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Aerospace — Hose assemblies in polytetrafluoroethylene (PTFE) for use up to 232 °C and 10 500 kPa — Technical specifications and requirements

Aéronautique et espace — Tuyauteries flexibles en polytétrafluoroéthylène (PTFE), pour utilisation jusqu'à 232 °C et 10 500 kPa — Spécifications techniques et exigences

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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Contents

Page

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 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.

ISO 10502 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 10502:1992), which has been technically revised as follows:

a) requirements have been aligned to ISO 8829-1;

b) units in inches have been added;

c) in 3.4.1, the requirement relating to relative density has been updated;

d) in 3.7, length tolerances have been added;

e) in 3.9.3, a requirement has been added to include as a permanent marking on the hose assembly the fire resistance type according to ISO 2685;

f) Annex A, dealing with equivalent materials and components, has been updated.

Aerospace — Hose assemblies in polytetrafluoroethylene (PTFE) for use up to 232 °C and 10 500 kPa — Technical specifications and requirements

1 Scope

This International Standard specifies requirements for polytetrafluoroethylene (PTFE) hose assemblies for use in aircraft hydraulic, fuel and lubricating oil systems at temperatures between −55 °C (−67 °F) and 232 °C (450 °F) for Class I assemblies and between −55 °C (−67 °F) and 135 °C (275 °F) for Class II assemblies, and at nominal pressures up to 10 500 kPa (1 523 psi) (105 bar[1)]). The hose assemblies are also suitable for use within the same temperature and pressure limitations in aerospace pneumatic systems where some gaseous diffusion through the wall of the PTFE liner is tolerated.

This International Standard covers hose assemblies of the following classes:

— class I: hose assemblies with fitting of corrosion-resistant steel or titanium parts [232 °C (450 °F)];

— class II: hose assemblies with fitting of corrosion-resistant steel and aluminium parts [135 °C (275 °F)], DN12 and larger.

The hose assemblies specified in this International Standard are not intended for use in pneumatic storage systems. In addition, it is intended that installations in which the limits specified in this International Standard are exceeded, or in which the application is not covered specifically by this International Standard, for example for oxygen, be subject to the approval of the purchaser.

2 Normative references

The following referenced documents are indispensable for the application 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 2685, *Aircraft — Environmental test procedure for airborne equipment — Resistance to fire in designated fire zones*

ISO 2859-1, *Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

ISO 5855-3, *Aerospace — MJ threads — Part 3: Limit dimensions for fittings for fluid systems*

ISO 6772, *Aerospace — Fluid systems — Impulse testing of hydraulic hose, tubing and fitting assemblies*

ISO 7258, *Polytetrafluoroethylene (PTFE) tubing for aerospace applications — Methods for the determination of the density and relative density*

ISO 8829-1:2009, *Aerospace — Test methods for polytetrafluoroethylene (PTFE) inner-tube hose assemblies — Part 1: Metallic (stainless steel) braid*

1) 1 bar = 100 kPa.

3 Requirements

3.1 Qualification

Hose assemblies supplied in accordance with this International Standard shall be representative of products which have been subjected to, and have successfully passed, the tests specified in this International Standard, and which meet the requirements of this International Standard.

3.2 Materials

3.2.1 General

The hose assemblies shall be uniform in quality and free from defects in material as is consistent with good manufacturing practice. They shall conform to the applicable specifications and requirements of this International Standard.

3.2.2 Metals

Corrosion-resistant steel shall be used for the hose; fittings shall be of corrosion-resistant steel, titanium, or aluminium alloy suitably treated to resist corrosion when in storage or during normal service use. Metals shall conform to the applicable specifications given in Table 1 (or equivalent specifications; see Annex A).

Table 1 — Metals for use in hose assemblies

Form	Metal	**Material No.** (see Annex A)
Bars and forgings	Austenitic, annealed or as-rolled, corrosion-resistant steel	1
	Austenitic, annealed or as-rolled, heat-stabilized, corrosion-resistant steel	2 and 3
	Precipitation-hardening, corrosion-resistant steel; solution heat treated and in artificially aged condition	4, 5 and 6
	Titanium 6Al-4V	7 and 23
	Aluminium alloy 2014	17
	Aluminium alloy 2024	18
	Aluminium alloy 6061	19 and 20
Tubing	Austenitic, seamless or welded, annealed, corrosion-resistant steel	8
	Austenitic, seamless or welded, stabilized, corrosion-resistant steel	9 and 10
	Titanium 3Al-2,5V	11
	Titanium T40	24
	Aluminium alloy 5052	21
	Aluminium alloy 6061	22
Wire	Austenitic, cold-drawn, corrosion-resistant steel	12, 13 and 14

3.3 Construction

3.3.1 General

The hose assembly shall consist of

a) a seamless PTFE inner tube (see 3.3.2),

b) corrosion-resistant steel-wire reinforcement (see 3.3.3), and

c) aluminium, corrosion-resistant steel or titanium end-fittings (see 3.3.4),

as required to meet the construction and performance requirements of this International Standard and as required for its intended use.

3.3.2 Inner tube

The inner tube shall be of a seamless construction of virgin PTFE resin of uniform gauge; it shall have a smooth bore and shall be free from pitting or projections on the inner surface. Additives may be included in the compound from which the tube is extruded.

3.3.3 Reinforcement

The reinforcement shall consist of corrosion-resistant steel wires conforming to the applicable specifications given in 3.2.2. The wires shall be arranged on the outside surface of the inner tube so as to provide sufficient strength to ensure compliance with the requirements of this International Standard.

Broken or missing reinforcing wires or buckled wires more than 1,5 mm (0.06 in) above the outside diameter surface shall be cause for rejection. Crossed-over reinforcing wires need not be cause for rejection of the hose assembly.

3.3.4 Fittings

3.3.4.1 General

It shall be proven that all fittings comply with the requirements of this International Standard. The hose attachment fitting may be of a permanent or of a reusable design.

Unless otherwise specified by the purchaser, the hose assembly end fittings shall have 24° cone fittings.

3.3.4.2 Insert fittings

Insert fittings shall be manufactured in one piece wherever possible. Those constructed of more than one piece shall have either welded joints using butt-weld or lap-weld design, or braze joints using lap-braze design, fabricated from annealed corrosion-resistant steel, titanium or aluminium alloy tubing. Welded and redrawn tubing (materials No. 8 and No. 9; see Annex A) may be used for corrosion-resistant steel.

3.4 Inner tube requirements

3.4.1 Density and relative density

The relative density of the hose inner tube shall not exceed 2,210 g/cm^3 (0.079 8 lb/in^3) when tested in accordance with ISO 7258, either method A or method B (as specified in ISO 8829-1). The density shall not exceed 2,155 g/cm^3 (0.077 9 lb/in^3) when tested in accordance with ISO 7258, method C (as specified in ISO 8829-1).

3.4.2 Tensile strength

When tested in accordance with ISO 8829-1:2009, 4.2, the longitudinal tensile strength for all sizes of tubes shall be at least 15,1 N/mm^2 (2 190 psi)[2)].

When tested in accordance with ISO 8829-1, the transverse tensile strength for sizes DN16 and larger shall be at least 12,4 N/mm^2 (1 798 psi); for sizes under DN16, the transverse strength need not be tested.

3.4.3 Elongation

When tested in accordance with ISO 8829-1, the elongation shall be at least 200 %.

2) 1 N/mm^2 = 1 MPa.

3.4.4 Tube roll

The tube shall not leak, split, burst or show any signs of malfunction, when tested through the sequence specified in ISO 8829-1.

3.4.5 Tube proof pressure

After being subjected to the tube roll test sequence (see 3.4.4), the tube, without reinforcing wires, shall not leak, burst or show any signs of malfunction, when tested as specified in ISO 8829-1.

3.4.6 Electrical conductivity

When tested in accordance with ISO 8829-1:2009, 4.4, the electrical current shall be greater than or equal to

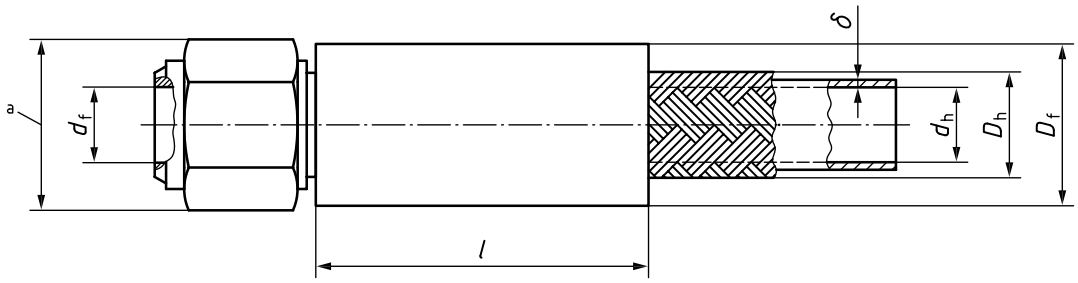
a) 10 µA for sizes DN05 to DN12 (incl.), or

b) 20 µA for sizes DN16 and over.

3.5 Hose

3.5.1 Dimensional requirements

The hose assembly dimensions, except for length, shall be as specified in Figure 1 and Table 2.



[a] Width across corners of nut and socket hexagon may exceed the values given for D_f (see footnote b of Table 2).

Figure 1 — Hose and fitting dimensions

Table 2 — Hose and fitting dimensions (see Figure 1)

Dimensions in millimetres (inches)

Hose dash size	Hose size	Hose (braided)			Fitting		Attachment length	Wall thickness of inner tube		Number of braids
		Inside diameter	Outside diameter		Inside diameter[a]	Outside diameter[b]				
		d_h	D_h		d_f	D_f	l	δ		
	(nom.)	min.	min.	max.	min.	max.	max.	min.	max.	
-03	**DN05**	2,3 (0.091)	5,8 (0.228)	6,8 (0.268)	2 (0.079)	12,7 (0.500)	31,8 (1.252)	0,89 (0.035)	1,19 (0.047)	1
-04	**DN06**	4,4 (0.173)	7,7 (0.303)	9,5 (0.374)	3,4 (0.134)	14,2 (0.559)	31,8 (1.252)			
-05	**DN08**	5,8 (0.228)	9,3 (0.366)	10,6 (0.417)	4,9 (0.193)	16 (0.630)	34,3 (1.350)			
-06	**DN10**	7,6 (0.299)	10,9 (0.429)	12,7 (0.500)	6,5 (0.256)	18 (0.709)	37 (1.457)			
-08	**DN12**	9,9 (0.390)	13,9 (0.547)	15,6 (0.614)	8,5 (0.335)	21,4 (0.843)	44 (1.732)	0,97 (0.038)	1,27 (0.050)	
-10	**DN16**	12,3 (0.484)	16,3 (0.642)	20,3 (0.799)	11 (0.433)	26 (1.024)	49 (1.930)	1,07 (0.042)	1,37 (0.054)	
-12	**DN20**	15,6 (0.614)	19,5 (0.768)	23,0 (0.906)	13,8 (0.543)	30 (1.181)	55,1 (2.169)			
-16	**DN25**	21,6 (0.850)	27,4 (1.079)	29,0 (1.142)	19,7 (0.776)	38,6 (1.520)	65 (2.559)			2
-20	**DN32**	28 (1.102)	33,7 (1.327)	35,3 (1.390)	25,4 (1.000)	50,8 (2.000)	66,1 (2.600)	1,14 (0.045)	1,45 (0.057)	
-24	**DN40**	34,1 (1.343)	41,6 (1.638)	43,3 (1.705)	31,7 (1.248)	58 (2.283)	68,1 (2.681)	1,65 (0.065)	1,96 (0.077)	

[a] Minimum inside diameter through the elbow area may be 0,8 mm (0.031 in) less than the values given for d_f.

[b] Width across corners of nut and socket hexagon may exceed the values given for D_f.

3.5.2 Physical requirements

Hose assemblies shall comply with the physical and linear density (weight) requirements; refer to the relative dash size as specified in Table 3.

3.5.3 Bore check

When bent to the appropriate minimum bend radius as specified in Table 3, the hose assembly shall permit the free passage of a solid rigid sphere throughout its length. The diameter of the sphere shall be 90 % of the appropriate minimum internal diameter of the end fittings as specified in Table 2. For elbow fittings, see footnote a to Table 2.

Table 3 — Physical requirements of hose assemblies and linear density (weight) of hose

Hose dash size	Hose size	Maximum hose weight[a]	Operating pressure	Proof pressure	Burst pressure		Bend radius at inside of bend	Volumetric expansion	Effusion	Effusion after stress degradation	Negative pressure
	(nom.)				min.		min.	max.	(per 1/2 h)	(per min)	
					Room temp.	High temp.					
		kg/m (lb/in)	kPa (psi)	kPa (psi)	kPa (psi)	kPa (psi)	mm (in)	ml/m (cm^3/in)	ml/m (cm^3/ft)	ml/m (cm^3/in)	kPa (inHg)
-03	**DN05**	0,089 (0.005)	10 500 (1 500)	21 000 (3 000)	83 000 (12 000)	48 000 (7 000)	50 (1.97)	1,1 (0.028)	13 (4.0)	394 (10.0)	95 (28)
-04	**DN06**	0,129 (0.007)	10 500 (1 500)	21 000 (3 000)	83 000 (12 000)	48 000 (7 000)	50 (1.97)	1,1 (0.028)	13 (4.0)	315 (8.0)	95 (28)
-05	**DN08**	0,147 (0.008)	10 500 (1 500)	21 000 (3 000)	69 000 (10 000)	45 000 (6 500)	50 (1.97)	1,6 (0.041)	16 (4.9)	315 (8.0)	95 (28)
-06	**DN10**	0,183 (0.010)	10 500 (1 500)	21 000 (3 000)	62 000 (9 000)	45 000 (6 500)	100 (3.94)	—	16 (4.9)	315 (8.0)	95 (28)
-08	**DN12**	0,235 (0.013)	10 500 (1 500)	21 000 (3 000)	56 000 (8 100)	41 000 (6 000)	120 (4.72)	—	16 (4.9)	158 (4.0)	95 (28)
-10	**DN16**	0,305 (0.017)	10 500 (1 500)	21 000 (3 000)	48 000 (7 000)	38 000 (5 500)	140 (5.51)	—	16 (4.9)	79 (2.0)	95 (28)
-12	**DN20**	0,486 (0.027)	7 000 (1 000)	14 000 (2 000)	34 000 (5 000)	24 000 (3 500)	165 (6.50)	—	20 (6.1)	79 (2.0)	70 (21)
-16	**DN25**	0,863 (0.048)	8 750 (1 250)	17 500 (2 500)	34 000 (5 000)	24 000 (3 500)	190 (7.48)	—	26 (7.9)	79 (2.0)	50 (15)
-20	**DN32**	1,110 (0.062)	7 000 (1 000)	14 000 (2 000)	27 5000 (4 000)	21 000 (3 000)	280 (11.02)	—	26 (7.9)	79 (2.0)	35 (10)
-24	**DN40**	1,500 (0.084)	7 000 (1 000)	14 000 (2 000)	27 500 (4 000)	21 000 (3 000)	355 (13.98)	—	26 (7.9)	79 (2.0)	30 (9)

[a] Hose weight shall be determined on a minimum length of 300 mm.

3.6 Screw threads

Unless otherwise specified (see 3.3.4), fitting threads shall be in accordance with ISO 5855-3. A 10 % increase in the tolerance of the fitting thread of the nut following proof testing need not be cause for rejection of the hose assembly.

3.7 Length tolerances

Tolerances on hose assembly lengths shall be as follows:

— ±3,18 mm (0.125 in) for lengths < 457,2 mm (18 in);

— ±6,35 mm (0.250 in) for lengths ≥ 457,2 mm (18 in) and < 914,4 mm (36 in);

— ±12,7 mm (0.500 in) for lengths ≥ 914,4 (36 in) and < 1 270 mm (50 in);

— ±25,4 mm (1.0 in) for lengths ≥ 1 270 mm (50 in).

3.8 Part numbering of interchangeable parts

All parts complying with this International Standard and having the same manufacturer's or standard part number shall be functionally and dimensionally interchangeable.

3.9 Identification of products

3.9.1 General

The hose assembly and its component parts shall be permanently marked.

3.9.2 Fittings

The hose manufacturer's name or trade mark shall be permanently marked on one element of all end fittings.

3.9.3 Hose assembly

A permanent marking shall be applied on a fitting or on a permanent band or bands securely attached to the hose. Bands shall be no wider than 25 mm (0.98 in) and shall not impair the flexibility or the performance of the hose. Unless otherwise specified, the marking on the fitting or band shall include the following information:

a) the assembly manufacturer's name or trade mark, and the number of this International Standard (i.e. ISO 10502);

b) the complete hose assembly part number;

c) the nominal pressure, "10 500 kPa (1 523 psi)" or as applicable according to Table 3;

d) the operating temperature, "232 °C (450 °F)" or "135 °C (275 °F)" (as applicable), if required;

e) the pressure test symbol, "PT";

f) the date of manufacture of the hose assembly, expressed in terms of month and year, or the batch number;

g) fire resistance type according to ISO 2685 (as applicable).

3.10 Workmanship

3.10.1 General

The hose assembly, including all parts, shall be constructed and finished in a thoroughly workmanlike manner. All surfaces shall be free from burrs and sharp edges.

3.10.2 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.

3.10.3 Cleaning

All hose assemblies shall be free from oil, grease, dirt, moisture, cleaning solvents and other foreign materials, both internally and externally.

Hose assemblies shall be inspected as follows when properly cleaned.

a) Visually inspect hose assembly ends for installation of plug or cap at fitting. Both ends should be firmly capped. An uncovered fitting nipple end shall be cause for rejection.

b) Remove caps or plugs, place a light source at one end of the hose assembly and visually examine the hose assembly, without magnification, from the opposite end. Oil, grease, dirt, moisture or any other foreign materials shall be cause for rejection.

3.11 Hose assembly — Test and performance requirements

3.11.1 Proof pressure

When tested in accordance with ISO 8829-1, each hose assembly shall withstand the proof pressure specified in Table 3 for a minimum of 2 min without malfunction or leakage.

3.11.2 Elongation and contraction

When two test specimens of the sample hose assemblies are tested in accordance with ISO 8829-1, there shall be no change in length of more than ±2 % in a 250 mm (9.84 in) gauge length.

3.11.3 Volumetric expansion

When two test specimens of the sample hose assemblies are tested in accordance with ISO 8829-1, the volumetric expansion shall not exceed the limits specified in Table 3.

3.11.4 Pneumatic effusion

When two test specimens of the sample hose assemblies are tested in accordance with ISO 8829-1, the total rate of effusion shall not exceed that specified in Table 3.

3.11.5 Pneumatic surge

When two test specimens of the sample hose assemblies are tested in accordance with ISO 8829-1, the inner tubes of the test specimens shall not collapse or show signs of degradation.

3.11.6 Fuel resistance

When two test specimens of the sample hose assemblies are tested in accordance with ISO 8829-1, they shall not leak or show signs of degradation.

3.11.7 Impulse

3.11.7.1 Preconditioning

Six sample hose assemblies with a 90° elbow fitting on one end of the hose and a straight fitting on the other end of the hose shall be tested. If approval is being sought for both the bent-tube and the forged-elbow configurations, then half of the samples (i.e. three specimens) shall use the bent elbows, while the other half of the samples shall have the forged elbows.

Two test specimens shall be oil aged, two air aged, and two unaged (see 4.5.6).

3.11.7.2 Procedure

Subject the sample hose assemblies at room temperature to the proof pressure specified in Table 3 for a minimum of 5 min. Then test them in accordance with ISO 8829-1, except that sizes DN25, DN32 and DN40 shall be tested straight, without bending.

3.11.7.3 Requirements

When tested for 100 000 cycles of impulse testing, the sample hose assemblies shall comply with the test requirements without any signs of leakage [see also item h) in Clause 6].

3.11.8 Stress degradation

When two test specimens of the sample hose assemblies are tested in accordance with ISO 8829-1, the average rate of effusion shall not exceed that specified in Table 3.

3.11.9 Low-temperature flexing

When three test specimens of the sample hose assemblies are tested in accordance with ISO 8829-1, they shall not show signs of damage after flexing.

3.11.10 Leakage

When two test specimens of the sample hose assemblies are tested in accordance with ISO 8829-1, there shall be no leakage.

3.11.11 Corrosion

Two test specimens of the sample hose assemblies shall be tested in accordance with the following procedure. The assembly shall be mounted in a vertical position, pressurized to the operating pressure given in Table 3, and immersed in a (2,5 ± 0,1) % NaCl solution for 5 min then hot air dried at 60 °C (140 °F) for 25 min. This cycle shall be repeated for a total of 172 h. Following completion, one assembly shall be room-temperature burst tested in accordance with 3.11.13 and one assembly high-temperature burst tested in accordance with 3.11.14.

3.11.12 Repeated installation

3.11.12.1 Procedure

Two test specimens of the sample hose assemblies shall be tested as follows. Screw end fittings on hose assemblies to appropriate union adaptors eight times using system fluid or an equivalent lubricant. Each of the eight cycles shall include the complete removal of the hose fitting from the manifold union. Tighten fitting nuts to the torques specified in the applicable fitting specification; test one half of the sample to the minimum tightening torque and test the other half to the maximum tightening torque. Following the first, fourth and eighth installation, carry out proof pressure tests in accordance with 3.11.1. Following the eighth installation, pressure test the hose fittings with air or nitrogen gas for 5 min at the nominal operating pressure.

3.11.12.2 Requirements

The assembly end fittings shall show no signs of leakage, galling or other malfunction.

3.11.13 Burst pressure at room temperature

When two test specimens of the sample hose assemblies are tested in accordance with ISO 8829-1, they shall not leak or burst at any pressure below the burst pressure at the room temperature specified in Table 3.

3.11.14 Burst pressure at high temperature

When two test specimens of the sample hose assemblies are tested in accordance with ISO 8829-1, they shall not leak or burst at any pressure below the high-temperature burst value specified in Table 3.

3.11.15 Vacuum

When three test specimens of the sample hose assemblies are tested in accordance with ISO 8829-1, the hose shall not collapse or buckle. After completion of the test, a spherical ball of a diameter as given in Table 4 shall be rolled freely through the length of the hose assembly.

Table 4 — Spherical ball size for verifying the internal diameter of hose after vacuum test

Dimensions in millimetres (inches)

Hose size	DN05	DN06	DN08	DN10	DN12	DN16	DN20	DN25	DN32	DN40
Ball diameter	1,9 (0.075)	3,2 (0.126)	4,7 (0.185)	6,3 (0.248)	7,9 (0.311)	10,3 (0.406)	13,5 (0.531)	19,5 (0.768)	24,5 (0.965)	31,7 (1.248)

3.11.16 Pneumatic leakage

When two test specimens of the sample hose assemblies are tested in accordance with ISO 8829-1, they shall withstand the operating pressure specified in Table 3 without leakage. The test assemblies shall be prepared without the use of any oil during assembly.

3.11.17 Electrical conductivity

When tested in accordance with ISO 8829-1, hose assemblies of sizes DN06 through DN12 shall be capable of conducting a direct current greater than or equal to 6 µA; sizes DN16 and over shall be capable of conducting a current greater than or equal to 12 µA. One sample shall be used for this test.

3.11.18 Fire resistance

3.11.18.1 General

If the hose assemblies are required to have a specified resistance to fire, two test specimens of the sample hose assemblies, which may be fitted with fire sleeves (see Table A.1, No. 15), shall be tested in accordance with ISO 2685.

NOTE On occasions, a test might not be valid because of failure to hold the flame temperature at the specified value; for this reason it is advised to prepare four hose assemblies for this test.

3.11.18.2 Requirements

The test specimens shall withstand the effects of the flame without leakage for the following periods, as appropriate:

— fire-resistant assemblies: 5 min;

— fireproof assemblies: 15 min.

4 Responsibility for inspection

4.1 General

Unless otherwise specified in the contract or purchase order, the supplier is responsible for carrying out all inspections and tests in accordance with the requirements of this International Standard. Unless otherwise specified, the supplier may use his own facilities or any commercial laboratory acceptable to the procuring activity. The purchaser reserves the right to perform any of the inspections set out in the procurement specification (i.e. this International Standard) where such inspections are deemed necessary to ensure that supplies and services conform to specified requirements.

4.2 Classification of inspections

The examining and testing of hose assemblies shall be classified as:

a) qualification inspections (see 4.3);

b) quality conformance inspections (see 4.4).

4.3 Qualification inspections

4.3.1 Qualification test samples

Test samples shall consist of the number of test specimens specified in Table 6, the lengths of which are specified in Table 5.

Table 5 — Length of test specimens

Dimensions in millimetres (inches)

Hose size	Length of test specimens		
	for impulse tests (3.11.7)	**for resistance tests** (3.11.18)	**for other tests**[a]
DN05	360 (14.0)	600 (24)	460 (18.0)
DN06	360 (14.0)	600 (24)	460 (18.0)
DN08	410 (16.0)	600 (24)	460 (18.0)
DN10	460 (18.0)	600 (24)	460 (18.0)
DN12	550 (21.5)	600 (24)	460 (18.0)
DN16	600 (23.5)	600 (24)	460 (18.0)
DN20	700 (27.5)	600 (24)	460 (18.0)
DN25	460 (18.0)	600 (24)	460 (18.0)
DN32	460 (18.0)	600 (24)	460 (18.0)
DN40	460 (18.0)	600 (24)	460 (18.0)

[a] One additional sample of each hose size, in the lengths specified in ISO 8829-1, shall be used for electrical conductivity tests (3.11.17).

4.3.2 Test report, test samples and data for the purchaser

If the tests are carried out at a location other than the laboratory of the purchaser, the following information shall be made available to the purchaser on request:

a) test report: three copies of a test report which shall include a report of all tests and an outline description of the tests and conditions;

b) test sample: the sample which was tested, when requested by the purchaser;

c) list of sources of hose or hose components, including name of source and product identification for inner tube, hose and assembly.

Log sheets, containing required test data, shall remain on file at the source test facility and are not to be sent to the qualifying activity unless specifically requested.

4.3.3 Qualification testing

Qualification testing shall consist of all the examinations and tests specified in 3.4 and 3.11; the test sequence shall be in accordance with Table 6.

Table 6 — Qualification test sequence and number of test specimens in sample

Relevant inspection/test		Inner tube	Sample hose assemblies																					
			Test specimen No.																					
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
3.3	General examination[a]	X X																						
3.4.1	Density and relative density[a]	X X																						
3.4.2	Tensile strength[a]	X X																						
3.4.3	Elongation[a]	X X																						
3.4.4	Tube roll[a]	X X																						
3.4.5	Proof pressure[a]	X X																						
3.4.6	Electrical conductivity (inner tube)[a]	X X																						
3.5 to 3.9	General examination		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3.11.1	Proof pressure		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3.11.2	Elongation and contraction					X							X											
3.11.3	Volumetric expansion					X							X											
3.11.4	Pneumatic effusion								X	X														
3.11.5	Pneumatic surge								X	X														
3.11.6	Fuel resistance				X	X																		
3.11.7	Impulse — Unaged															X	X							
	Impulse — Air-aged																	X	X					
	Impulse — Oil-aged																			X	X			
3.11.8	Stress degradation										X	X												
3.11.9	Low-temperature flexing				X							X	X											
3.11.10	Leakage								X	X														
3.11.11	Corrosion						X	X																
3.11.12	Repeated installation		X	X																				
3.11.13	Burst pressure at room temperature						X		X															
3.11.14	Burst pressure at high temperature							X		X														
3.11.15	Vacuum				X							X	X											
3.11.16	Pneumatic leakage													X	X									
3.11.17	Electrical conductivity (hose assembly)																					X		
3.11.18	Fire resistance (when required)																						X	X

Key: X represents one inspection/test.

[a] Production lot records may be used to verify conformance to these tests if the PTFE tube or hose assembly being used is an established production item.

4.4 Quality conformance inspections

4.4.1 General

For quality conformance inspections, sampling shall be carried out in accordance with the procedure specified in ISO 2859-1. Quality conformance inspections shall consist of the following tests:

a) individual tests — 100 % inspection (see 4.4.2);

b) sampling tests (see 4.4.3);

c) periodic control tests (see 4.4.4).

4.4.2 Individual tests

Each hose assembly shall be subjected to the following tests:

a) general examination of product (see 3.5 to 3.9);

b) proof pressure tests (see 3.11.1).

Production samples that are proof-pressure tested with water shall be air-dried prior to capping (see cleaning requirements in 3.10.3).

4.4.3 Sampling tests

The following inspections or tests shall be carried out in the order indicated:

a) density and relative density with braid removed (see 3.4.1);

b) internal cleanliness (see 3.10.3);

c) leakage tests (see 3.11.10);

d) burst pressure at room temperature (see 3.11.13).

The inspections or tests shall be carried out on eight hose assemblies, selected at random from each inspection lot. The inspection lot shall consist of not more than 3 000 hose assemblies, all of one size, manufactured under essentially the same conditions. One hose assembly tested from each lot of 375 hose assemblies is also permitted.

Density tests should be carried out on separate samples. The other tests may be conducted using the same sample.

4.4.4 Periodic control tests

4.4.4.1 General

The inspections and tests specified in 4.4.4.2 and 4.4.4.3 shall be carried out as indicated on eight hose assemblies manufactured from bulk hose lengths selected at random from each inspection lot. The inspection lot shall consist of not more than 6 000 m (20 000 ft) of hose, all of one size, manufactured under essentially the same conditions. The use of two hose assemblies manufactured and tested from each lot of 1 500 m (5 000 ft) of hose is also permitted.

4.4.4.2 Assembly and braid

Four hose assemblies [or one hose assembly from a lot of 1 500 m (5 000 ft)] shall be subjected to the following tests in the order indicated:

a) elongation and contraction (see 3.11.2);

b) impulse (see 3.11.7).

4.4.4.3 Assembly and hose inner liner

Four hose assemblies [or one hose assembly from a lot of 1 500 m (5 000 ft)] shall be subjected to the following tests in the order indicated:

a) stress degradation (see 3.11.8);

b) electrical conductivity (see 3.11.17).

4.4.5 Rejection and re-test

4.4.5.1 Rejection

If one or more items selected from a lot fails to meet the requirements of this International Standard, the lot shall be rejected.

4.4.5.2 Resubmitted lots

Once a lot (or part of a lot) has been rejected by the purchaser, it may be resubmitted for tests after the manufacturer has supplied, in writing, full particulars concerning the cause of the previous rejection and the action taken to correct the defects in the lot.

4.4.6 Changes in inspection procedures

Changes in inspection severity levels (for example from normal to tightened inspection) shall be in accordance with ISO 2859-1. All inspection plans shall be single sampling plans with an acceptable quality level (AQL) of 1 %.

4.4.7 Destructive test sample

Prior to testing, a letter “D” shall be impression-stamped on each end fitting of those assemblies used for destructive tests (see 4.4.3 and 4.4.4).

4.5 Test conditions

4.5.1 Fitting ends

Qualification tests shall be carried out on assemblies using straight-type swivel ends with dimensions as specified in Figure 1 and Table 2, except for the impulse test specimens, which require a 90° elbow fitting on one end. Satisfactory qualification tests on these hose assemblies shall constitute qualification approval on hose assemblies using other fittings that have an identical hose attachment method and design.

4.5.2 End connections

Each hose end shall be connected to a steel or aluminium mating fitting (as applicable), using a lubricant, and torque-tightened.

4.5.3 Test fluids

Test fluids shall be as specified in ISO 8829-1.

4.5.4 Temperature

4.5.4.1 Qualification test temperature

Qualification test temperatures shall be as defined in ISO 8829-1 except that Class II hose assemblies with aluminium fittings shall be limited to minimum and maximum temperature limits of −55 °C (−67 °F) to 135 °C (275 °F) for all test parameters.

4.5.4.2 Temperature measurements

Unless otherwise specified, temperature measurements shall be taken within 150 mm (5.91 in) of the hose assemblies under test. Unless otherwise specified, all temperatures shall have a tolerance of $^{+8}_{-3}$ °C ($^{+14}_{-5}$ °F).

4.5.5 Pressure measurements

Unless otherwise specified, all pressures shall have a tolerance of ±500 kPa (±73 psi).

4.5.6 Preparation of test specimens

4.5.6.1 Oil ageing

In all the tests using oil-aged test specimens, the hose assemblies shall be filled with a high-temperature test fluid and soaked in an air oven at a temperature of 204 °C (400 °F) for 7 days. All air shall be excluded from the bore of the assembly during the test. No pressure shall be applied to the assembly during the ageing period.

4.5.6.2 Air ageing

Air-aged test specimens shall be kept in air at a temperature of 204 °C (400 °F) for 7 days.

4.5.6.3 Unaged test specimens

Unaged assemblies shall be as manufactured.

4.6 Inspection methods

4.6.1 Examination of product

4.6.1.1 Inner tube

Each length of tubing shall be examined to determine conformance to the requirements laid down in 3.3.2 with respect to material, size, workmanship and dimensions.

4.6.1.2 Hose assembly

Each hose assembly shall be visually inspected to determine conformance to this International Standard, and inspected for compliance with construction and reinforcement requirements (see 3.3). In addition, each hose assembly shall be checked to determine conformance with respect to dimensions and linear density (see 3.5).

5 Preparation for delivery

5.1 Preservation and packaging

All openings shall be sealed with caps or plugs (No. 16, Table A.1). Preservation and packaging shall be according to the customer's requirements.

5.2 Marking

Interior and exterior containers shall be marked according to the customer's requirements.

6 Ordering data

Unless otherwise agreed between purchaser and supplier, the procurement documents shall include:

a) a reference to this International Standard (i.e. title, number and date of edition);

b) the details of parts required (part number, size, length, sleeving);

c) type, size, or special features of end fittings desired (see 3.3.4);

d) data requirements (see 4.3.2);

e) applicable levels of preservation, packaging and marking (see 5.1 and 5.2);

f) a statement in the event of a special request that test specimens subjected to destructive testing are not to be considered or shipped as part of the contract or order;

g) whether fire resistance or fireproofing is required;

h) any deviations from the parameters for impulse testing specified in ISO 6772 and ISO 8829-1 (see 3.11.7).

Annex A
(informative)

Equivalent materials and components

As yet, International Standards giving specifications for appropriate materials or components for use in hose assemblies in aircraft fluid systems are not available. For the time being, materials and components specified in national standards are given in Table A.1. Materials and components of equivalent properties and characteristics as specified in other national standards may be used; however, it should be borne in mind, when selecting materials and components, that non-equivalent materials and components may cause differences in test results and, more importantly, in the performance of hose assemblies. Eventually, references to national standards will be deleted and replaced by references to International Standards when they become available.

Table A.1 — Equivalent materials and components

No.	Equivalent materials and components					
	France		UK		USA	
	National standard applicable	Description	National standard applicable	Description	National standard applicable[a]	Description
1	AIR 9160	Stainless steels Z 10 CNT 18-11 Z 8 CND 17-04	Same as for USA		AMS 5639 **(304)**	Steel, corrosion-resistant, bars, wire, forgings, tubing, and rings 19Cr - 10Ni solution heat treated - UNS S30400
2			BS Aerospace series 2S 129	18/9 chromium-nickel corrosion-resisting steel (titanium-stabilized) billets, bars, forgings and parts	AMS 5645 **(321)**	Steel, corrosion and heat resistant, bars, wire, forgings, tubing, and rings 18Cr - 10Ni - 0.40Ti (SAE 30321) solution heat treated - UNS S32100
3			BS Aerospace series 2S 130	18/9 chromium-nickel corrosion-resisting steel (niobium-stabilized) billets, bars, forgings and parts	AMS 5646 **(347)**	Steel, corrosion and heat-resistant, bars, wire, forgings, tubing, and rings 18Cr - 11 Ni - 0.60Cb (SAE 30347) solution heat treated - UNS S34700
4	—	—	BS Aerospace series 2S 145	Chromium-nickel-copper-molybdenum corrosion-resisting steel (precipitation hardening) billets, bars, forgings and parts	AMS 5643 **(17-4 PH)**	Steel, corrosion-resistant, bars, wire, forgings, tubing, and rings 16Cr - 4.0Ni - 0.30Cb - 4.0Cu solution heat treated, precipitation hardenable - UNS S17400
5			Same as for USA		AMS 5644 **(17-7 PH)**	Steel bars and forgings, corrosion heat resistant 17Cr - 7Ni - 1Al - UNS S17700
6					AMS 5743 **(15-5 PH)**	Steel bars and forgings, corrosion- and moderate heat-resistant 15,5 Cr-4,5Ni-2,9Mo-0,10N (solution heat treated, sub-zero cooled, equalized and oven-tempered)
7	AIR 9182 and AIR 9183	Non-alloyed titanium T35, T40 and T60 titanium alloy T-A6V	BS Aerospace series 2TA 11, 2TA 12 and 2TA 13	Bar and section for machining/ forging stock/forgings of titanium-aluminium-vanadium alloy (tensile strength 900 MPa to 1 160 MPa)	AMS 4928 **(6Al-4V)**	Titanium alloy bars, wire, forgings, rings, and drawn shapes 6Al - 4V annealed - UNS R56400

[a] Material designation is given in bold type in parentheses after the standard number.

Table A.1 *(continued)*

No.	Equivalent materials and components					
	France		UK		USA	
	National standard applicable	Description	National standard applicable	Description	National standard applicable[a]	Description
8	AIR 9160	Stainless steels Z 10 CNT 18-11 Z2 CN 18-11	BS Aerospace series T72-T73	18/10 chromium-nickel corrosion-resisting steel tube for hydraulic purposes (niobium/titanium stabilized: 550 MPa)	AMS 5639 **(304)**	Steel, corrosion-resistant, bars, wire, forgings, tubing, and rings 19Cr - 10Ni solution heat treated - UNS S30400
					AMS5647 **(304L)**	Steel, Corrosion-Resistant, Bars, Wire, Forgings, Tubing, And Rings 19Cr - 9.5Ni Solution Heat Treated - UNS S30403
9					AMS 5645 **(321)**	Steel, corrosion and heat resistant, bars, wire, forgings, tubing, and rings 18Cr - 10Ni - 0.40Ti (SAE 30321) solution heat treated - UNS S32100
10					AMS 5646 **(347)**	Steel, corrosion and heat-resistant, bars, wire, forgings, tubing, and rings 18Cr - 11 Ni - 0.60Cb (SAE 30347) solution heat treated - UNS S34700
11	—	—	—		AMS 4945 **(3Al-2.5V)**	Titanium alloy tubing, seamless, hydraulic 3Al - 2.5V, controlled contractile strain ratio cold worked, stress relieved - UNS R56320
12	AIR 9160	Stainless steel Z 2 CN 18-10	Same as for USA		AMS 5689 **(321)**	Steel, corrosion and heat resistant, wire 18Cr - 10.5Ni - 0.40Ti (SAE 30321) solution heat treated - UNS S32100
13					AMS 5690 **(316)**	Steel, corrosion and heat resistant, wire 17Cr - 12Ni - 2.5Mo (SAE 30316) solution heat treated - UNS S31600
14			DTD 189	—	AMS 5697 **(304)**	Steel, corrosion-resistant, wire 19Cr - 9.5Ni (SAE 30304) solution heat treated - UNS S30400
15	—	—	—	—	AS 1072	Sleeve, hose assembly, fire protection
16					MIL-C-5501	Caps and plugs, protective, dust and moisture seal (general specification)
17	—	—	BS Aerospace series L 65	Bars and extruded sections in aluminium-copper-silicon-magnesium alloy	AMS 4121 **(2014-T6)**	Aluminum alloy bars, rods, and wire, rolled or cold finished 4.5Cu - 0.85Si - 0.80Mn - 0.50Mg (2014-T6) solution and precipitation heat treated - UNS A92014
18			BS Aerospace series L 102		AMS 4339 **(2024-T851)**	Aluminum alloy, rolled or cold finished bars and rods 4.4Cu - 1.5Mg - 0.60Mn (2024-T851) solution heat treated, cold worked, and artificially aged - UNS A92024
19			BS Aerospace series 2L 85		AMS 4117 **(6061-T6, T651)**	Aluminum alloy, rolled or cold finished bars, rods, and wire and flash welded rings 1.0Mg - 0.60Si - 0.28Cu - 0.20Cr (6061; -T6, -T651) solution and precipitation heat treated - UNS A96061
20			—	—	AMS 4127 **(6061-T6)**	Aluminum alloy, forgings and rolled or forged rings (6061-T6) solution and precipitation heat treated - UNS A96061

[a] Material designation is given in bold type in parentheses after the standard number.

Table A.1 *(continued)*

No.	Equivalent materials and components					
	France		UK		USA	
	National standard applicable	Description	National standard applicable	Description	National standard applicable[a]	Description
21	—	—	BS Aerospace series 4L 56	Tubing in aluminium-magnesium alloy	AMS 4069 **(5052-0)**	Aluminum alloy, drawn, round seamless tubing close tolerance 2.5Mg - 0.25Cr (5052-0) annealed - UNS A95052
22			—	—	AMS 4082 **(6061-T6)**	Aluminum alloy, seamless drawn tubing 1.0Mg - 0.60Si - 0.28Cu - 0.20Cr (6061-T6) solution and precipitation heat treated - UNS A96061
23	—	—	—	—	AMS 4965 **(6Al-4V)**	Titanium alloy, bars, wire, forgings, and rings 6.0Al - 4.0V solution heat treated and aged - UNS R56400
24	—	Non-alloyed titanium T40 tubing	—	—	**(CP)**	—

[a] Material designation is given in bold type in parentheses after the standard number.

ICS 49.080; 83.140.40

Price based on 19 pages