INTERNATIONAL STANDARD

ISO 8913

Second edition
1994-12-15

Aerospace — Lightweight polytetrafluoroethylene (PTFE) hose assemblies, classification 204 °C/21 000 kPa — Procurement specification

Aéronautique et espace — Tuyauteries flexibles en polytétrafluoroéthylène (PTFE), série légère, classification 204 °C/21 000 kPa *— Spécification d'approvisionnement*

Reference number
ISO 8913:1994(E)

Foreword

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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.

International Standard ISO 8913 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 8913:1989), of which it constitutes a technical revision.

Annex A of this International Standard is for information only.

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Aerospace — Lightweight polytetrafluoroethylene (PTFE) hose assemblies, classification 204 °C/21 000 kPa — Procurement specification

1 Scope

This International Standard specifies requirements for lightweight polytetrafluoroethylene (PTFE) hose assemblies for use in aircraft hydraulic systems at temperatures between − 55 °C and + 204 °C and at a nominal pressure up to 21 000 kPa (210 bar). The hose assemblies are also suitable for use within the same temperature and pressure limitations in aircraft pneumatic systems where some gaseous diffusion through the wall of the PTFE liner may be tolerated.

The use of these hose assemblies in high-pressure pneumatic storage systems is not recommended. In addition, 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, shall be subject to the approval of the purchaser.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 2685:1992, *Aircraft — Environmental conditions and test procedures for airborne equipment — Resistance to fire in designated fire zones.*

ISO 2859-1:1989, *Sampling procedures for inspection by attributes — Part 1: Sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection.*

ISO 5855-3:1988, *Aerospace — MJ threads — Part 3: Limit dimensions for fittings for fluid systems.*

ISO 6772:1988, *Aerospace — Fluid systems — Impulse testing of hydraulic hose, tubing and fitting assemblies.*

ISO 7258:1984, *Polytetrafluoroethylene (PTFE) tubing for aerospace applications — Methods for the determination of the density and relative density.*

ISO 8829:1990, *Aerospace — Polytetrafluoroethylene (PTFE) hose assemblies — Test methods.*

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 which have successfully passed the requirements and tests specified in this International Standard.

3.2 Materials

3.2.1 General

The hose assembly materials shall be as described in this International Standard (see, in particular, annex A). All materials not specifically described in this International Standard shall be of the highest quality and suitable for the purpose intended.

3.2.2 Metals

Metals used in the hose and fittings shall be corrosion-resistant or titanium and shall conform to the applicable specifications described in table 1 (or equivalent specifications; see annex A).

3.3 Construction

3.3.1 General

The hose assembly shall consist of

— a seamless PTFE inner tube (see 3.3.2),

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

— corrosion-resistant steel and/or titanium end-fittings (see 3.3.4),

as required to meet the construction and performance requirements laid down in 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 with no more than 2 % of such additives being retained in the mixture.

3.3.3 Reinforcement

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

Broken or missing reinforcing wires shall be cause for rejection; crossed-over reinforcing wires shall not be cause for rejection of the flexible hose assembly.

3.3.4 Fittings

3.3.4.1 General

It shall be proven that all fittings comply with the requirements laid down in this International Standard. Unless otherwise specified by the purchaser, the hose assemblies shall have flareless fittings (24° cone coupling).

NOTE 1 An International Standard (ISO 7321) specifying the geometric definition of a 24° cone coupling is currently being prepared.

Table 1 — Metals to be used 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, stabilized, corrosion-resistant steel	2 and 3
	Precipitation-hardening, corrosion-resistant steel	4, 5 and 6
	Titanium 6Al-4V	7
Tubing	Austenitic, seamless or welded, annealed, corrosion-resistant steel	8
	Austenitic, seamless or welded, stabilized, corrosion-resistant steel	9 and 10
	Cold-worked, stress-relieved titanium alloy	11
Wire	Austenitic, cold-drawn, corrosion-resistant steel	12, 13 and 14

3.3.4.2 Insert fittings

Insert fittings shall be manufactured in one piece wherever possible; those made of other than one-piece construction shall be butt-welded, fabricated unless otherwise agreed by the purchaser, from corrosion-resistant steel tubing or titanium. Welded and redrawn tubing (materials Nos. 8 and 9; see annex A) may be used.

3.4 Inner tube

3.4.1 Density and relative density

The relative density of the hose inner tube shall not exceed 2,155, when tested in accordance with ISO 7258, either method A or method B (as specified in ISO 8829). The density shall not exceed 2,204 g/cm^3, when tested in accordance with ISO 7258, method C (as specified in ISO 8829).

3.4.2 Tensile strength

When tested in accordance with ISO 8829:1990, subclause 4.2, the longitudinal tensile strength for all sizes of tubes shall be at least 15,1 N/mm^{2*}).

When tested in accordance with ISO 8829:1990, subclause 4.2, the transverse tensile strength for sizes DN16 and larger shall be at least 12,4 N/mm^2; for sizes under DN16, the transverse strength need not be tested.

3.4.3 Elongation

When tested in accordance with ISO 8829:1990, subclause 4.2, the elongation shall be at least 200 %.

3.4.4 Tube roll

The tube shall not leak, split, burst or show any signs of malfunction, when tested through the sequence as specified in ISO 8829:1990, subclause 4.3.2.

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 8829:1990, subclause 4.3.3.

3.4.6 Electrical conductivity

When tested in accordance with ISO 8829:1990, subclause 4.4, the electrical current shall be equal to or greater than

a) 10 µA for sizes DN06 to DN12 (inclusive);

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.

3.5.2 Physical requirements

Hose assemblies shall comply with the physical and linear density (weight) requirements 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 1) to table 2.

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 during assembly or testing shall not be cause for rejection of the hose assembly.

*) 1 N/mm^2 = 1 MPa

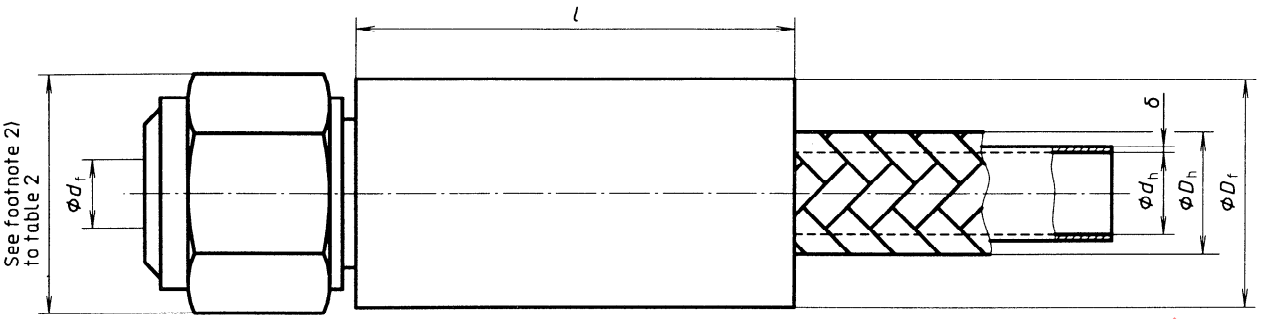

Figure 1 — Hose and fitting dimensions

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

Dimensions in millimetres

Hose size	Hose (braided)			Fitting		Attachment length	Wall thickness of inner tube
	Inside diameter d_h	Outside diameter D_h		Inside diameter[1] d_f	Outside diameter[2] D_f	l	δ
(nom.)	min.	min.	max.	min.	max.	max.	min.
DN06	5,4	9,1	9,9	3,6	18	25,6	0,9
DN10	7,6	11,6	12,5	6,4	20,3	28	
DN12	9,9	14,9	15,6	9,1	25	34	1
DN16	12,3	17,5	18,5	11,6	28	35	1,1
DN20	15,3	24,1	25,2	14,4	35	36	
DN25	21,6	31,2	32,3	19,3	42,2	41	

1) Minimum inside diameter through the elbow area may be 85 % of the values given for d_f.

2) Width across corners of nut and socket hexagon may exceed the values given for D_f.

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

Hose size	Linear density (weight) of hose[1]	Operating pressure	Proof pressure	Burst pressure		Bend radius at inside of bend	Volumetric expansion
				at room temperature	at high temperature		
	max.			min.	min.	min.	max.
	kg/m	kPa	kPa	kPa	kPa	mm	ml/m
DN06	0,17	21 000	42 000	84 000	63 000	38	2,6
DN10	0,27					63	3,4
DN12	0,36					73	5,3
DN16	0,48					82	8,7
DN20	0,98					101	11,8
DN25	1,52					127	29,5

1) The linear density (weight) of the hose shall be determined on a minimum length of 300 mm.

3.7 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.

3.8 Identification of products

3.8.1 General

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

3.8.2 Fittings

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

3.8.3 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 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 trademark, and the number of this International Standard;

b) the complete hose assembly part number;

c) the nominal pressure "21 000 kPa", as applicable;

d) the operating temperature, "204 °C", if required;

e) the pressure test symbol, "PT";

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

3.9 Workmanship

3.9.1 General

Workmanship shall be of such quality as to assure that hose assemblies furnished under this specification are free of defects that compromise, limit or reduce performance or intended use.

Hose assemblies shall be free of burrs, scratches, sharp edges, loose components, chips or foreign materials.

3.9.2 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.

3.9.3 Cleaning

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

3.10 Hose assembly — Test and performance requirements

3.10.1 Proof pressure

When tested in accordance with ISO 8829:1990, subclause 5.8, each hose assembly shall withstand the proof pressure specified in table 3 without malfunction or leakage.

3.10.2 Elongation and contraction

When two test specimens of the sample hose assemblies are tested in accordance with ISO 8829:1990, subclause 5.5, there shall be no change in length by more than ± 2 % in a 250 mm gauge length.

3.10.3 Volumetric expansion

When two test specimens of the sample hose assemblies are tested in accordance with ISO 8829:1990, subclause 5.6, the volumetric expansion shall not exceed the limits specified in table 3.

3.10.4 Leakage

When two test specimens of the sample hose assemblies are tested in accordance with ISO 8829:1990, subclause 5.7, there shall be no leakage.

3.10.5 Thermal shock

3.10.5.1 Preconditioning

Two test specimens of the sample hose assemblies shall be tested: one test specimen shall be air-aged and the other shall be unaged (see 4.5.6).

3.10.5.2 Requirement

When tested in accordance with ISO 8829:1990, subclause 5.17, the test specimens shall neither leak nor show any signs of malfunction during the proof pressure phase of the test; during the burst pressure phase of the test, if leakage or signs of malfunction occur below the minimum burst pressure at the high temperature specified in table 3, the samples shall be deemed to have failed.

3.10.6 Impulse

3.10.6.1 Preconditioning

Six sample hose assemblies having a 90° elbow fitting on one end of the hose and a straight fitting on the other end of the hose shall be tested.

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

After this initial preconditioning, subject the test specimens at room temperature to the proof pressure specified in table 3 for at least 5 min. Then pressurize the test specimens to 21 000 kPa. While maintaining this pressure at room temperature, immerse the test specimens in a 35 g/l ± 1 g/l sodium chloride solution — the sodium chloride solution shall contain a dry basis of not more than 0,1 % (*m/m*) sodium iodide and 0,5 % (*m/m*) total impurities — for 8 min to 10 min. Allow to dry in air for the remainder of 1 h. Repeat this subsequent immersion and air-drying process no fewer than 50 times.

3.10.6.2 Requirement

When tested in accordance with ISO 8829:1990, subclause 5.10 (i.e. in accordance with ISO 6772), the sample hose assemblies shall comply with the test requirements without any signs of leakage [see also item h) in clause 6].

3.10.7 Assembly flexibility

When two test specimens of the sample hose assemblies are flexure-tested in accordance with ISO 8829:1990, subclause 5.11, they shall not leak or show any other signs of malfunction. The test specimens shall be mounted in a test setup, shown in figure 2, having the dimensions specified in table 4.

3.10.8 Stress degradation

When two test specimens of the sample hose assemblies are tested in accordance with ISO 8829:1990, subclause 5.1, they shall not exceed an average rate of effusion of 80 ml/min per metre of hose length for any size.

Dimensions in millimetres

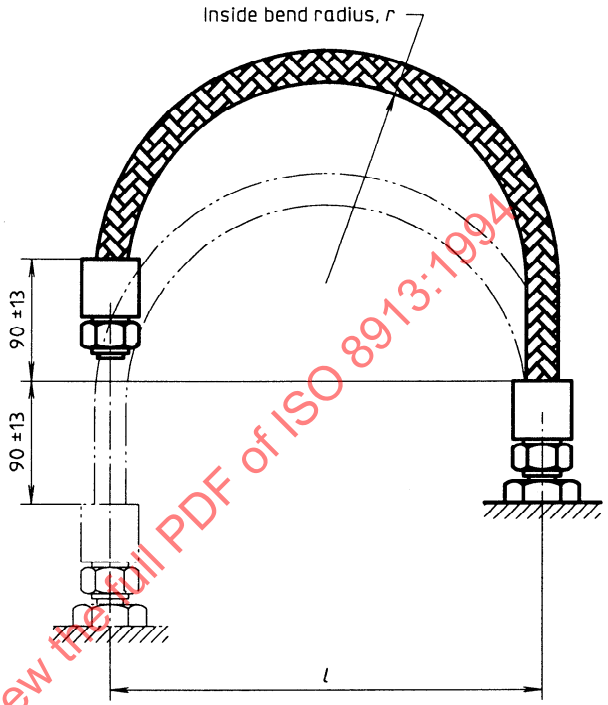

Figure 2 — Test setup for flexure test

Table 4 — Flexure test dimensions

Dimensions in millimetres

Hose size	*r* ± 10 %	*l* (approx.)
DN06	38	82
DN10	63	136
DN12	73	158
DN16	82	180
DN20	101	222
DN25	127	280

3.10.9 Pneumatic surge

When two test specimens of the sample hose assemblies are tested in accordance with ISO 8829:1990, subclause 5.16, the inner tubes of the test specimens shall not collapse or show signs of degradation.

3.10.10 Pneumatic effusion

When two test specimens of the sample hose assemblies are tested in accordance with ISO 8829:1990, subclause 5.2, they shall not exceed a total rate of effusion of 26 ml per metre of hose length for any size.

3.10.11 Repeated installation

3.10.11.1 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; 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 3.10.1. Following the eighth installation, pressure-test the hose fittings with air or nitrogen gas for 5 min at the nominal system pressure.

3.10.11.2 Requirement

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

3.10.12 Burst pressure at room temperature

When two test specimens of the sample hose assemblies are tested in accordance with ISO 8829:1990, subclause 5.9.3, they shall not leak or burst at any pressure below the burst pressure at room temperature specified in table 3.

3.10.13 Electrical conductivity

When tested in accordance with ISO 8829:1990, subclause 5.3, hose assemblies shall be capable of conducting a direct current equal to or greater than

a) 6 µA for sizes DN06 to DN12 (inclusive);

b) 12 µA for sizes DN16 and over.

3.10.14 Fire resistance

3.10.14.1 If the hose assemblies are required to withstand a specified resistance to fire, two test specimens of the sample hose assemblies, which may be fitted with fire sleeves (component No. 1; see annex A) or equivalent, shall be tested in accordance with ISO 2685.

NOTE 2 On occasions, a test may 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.

3.10.14.2 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 Quality assurance

4.1 Responsibility for inspection

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 specified in 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 5 and the number and lengths of test specimens specified in table 6.

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 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 3.10; the test sequence shall be as shown in table 4.

4.3.4 Criteria for requalification

a) Any change in a previously qualified hose-to-fitting joint and/or hose construction relative to design, material or method of attachment would require a full requalification.

b) Qualification approval of other types of end fitting connection designs, utilizing a previously qualified hose-to-fitting joint design, requires the following additional testing to be performed:

— proof pressure test (see 3.10.1);

— leakage test (see 3.10.4);

— repeated installation (see 3.10.11);

— room temperature burst (see 3.10.12).

c) If hose previously qualified is procured from a new manufacturing source, then complete requalification testing is required.

4.4 Quality conformance inspections

4.4.1 General

Quality conformance inspections shall be sampled in accordance with the procedure laid down in ISO 2859-1 and 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 3.10.1).

Production samples that are proof-pressure-tested with water shall be air-dried prior to capping (see cleaning requirements in 3.9.3).

4.4.3 Sampling tests

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

a) density and relative density (see 3.4.1);

b) internal cleanliness (see 3.9.3);

c) leakage tests (see 3.10.4);

d) burst pressure at room temperature (see 3.10.12).

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.

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 ten hose assemblies manufactured from bulk hose length selected at random from each inspection lot. The inspection lot shall consist of not more than 6 000 m 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 of hose is also permitted.

Table 5 — 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
3.3	General examination[1]		X X																	
3.4.1	Density and relative density[1]		X X																	
3.4.2	Tensile strength[1]		X X																	
3.4.3	Elongation[1]		X X																	
3.4.4	Tube roll[1]		X X																	
3.4.5	Proof pressure[1]		X X																	
3.4.6	Electrical conductivity[1]		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
3.10.1	Proof pressure			X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X
3.10.2	Elongation and contraction			X	X															
3.10.3	Volumetric expansion					X	X													
3.10.4	Leakage							X	X											
3.10.5	Thermal shock and burst pressure at high temperature							X	X											
3.10.6	Impulse[2]	Unaged								X	X									
		Air-aged										X	X							
		Oil-aged												X	X					
3.10.7	Flexure			X	X															
3.10.8	Stress degradation															X	X			
3.10.9	Pneumatic surge															X	X			
3.10.10	Pneumatic effusion					X	X													
3.10.11	Repeated installation			X	X															
3.10.12	Burst pressure at room temperature					X	X													
3.10.13	Electrical conductivity																	X		
3.10.14	Fire resistance (when required)																		X	X

Key: X means one inspection/test.

1) 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.

2) These test specimens shall have a 90° elbow fitting on one end of the hose and a straight-type fitting on the other end of the hose. If approval is being sought for both the bent-tube and the forged-elbow configuration, then one-half of the sample (i.e. three test specimens) shall use the bent elbows, while the other half of the sample shall have the forged elbows.

Table 6 — Length of test specimens

Dimensions in millimetres

Hose size	Length of test specimens				
	for impulse tests (3.10.6) (Six specimens, Nos. 7 to 12)	**for flexure tests (3.10.7)** (Two specimens, Nos. 1 and 2)	**for electrical conductivity test (3.10.13)** (One specimen, No.15)	**for fire resistance (3.10.14)** (Two specimens, Nos. 16 and 17)	**for other tests** (Six specimens, Nos. 3 to 6 and Nos. 13 and 14)
DN06	300	400	One sample for each size with a specimen length as specified in ISO 8829	600	500
DN10	400	500			
DN12	500				
DN16		600			
DN20	600	700			
DN25	800	800			

4.4.4.2 Assembly and braid

Six hose assemblies from a lot of 6 000 m (or one hose assembly from a lot of 1 500 m) shall be subjected to the following tests in the order indicated:

a) elongation and contraction (see 3.10.2);

b) impulse (see 3.10.6).

4.4.4.3 Hose inner liner

Four hose assemblies from a lot of 6 000 m (or one hose assembly from a lot of 1 500 m) shall be subjected to the following test in the order indicated:

a) stress degradation (see 3.10.8);

b) electrical conductivity (see 3.10.13).

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, in writing, has supplied full particulars concerning the cause of 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 Assembly, ends and hose

4.5.1.1 Assembly ends

Qualification tests shall be carried out on assemblies using straight-type swivel ends with dimensions as shown in figure 1 and table 2 except for the test specimens requiring 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.

4.5.1.2 Assembly, hose

Qualification shall be carried out on assemblies using one hose construction and one hose manufacturer. Separate qualification tests shall be carried out for each manufacturer of hose and each different construction.

4.5.2 End connections

Each hose end shall be connected to a steel fitting, using a lubricant, and torque-tightened.

4.5.3 Test fluids

Test fluids shall be as specified in ISO 8829.

4.5.4 Temperature measurements

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

4.5.5 Pressure measurements

Unless otherwise specified, all pressures shall have a tolerance of ± 500 kPa.

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 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 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 Storage and packaging

All openings shall be sealed with caps or plugs (component No. 2; see annex A). Storage and packaging shall be to the customer's requirements.

5.2 Marking

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

6 Ordering data

The following information shall be included in the purchase order:

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 storage, packaging and packing (see 5.1 and 5.2);

f) a statement in the event of a special request that test specimens subject to destructive testing are to be considered or shipped as part of the contract or order;

g) whether fire resistance or fireproofing is required;

h) any deviations to the parameters for impulse testing specified in ISO 6772 and ISO 8829 (see 3.10.6).

Annex A
(informative)

Equivalent materials and components

As yet, International Standards giving specifications for appropriate materials or components to be used in hose assemblies in aircraft fluid systems are not available. For the time being, materials and components specified in national standards are given in tables A.1 and A.2, respectively. 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 — some specifications for materials and forms have reached the stage of draft proposal and reference is made to these for information purposes in the far-right column of table A.1.

Table A.1 — Equivalent materials

Material No.	Equivalent materials						ISO draft proposal No.
	France		UK		USA		
	National standard applicable	Designation	National standard applicable	Description	National standard applicable[1)]	Description	
1	AIR 9160	Z2 CN 18-10 Z6 CN 18-09	Same as for USA		AMS 5639 **(304)**	Steel bars, forgings, tubing and rings, corrosion-resistant 19Cr-10Ni (SAE 30304), solution heat treated	ISO 9551 (bars) ISO 9550 (forgings)
2		Z10 CNT 18-11 Z6 CNT 18-10	BS Aerospace series S 129	18/9 chromium-nickel corrosion-resisting steel (titanium stabilized) billets, bars, forgings and parts	AMS 5645 **(321)**	Steel bars, forgings, tubing and rings, corrosion- and heat-resistant 18Cr-10Ni-0,4Ti (SAE 30321), solution heat treated	ISO 9521 (bars)
3		Z10 CNT 18-11 Z6 CNNh 18-10	BS Aerospace series S 130	18/9 chromium-nickel corrosion-resisting steel (niobium stabilized) billets, bars, forgings and parts	AMS 5646 **(347)**	Steel bars, forgings, tubing and rings, corrosion- and heat-resistant 18Cr-11Ni-0,6 (Nb + Ta) (SAE 30347), solution heat treated	ISO 9531 (bars)
4	prEN 2539 prEN 3161 prEN 3162	Z6 CNU 17-04	BS Aerospace series S 145	Chromium-nickel-copper- molybdenum corrosion-resisting steel (precipitation hardening) billets, bars, forgings and parts	AMS 5643 **(17-4)**	Steel bars, forgings, tubing and rings, corrosion-resistant 16,5Cr-4,0Ni-4,0Cu	ISO 9582 (bars for machining) ISO 9581 (bars for forging)

Material No.	Equivalent materials						ISO draft proposal No.
	France		UK		USA		
	National standard applicable	Designation	National standard applicable	Description	National standard applicable[1]	Description	
5	—	—	Same for USA		AMS 5644	Steel bars and forgings, corrosion-resistant 17Cr-7Ni-1Al	—
6	AIR 9160	Z12 CND 16-04 Z15 CN 16-02			AMS 5743	Steel bars and forgings, corrosion- and moderate heat-resistant 15,5Cr-4,5Ni-2,9Mo-0,10N (solution heat treated, sub-zero cooled, equalized and oven-tempered)	—
7	AIR 9182 prEN 2530 prEN 3311 prEN 3314	T 35 T 40 T 60 TA 6V	BS Aero-space series 2TA 11, 2TA 12 and 2TA 13	Bar and section for machining/forging, stock/forgings and titanium-aluminium-vanadium alloy (tensile strength 900 MPa to 1 160 MPa)	AMS 4928 **(6-4)**	Titanium alloy bars, forgings and rings 6Al-4V, annealed 120 000 psi (825 MPa) yield strength	ISO 9600 (forgings)
8	AIR 9423	Z2 CN 18-10 Z6 CN 18-09	BS Aero-space series T 72-T 73	18/10 chromium-nickel corrosion-resisting steel tube for hydraulic purposes (niobium/titanium stabilized, 550 MPa)	MIL-T-8504 **(304)**	Steel corrosion-resisting (304), aerospace vehicle hydraulic systems, annealed, seamless and welded	ISO 9552 (tubes)
9		Z6 CNT 18-10			MIL-T-8808 **(321)**	Tubing, steel, corrosion-resistant (18-8 stabilized), aircraft hydraulic quality (composition 321)	ISO 9522 (tubes)
10	AIR 9160	Z10 CNT 18-10			MIL-T-8808 **(347)**	Tubing, steel, corrosion-resistant (18-8 stabilized), aircraft hydraulic quality (composition 347)	ISO 9532 (tubes)
11	prEN 9160	TA 3V2,5	—	—	AMS 4945	Tubing, titanium 3Al-2,5V, texture controlled	—
12	AIR 9160	Z10 CNT 18-10	Same as for USA		AMS 5689	Steel wire, corrosion- and heat-resistant 18Cr-9,5Ni-Ti (SAE 30321), solution heat treated	—
13		Z6 CND 15-07 Z6 CND 17-11			AMS 5690	Steel wire, corrosion- and heat-resistant 17Cr-12Ni-2,5Mo (SAE 30316), solution heat treated	—
14		Z2 CN 18-10 DTD 189		—	AMS 5697	Steel wire, corrosion-resistant 19Cr-9,5Ni (SAE 30304)	—

1) Material designation is given in bold type in parentheses after the standard number.