the most appropriate method in ISO 4671, the internal diameter shall lie within the tolerance limits specified in [Table 2](#).

**Table 2 — Internal diameters and tolerances**

Internal diameter mm	Tolerance limits mm
19,0	±0,8
25,0	±0,8
31,5	±0,8
38,0	±0,8
50,0	±1,2
63,0	±1,2
76,0	±1,2
100,0	±1,6
101,5	±1,6

## 7.2 Thickness

When measured in accordance with the most appropriate method in ISO 4671, the thickness of the lining shall be not less than 1,6 mm.

When measured in accordance with the most appropriate method in ISO 4671, the thickness of the cover shall be not less than 1,6 mm for hoses of nominal bore less than 50 and not less than 2,0 mm for hoses of nominal bore 50 and greater.

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## 7.3 Concentricity

When determined in accordance with the most appropriate method in ISO 4671, the concentricity, based on a total indicator reading between the bore and the outside surface of the cover, shall be no greater than 1,0 mm.

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## 7.4 Tolerances on length

The tolerances on the measured length shall be ±1 % of the specified length.

## 7.5 Mass per unit length of hose

The maximum mass per unit length shall be as given in [Table 3](#).

**Table 3 — Mass per unit length of hose**

Nominal internal diameter	Maximum mass per unit length of hose	
	Types B and C kg/m	Types E and F kg/m
19,0	0,9	1,1
25,0	1,1	1,5
31,5	1,4	1,9
38,0	1,7	2,2
50,0	2,7	3,0
63,0	3,5	4,0
76,0	4,0	4,7
100,0	6,5	7,5
101,5	6,5	7,5

## 8 Physical properties

### 8.1 Rubber compounds

The physical properties of the rubber compounds used for the lining and cover shall comply with the values given in [Table 4](#), when tested by the methods listed in [Table 4](#). Tests shall be carried out on test pieces or test samples taken either from the hose or from separately vulcanized sheets, except for the cold embrittlement and abrasion resistance tests which shall be carried out on moulded test pieces vulcanized to the same state as the hose. The tests which shall be carried out for type testing and routine testing are given in [Annex M](#). The tests recommended for production acceptance testing are given in [Annex N](#).

**Table 4 — Requirements for rubber compounds**

Property	Unit	Requirement		Method of test
		Lining	Cover	
Tensile strength, min.	MPa	7,0	7,0	ISO 37 (dumb-bell test pieces)
Elongation at break, min.	%	250	300	ISO 37 (dumb-bell test pieces)
Change in volume (swelling) in fuel, max.	%	50	75	ISO 1817:2015, 8.3 (48 h at 40 °C in liquid B)
Fuel-soluble matter, max.	%	4,0	Not applicable	<a href="#">Annex A</a>
Cold embrittlement		No cracking	No cracking	<a href="#">Annex B</a>
Abrasion resistance, max.	mm <sup>3</sup>	Not applicable	140	ISO 4649:2010, Method A
Ageing				ISO 188 (7 days at 70 °C) (air-oven method)
Tensile strength change, max.	%	±30	±30	ISO 37 (see above)
Elongation at break change, max.	%	±30	±30	ISO 37 (see above)

### 8.2 Finished hoses and hose assemblies

Finished hoses and hose assemblies shall meet the requirements specified in [Table 5](#).

**Table 5 — Requirements for finished hoses and hose assemblies**

Property	Requirement	Method of test
<b>Hose dimensions</b>		
Internal diameter	See <a href="#">Table 2</a>	ISO 4671
Lining thickness, min.	1,6 mm	ISO 4671
Cover thickness, min.	1,6 mm (nominal bore < 50) 2,0 mm (nominal bore ≥ 50)	ISO 4671
Concentricity, max.	1,0 mm	ISO 4671
Length tolerances	±1 %	ISO 4671
Mass per unit length, max.	See <a href="#">Table 3</a>	
<b>Hose tests</b>		
Adhesion between components (dry), min.	3,0 N/mm 2,0 N/mm	<a href="#">Annex C</a>
After contact with fuel, min.		
Fuel contamination, $R_e$ , max.	10 mg/100 ml	<a href="#">Annex D</a>

Table 5 (continued)

Property	Requirement	Method of test
Fuel discolouration	Not less than +15 Saybolt for normal hose	<a href="#">Annex D</a>
Ozone resistance	No cracking observed under ×2 magnification	ISO 7326 (40 °C)
Flexibility at ambient and low temperature	No permanent deformation or visible structural damage, no increase in electrical resistance outside the specified limits, no impairment of electrical continuity and shall comply with the proof-pressure requirements in <a href="#">Annex J</a> at (20 ± 5) °C	<a href="#">Annex E</a> (20 °C) <a href="#">Annex F</a> (-30 °C)
Crush recovery (type F only) After 1 min After 10 min	Regains 90 % of original diameter Regains 95 % of original diameter Shall comply with the proof-pressure requirement in <a href="#">Annex J</a> at (20 ± 5) °C	<a href="#">Annex G</a>
Cyclic kinking (types B and C only)	No leakage at proof pressure at (20 ± 5) °C No increase in electrical resistance or impairment of electrical continuity Any adhesion between components to be less than 2,0 N/mm	<a href="#">Annex H</a>
Flammability	Hose shall cease burning immediately on removal of flame and there shall be no glowing visible after 2 min.	<a href="#">Annex I</a>
Change in length at working pressure, max.	Types B and C: 0 to +7 % Types E and F: 0 to +12 %	<a href="#">Annex J</a>
Proof pressure	At 4,0 MPa (40 bar): No leakage or damage No increase in electrical continuity or resistance beyond the specified limits	<a href="#">Annex J</a>
Burst pressure, min.	8,0 MPa (80 bar)	<a href="#">Annex J</a>
Vacuum test	Types B and C at 15 kPa (0,15 bar) absolute: no visible structural damage Types B and C at 85 kPa (0,85 bar) absolute: loss of circularity not to exceed 20 % of internal diameter Type E at 15 kPa (0,15 bar) absolute: ball shall pass and no visible structural damage Type F at 35 kPa (0,35 bar) absolute: ball shall pass and no visible structural damage	<a href="#">Annex K</a>
Electrical properties	The electrical properties of the hose shall be such that the electrical requirement for the hose assemblies is met.	<a href="#">9.1</a> , <a href="#">9.2</a>