INTERNATIONAL STANDARD

ISO 7313

Second edition
2020-03

Aircraft — High temperature convoluted hose assemblies in polytetrafluoroethylene (PTFE)

Aéronefs — Tuyauterie flexible, haute température, convolutée, en polytétrafluoréthylène (PTFE)

Reference number
ISO 7313:2020(E)

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Published in Switzerland

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Foreword

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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).

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).

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

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 10, *Aerospace fluid systems and components*.

This second edition cancels and replaces the first edition (ISO 7313:1984), which has been technically revised. The main changes compared to the previous edition are as follows:

— Clause 2, normative references, has been updated;

— the structure of the document has been changed.

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.

Aircraft — High temperature convoluted hose assemblies in polytetrafluoroethylene (PTFE)

1 Scope

This document specifies characteristics of hose assemblies with corrosion-resistant metallic braid and convoluted polytetrafluoroethylene (PTFE) inner tube for use in aircraft fluid systems at temperatures between -55 °C and +200 °C and at nominal pressures, depending on bore size, up to 6,8 MPa. Special approval from the proper national authority can be required if these hoses are to be part of a pressurized gas storage system.

Two types of hose assembly are covered in this document:

— Type 1: Non-conductive inner tube; and

— Type 2: Conductive inner tube.

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 756-1, *Propan-2-ol for industrial use — Methods of test — Part 1: General*

3 Terms and definitions

No terms and definitions are listed in this document.

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

4 Requirements

4.1 Qualification

The hose assemblies furnished in accordance with this document shall be a product identical to that which has passed the qualification tests herein and shall be suitable for use in aircraft fluid systems under the conditions specified herein.

4.2 Materials

4.2.1 General

The hose assemblies shall be uniform in quality and free from defects in material as is consistent with good manufacturing practice. Materials shall conform to applicable specifications and the requirements specified herein.

4.2.2 Metals

Metals shall be of corrosion-resistant type or be suitably treated to resist corrosion due to fluid being conveyed and/or salt spray and atmospheric conditions to which the hose assembly can be subjected when in storage or during normal service use.

4.2.3 Non-metallic materials

All materials used in the hose assemblies shall be "non-ageing" for storage and shall be compatible with system fluids and other hose assembly materials and suitable for the service intended.

4.3 Design

4.3.1 General

The hose assembly shall consist of a convoluted PTFE inner tube which may be covered with convoluted woven glass cloth and other suitable material. The convoluted PTFE inner tube may also be reinforced with stainless steel wire braid and with end fittings suitable for the intended installation. This document shall specifically cover the hose assembly made up of the specified hose and the hose attachment mechanism of the fitting.

4.3.2 Inner tube

The inner tube shall be of convoluted construction designed to promote easy bending. It shall be free from pitting or projections on the inner surface which can interfere with fluid flow.

4.3.3 Reinforcement

The reinforcement shall consist of a stainless-steel wire braid or braids of sufficient strength and corrosion resistance to meet the requirements of this document.

4.3.4 Interlayers

Interlayers, if used, shall be of suitable material.

4.3.5 Fittings

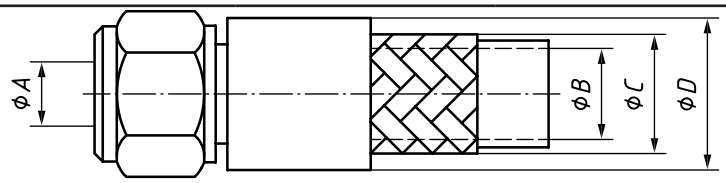
The fittings shall be specifically designed for this hose and materials shall be selected for the specific operating conditions. When the requirements for these fittings and this document conflict, this document shall take precedence.

4.4 Dimensions

4.4.1 Hose assembly dimensions

The dimensions of the hose assemblies shall be in accordance with Table 1.

Table 1 — Hose assembly dimensions



Key

A diameter of the nipple

B inside diameter of the inner tube

C outside diameter of the reinforcement

D outside diameter of the socket

Dimensions in millimetres

DN **Hose size**	*A* minimum	*B* minimum	*C* maximum	*D* maximum
06	3,0	4,8	11,3	14,0
10	6,0	8,6	14,3	19,1
12	8,7	12,7	20,0	22,3
16	10,9	14,9	21,9	24,1
20	16,1	19,0	27,8	32,5
25	21,2	23,8	33,4	38,1
32	27,5	30,1	39,7	43,2
40	33,3	36,5	47,7	50,8
50	46,3	49,2	60,4	65,0
63	57,8	61,9	73,1	76,2
80	70,4	74,6	87,3	94,0

4.4.2 Length

Hose assembly lengths shall be specified in the following increments only:

— 500 mm long and under: not less than 5 mm;

— 500 mm to 1 000 mm long: not less than 10 mm;

— 1 000 mm to 1 500 mm long: not less than 20 mm;

— over 1 500 mm long: not less than 30 mm.

Tolerances on hose assembly lengths shall be as follows:

— ±3 mm for lengths under 500 mm;

— ±7 mm for lengths from 500 mm to 900 mm;

— ±13 mm for lengths from 900 mm to 1 300 mm;

— ±1 % for lengths over 1 300 mm.

4.5 Performance

4.5.1 General

Each hose assembly shall be free from defects of material, workmanship, and finish; shall conform dimensionally to the requirements of this document; shall withstand the proof pressure specified in Table 2 without imperfection or leakage occurring when tested as specified in 5.4.3; and shall be capable of performance requirements specified below.

4.5.2 Examination of product

In accordance with 5.4.2.

4.5.3 Proof pressure

In accordance with 5.4.3.

4.5.4 Elongation and contraction

In accordance with 5.4.4.

4.5.5 Leakage

In accordance with 5.4.5.

4.5.6 Room temperature burst pressure

In accordance with 5.4.6.

4.5.7 High temperature burst pressure

In accordance with 5.4.7.

4.5.8 Oil resistance

In accordance with 5.4.8.

4.5.9 Fuel resistance

In accordance with 5.4.9.

4.5.10 Flexibility and vacuum

In accordance with 5.4.10.

4.5.11 Pressure impulse

In accordance with 5.4.11.

4.5.12 Conductivity (type 2 only)

In accordance with 5.4.12.

Table 2 — Physical requirements of hose assemblies

DN Hose size	Nominal pressure maximum MPa (bars)	Proof pressure minimum MPa (bars)	Minimum burst pressure at: room temperature MPa (bars)	Minimum burst pressure at: high temperature MPa (bars)	Bend radius at inside of bend mm	Test samples[a] Quantity of samples	Test samples[a] Length mm
06	6,8 (68)	13,6 (136)	27,2 (272)	19,0 (190)	32	11	460
10	6,8 (68)	13,6 (136)	27,2 (272)	19,0 (190)	57	11	460
12	6,8 (68)	13,6 (136)	27,2 (272)	19,0 (190)	73	11	460
16	6,1 (61)	12,2 (122)	24,4 (244)	17,0 (170)	76	11	460
20	6,1 (61)	12,2 (122)	24,4 (244)	17,0 (170)	95	11	460
25	6,1 (61)	12,2 (122)	24,4 (244)	17,0 (170)	127	11	460
32	6,1 (61)	12,2 (122)	24,4 (244)	17,0 (170)	160	4 7	460 510[b]
40	5,1 (51)	10,2 (102)	20,4 (204)	14,2 (142)	190	4 7	460 635[b]
50	1,7 (17)	3,4 (34)	6,8 (68)	4,7 (47)	255	4 7	460 790[b]
63	0,6 (6)	1,2 (12)	2,4 (24)	1,6 (16)	320	4 7	460 965[b]
80	0,6 (6)	1,2 (12)	2,4 (24)	1,6 (16)	380	4 7	460 1145[b]

[a] For Type 2 testing, one additional sample as noted in 5.4.12 is required.

[b] Assembly length required for the impulse test.

4.6 Part numbering of interchangeable parts

All parts having the same manufacturer's part number shall be directly and completely interchangeable with respect to installation and performance.

4.7 Product identification

4.7.1 General

Equipment, assemblies, and parts shall be marked for identification in accordance with appropriate standards to the extent applicable. The special marking specified in 4.7.2 and 4.7.3 shall be added.

4.7.2 Fittings

The manufacturer's name or trademark shall be permanently marked on each end fitting.

4.7.3 Assembly

The assembly shall be identified by a permanent marking on the end fitting or on a permanent band containing the following markings:

a) assembly manufacturer's name or trademark;

b) complete hose assembly part number;

c) nominal pressure in megapascals;

d) pressure test symbol "PT";

e) assembly specification "ISO 7313, and "type 1" or "type 2"; and

f) date of hose assembly manufacture expressed in terms of month and year.

4.8 Workmanship

4.8.1 General

The hose assembly including all parts shall be constructed and finished in a thoroughly workmanlike manner. All surfaces shall be free from burrs. All sealing surfaces shall be smooth, except that annular tool marks up to 2,5 µm maximum are acceptable.

4.8.2 Dimensions and tolerances

All pertinent dimensions and tolerances, where interchangeability, operation, or performance of the hose assembly may be affected, shall be specified on all drawings.

4.8.3 Cleaning

All hose assemblies shall be free from oil, grease, dirt, or any other foreign material, both internally and externally. Unless otherwise specified, hose assemblies shall be cleaned by flushing with suitable degreasing solvent, blow drying with air, and sealing with clean end caps.

4.8.4 Openings and covers

Openings shall be suitably protected against ingress of foreign material; all threads shall be protected against damage. All protective covers shall be of a configuration that prohibits assembly with the mating part without removal of the cover.

5 Quality assurance provisions

5.1 Classification of tests

The inspection and testing of hose assemblies shall be classified as follows:

a) acceptance (see 5.2); and

b) qualification testing (see 5.3).

5.2 Acceptance tests

5.2.1 General

Acceptance tests shall consist of:

a) individual test;

b) sampling test; and

c) periodic control test.

5.2.2 Individual tests

Each hose assembly delivered under this document shall be subjected to the following tests:

a) examination of product (see 5.4.2); and

b) proof pressure test (see 5.4.3).

5.2.3 Sampling test

5.2.3.1 The following test shall be performed on hose assemblies picked at random from each lot. A lot is defined as 500 assemblies of a given dash size, manufactured by the same process free from any deviations likely to have a significant effect on product quality.

5.2.3.2 One hose assembly shall be consecutively subjected to the following tests:

a) elongation and contraction test (see 5.4.4); and

b) leakage test (see 5.4.5).

5.2.4 Periodic control test

A fuel resistance test (see 5.4.9) shall be performed on at least two assemblies for each periodic control test selected from each 5 000 hose assemblies for each dash size, not necessarily manufactured during one continuous production run.

5.2.5 Rejection and retest

When one item selected from a production run fails to meet the specification, no items still on hand or later produced shall be accepted until the extent and cause of failure are determined and corrective actions, as necessary, taken.

For operational reasons, the individual tests may be continued pending the investigation of a sampling or periodic control test failure. Final acceptance of items on hand or produced later shall not be made until it is determined that items meet the requirements on which the rejection was based.

5.3 Qualification testing

The qualification of hose assemblies shall consist of all the tests described in this document. Unless otherwise specified by the purchaser, qualification samples and test sequence shall consist of:

a) eleven hose assemblies of each size of the length specified in Table 2 plus a conductivity specimen in accordance with 5.4.12 when required; and

b) the test schedule used shall be as specified in Table 3.

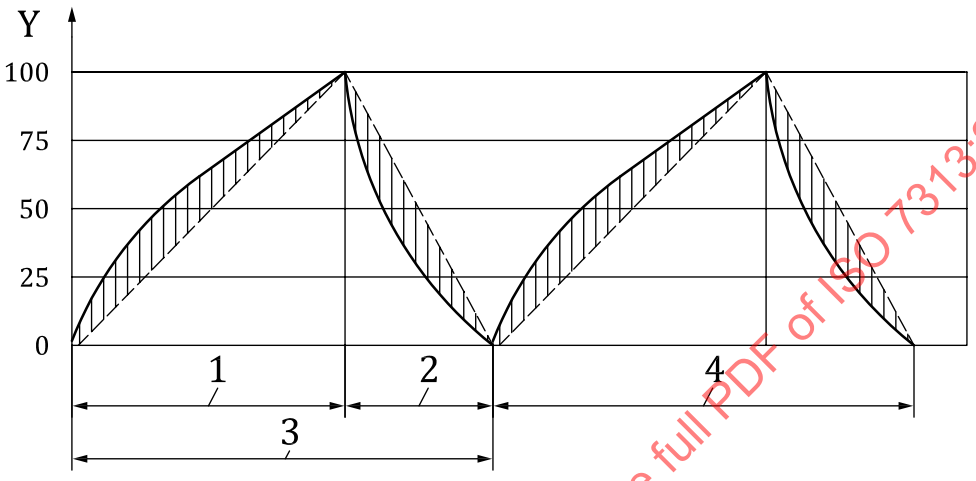
Table 3 — Qualification test schedule

Tests	Sample No.											
	1	2	3	4	5	6	7	8	9	10	11	12[a]
Examination of product	X	X	X	X	X	X	X	X	X	X	X	X
Proof pressure	X	X	X	X	X	X	X	X	X	X	X	
Elongation and contraction	X											
Leakage	X	X										
Oil resistance			X		X							
Fuel resistance				X		X						
Room temperature burst pressure			X	X								
High temperature burst pressure	X	X										
Flexibility and vacuum					X	X	X					
Salt corrosion										X	X	

[a] For type 2 assemblies only.

Table 3 *(continued)*

Tests	Sample No.											
	1	2	3	4	5	6	7	8	9	10	11	12[a]
Pressure impulse								X	X	X	X	
Conductivity												X
[a] For type 2 assemblies only.												



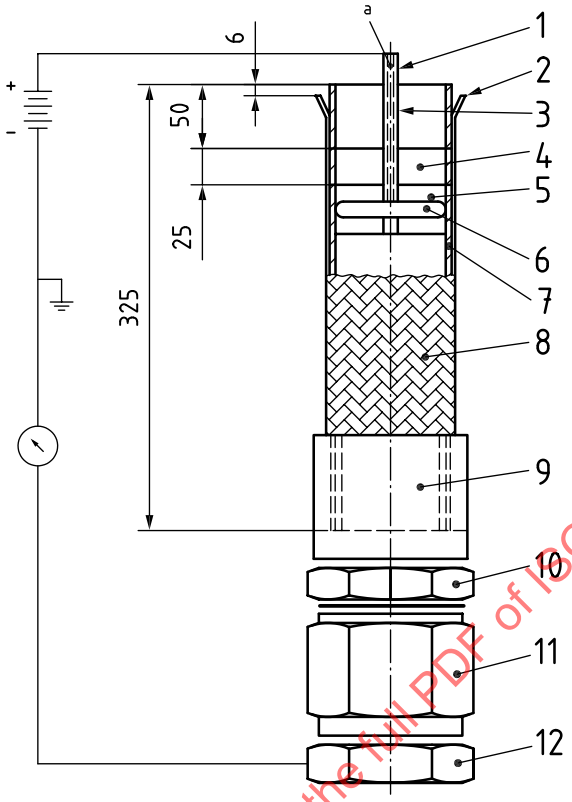
Key

1 2/3 to 3/4 cycle
2 1/3 to 1/4 cycle
3 one cycle; 2 to 3 s
4 one cycle; 2 to 3 s
Y percent operating pressure

The curve shown above is the approximate pressure/time cycle for proper severity for impulse testing hose assemblies. It is mandatory that the pressure peak rises to 100 % of nominal pressure. It is considered desirable that the pressure time curve be confined to the shaded area so that results of tests performed on different test machines will be more nearly comparable.

Figure 1 — Pressure impulse curve

Dimensions in millimetres



Key

a 1 000 V d.c.
1 conductor threaded into plug
2 flare reinforcement
3 vent
4 upper electrode (salt water solution or mercury)
(If used, salt water solution shall be 450 g NaCl for 1 l H_2O)
5 non-metallic plug
6 O-ring seal
7 inner tube
8 hose reinforcement
9 fitting socket
10 fitting nipple
11 fitting nut
12 mating adapter (insulate electrode from ground)

Figure 2 — Conductivity test diagram

5.4 Inspection methods

5.4.1 General

See Table 3 for the test schedule.

5.4.2 Examination of product

All hose assemblies shall be examined to determine conformance to this document with respect to material, size, workmanship, and identification. Broken or missing reinforcing wires or any other evidence of malfunction shall be cause for rejection. Crossed over reinforcing wires shall not be cause for rejection.

5.4.3 Proof pressure test

All hose assemblies shall be pressure-tested to the values specified in Table 2 for a period of not less than 30 s and not more than 5 min. All complete hose assemblies used for the tests described in this document shall have this proof pressure test applied to them. Any evidence of leakage from hose or fittings or any other evidence of malfunction shall constitute failure.

5.4.4 Elongation and contraction test

The test assembly shall be held in a straight unpressurized condition and a 250 mm standard length marked off on the hose. It shall then be pressurized to the operating pressure for 5 min minimum. At the end of this 5 min period, and while still pressurized, the standard length shall be measured and recorded. Within the standard hose length an elongation of +3 % and a reduction of -1 % is acceptable.

5.4.5 Leakage test

Two hose assemblies of each size shall be subjected to this test. The assemblies shall be pressurized while at room temperature to 0,17 MPa for a minimum of 5 min. The pressure shall be increased to a value equal to 70 % of the minimum room temperature burst pressure specified in Table 2 and again held for a minimum of 5 min. The pressure shall be completely released and again increased to 70 % of the minimum room temperature burst pressure and held for a minimum of 5 min. Any evidence of leakage shall constitute failure.

5.4.6 Room temperature burst pressure test

Room temperature shall be defined as (20 ± 15) °C. During this test the assemblies shall be fastened at one end to the source of pressure. They shall be straightened, and the free end shall not be restrained or fastened in any way. The rate of pressure rise shall be 170^{0}_{-10} MPa/min until failure occurs. The hose shall not burst, the fittings shall not blow off or loosen, and there shall be no leakage from the hose or fitting or any other evidence of malfunction below the minimum room temperature burst pressure specified in Table 2. The hose assemblies shall be under continuous observation during pressure increase and the type of failure shall be recorded.

5.4.7 High temperature burst pressure test

Two hose assemblies of each size shall be installed as described in 5.4.6, filled with a suitable test fluid and soaked for 1 h with ambient and fluid temperature at (200 ± 6) °C. After 1 h the pressure shall be raised to the operating pressure for 5 min. The pressure shall then be increased at the rate of 170^{0}_{-10} MPa/min until bursting or leakage occurs. Any leakage at pressure below the minimum high temperature burst pressure listed in Table 2 shall be evidence of failure. The hose assemblies shall be under continuous observation during pressure increase and the type of failure shall be recorded.

5.4.8 Oil resistance test

5.4.8.1 Two test samples of each size shall be filled with a synthetic base lubricating oil or another oil approved for use by the procuring authority and placed in an oven which shall be maintained at (200 ± 6) °C. Care should be taken to prevent the assembly from coming in contact with parts of the oven which are at a higher temperature. The same test fluid shall be used throughout this test except as

otherwise specified in 5.4.8.2. The assembly shall have a pressure applied equal to the nominal pressure as specified in Table 2.

5.4.8.2 At the end of a minimum of 16 h, the assembly shall be removed from the oven, drained and refilled with commercial grade jet engine fuel. A pressure shall be applied equal to the nominal pressure and maintained for a minimum of 2 h at room temperature.

5.4.8.3 The procedure specified in 5.4.8.1 and 5.4.8.2 shall be repeated for a total of three times.

5.4.8.4 At the completion of the above procedure, the test samples shall be drained and then filled with oil and placed in a cold chamber for 4 h, maintained at (–55 ± 3) °C. After the 4 h cold soak, the samples shall be subjected to a pressure equal to the nominal pressure specified in Table 2. The pressure shall be held for a minimum of 5 min and then released. This shall be repeated for a total of 10 times with a minimum of 5 min between each pressure application.

5.4.8.5 The assemblies shall again be placed in the cold chamber with the temperature at (-55 ± 3) °C for 24 h. At the end of this time, oil at a temperature of (200 ± 6) °C shall be circulated through the assemblies. Within 15 s after introduction of the hot oil, the pressure shall be increased to the proof pressure and held for a minimum of 2 min.

5.4.8.6 Any leakage of the test fluid from the assemblies during the preceding tests (5.4.8.1 to 5.4.8.5) shall be evidence of failure.

5.4.8.7 At the conclusion of the above tests, one of the test assemblies shall be used for the burst test of 5.4.6. The other assembly shall be subjected to the flexibility and vacuum test of 5.4.10.

5.4.9 Fuel resistance test

5.4.9.1 Two hose assemblies shall be subjected to the test with a commercial grade jet engine fuel at the nominal pressure as specified in Table 2 and at a temperature of (125 ± 6) °C. The sequence in 5.4.9.2 to 5.4.9.5 shall be performed.

5.4.9.2 The test assemblies shall be installed in a controlled temperature box with the fluid and ambient air at room temperature and the assemblies subjected to the nominal pressure as specified in Table 2. The temperature of the ambient air shall then be reduced to (-55 ± 3) °C and held for a minimum of 1 h.

5.4.9.3 The temperature of the fluid and the ambient air shall then be increased to (125 ± 6) °C. The hose assembly shall remain at the ambient and fluid temperature of (125 ± 6) °C and at the nominal pressure for a minimum of 48 h.

5.4.9.4 The assemblies shall them be subjected for 5 min at room temperature to the proof pressure as specified in Table 2. The assemblies shall show no evidence of leakage.

5.4.9.5 One of the assemblies shall then be subjected to the burst test as specified in 5.4.6 and the other assembly shall be subjected to the flexibility and vacuum test in 5.4.10.

5.4.10 Flexibility and vacuum test

5.4.10.1 One test assembly from the fuel resistance test (see 5.4.9), one from the oil resistance test (see 5.4.8) and one unaged sample shall be used for this test. The samples shall be filled with an iso-octane test fluid and placed in a cold chamber for 24 h maintained at a temperature of (–55 ± 3) °C.

5.4.10.2 At the end of this time and while still at this temperature, the samples shall be bent to the extreme around a mandrel with a radius equal to the minimum bend radius specified in Table 2. The