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

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Aéronautique et espace — Tuyauteries flexibles en polytétrafluoroéthylène (PTFE), pour utilisation jusqu'à 232 °C et 10 500 kPa — Spécification d'approvisionnement

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Foreword

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

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 and + 232 °C for Class I assemblies, − 55 °C and + 135 °C for Class II assemblies, and at nominal pressures up to 10 500 kPa (105 bar). 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 may be tolerated.

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The use of these hose assemblies in 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.

This International Standard covers hose assemblies of the following classes:

Class I: fitting assemblies of corrosion-resistant steel or titanium parts (232 °C);

Class II: fitting assemblies of corrosion-resistant steel and aluminium parts (135 °C), DN12 and larger.

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 assemblies shall be uniform in quality and free from defects in material as is consistent with

good manufacturing practice, and shall conform to the applicable specifications and requirements specified in this International Standard.

3.2.2 Metals

Metals used in the hose shall be corrosion-resistant steel, and fittings shall be corrosion-resistant steel, titanium, or aluminium alloy suitably treated to resist corrosion when in storage or during normal service use. They shall conform to the applicable specifications described in table 1 (or equivalent specifications; see annex A).

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, 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
	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 seamless PTFE inner tube (see 3.3.2),

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

— aluminium, corrosion-resistant steel 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.

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 laid down in this International Standard.

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

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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. 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.

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

3.3.4.2 Insert fittings

Insert fittings shall be manufactured in one piece wherever possible. Those of other than one-piece construction 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 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 2,204, when tested in accordance with ISO 7258, either method A or method B (as specified in ISO 8829). The density shall not exceed 2,155 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, 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, 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, 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, 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, 4.3.3.

3.4.6 Electrical conductivity

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

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.

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 following proof testing shall not be cause for rejection of the hose assembly.

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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 trade-mark shall be permanently marked on one element of all end fittings.

*) 1 N/mm^2 = 1 MPa

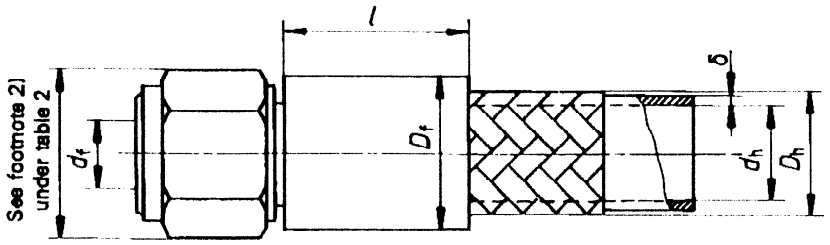

Figure 1 — Hose and fitting dimensions

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

Dimensions in millimetres

Hose size	Hose (braided)			Fitting		Attachment length	Wall thickness of inner tube		Number of braids
	Inside diameter	Outside diameter		Inside diameter[1]	Outside diameter[2]				
	d_h	D_h		d_f	D_f	l	δ		
(nom.)	min.	min.	max.	min.	max.	max.	min.	max.	
DN05	2,3	5,8	6,8	2	12,7	31,8			1
DN06	4,4	7,7	9,5	3,4	14,2	31			
DN08	5,8	9,3	10,6	4,9	16	34,3	0,89	1,19	
DN10	7,6	10,9	12,7	6,5	18	37			
DN12	9,9	13,9	15,6	8,5	21,4	44	0,97	1,27	
DN16	12,3	16,3	20,3	11	26	49			
DN20	15,6	19,5	23,0	13,8	30	55,1	1,07	1,37	
DN25	21,6	27,4	29,0	19,7	38,6	65			2
DN32	28	33,7	35,3	25,4	50,8	61,7	1,14	1,45	
DN40	34,1	41,6	43,3	31,7	58	68,1	1,65	1,96	

1) Minimum inside diameter through the elbow area may be 0,8 mm less than the values given for d_f.

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

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

Hose size (nom.)	Maximum hose weight[1]	Operating pressure	Proof pressure	Burst pressure min.		Bend radius at inside of bend min.	Volumetric expansion max.	Effusion (per 1/2 h)	Effusion after stress degradation (per min)	Negative pressure
				Room temp.	High temp.					
	kg/m	kPa	kPa	kPa	kPa	mm	ml/m	ml/m	ml/m	kPa
DN05	0,089	10 500	21 000	83 000	48 000	50	1,1	13	394	95
DN06	0,129	10 500	21 000	83 000	48 000	50	1,1	13	315	95
DN08	0,147	10 500	21 000	69 000	45 000	50	1,6	16	315	95
DN10	0,183	10 500	21 000	62 000	45 000	100		16	315	95
DN12	0,235	10 500	21 000	56 000	41 000	120		16	158	95
DN16	0,305	10 500	21 000	48 000	38 000	140		16	79	95
DN20	0,486	7 000	14 000	34 000	24 000	165		20	79	70
DN25	0,863	8 750	17 500	34 000	24 000	190		26	79	50
DN32	1,110	7 000	14 000	27 500	21 000	280		26	79	35
DN40	1,500	7 000	14 000	27 500	21 000	355		26	79	30

1) Hose weight shall be determined on a minimum length of 300 mm.

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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 "10 500 kPa" or as applicable per table 3;

d) the operating temperature, "232 °C" or "135 °C" (as applicable), 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

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.

3.9.2 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, moisture, cleaning solvents and other foreign materials, both internally and externally.

Hose assemblies shall meet the following requirements 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 other foreign materials shall be cause for rejection.

3.10 Hose assembly — Test and performance requirements

3.10.1 Proof pressure

When tested in accordance with ISO 8829:1990, 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, 5.5, there shall be no change in length of 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, 5.6, the volumetric expansion shall not exceed the limits specified in table 3.

3.10.4 Pneumatic effusion

When two test specimens of the sample hose assemblies are tested in accordance with ISO 8829:1990, 5.2, they shall not exceed a total rate of effusion as shown in table 3.

3.10.5 Pneumatic surge

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

3.10.6 Fuel resistance

When two test specimens of the sample hose assemblies are tested in accordance with ISO 8829:1990, 5.12, they shall not leak or show signs of degradation.

3.10.7 Impulse

3.10.7.1 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. If approval is being sought for both the bent-tube and the forged-elbow configurations, then one-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).

3.10.7.2 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 8829:1990, 5.10, except that sizes DN25, DN32 and DN40 shall be tested straight, without bending.

3.10.7.3 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].

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3.10.8 Stress degradation

When two test specimens of the sample hose assemblies are tested in accordance with ISO 8829:1990, 5.1.2, they shall not exceed an average rate of effusion as shown in table 3.

3.10.9 Low-temperature flexing

When three test specimens of the sample hose assemblies are tested in accordance with ISO 8829:1990, 5.13, they shall not show signs of damage after flexing.

3.10.10 Leakage

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

3.10.11 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 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 3.10.13 and one assembly high-temperature burst tested in accordance with 3.10.14.

3.10.12 Repeated installation

3.10.12.1 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; 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 operating pressure.

3.10.12.2 Requirements

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

3.10.13 Burst pressure at room temperature

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

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3.10.14 Burst pressure at high temperature

When two test specimens of the sample hose assemblies are tested in accordance with ISO 8829:1990, 5.9.4, they shall not leak or burst at any pressure below the high-temperature burst value specified in table 3.

3.10.15 Vacuum

When three test specimens of the sample hose assemblies are tested in accordance with ISO 8829:1990, 5.15, the hose shall not collapse or buckle. After completion of the test a spherical ball of a diameter as shown in table 4 shall be rolled freely through the length of the hose assembly.

3.10.16 Pneumatic leakage

When two test specimens of the sample hose assemblies are tested in accordance with ISO 8829:1990, 5.14, they shall withstand the operating pressure listed in table 3 without leakage. The test assemblies shall be prepared without the use of any oil during assembly.

3.10.17 Electrical conductivity

When tested in accordance with ISO 8829:1990, 5.3, hose assemblies of sizes DN06 through DN12 shall be capable of conducting a direct current equal to or greater than 6 µA and sizes DN16 and over a current equal to or greater than 12 µA. One sample shall be used for this test.

3.10.18 Fire resistance

3.10.18.1 General

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 (see table A.1, No. 15), 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.

3.10.18.2 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 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.

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

Hose size	DN05	DN06	DN08	DN10	DN12	DN16	DN20	DN25	DN32	DN40
Ball diameter, mm	1,9	3,2	4,7	6,3	7,9	10,3	13,5	19,5	24,5	31,7

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

Hose size	Length of test specimens		
	for impulse tests (3.10.7)	for fire resistance tests (3.10.18)	for other tests[1]
DN05	360	600	460
DN06	360	600	460
DN08	410	600	460
DN10	460	600	460
DN12	550	600	460
DN16	600	600	460
DN20	700	600	460
DN25	460	600	460
DN32	460	600	460
DN40	460	600	460

1) One additional sample of each size in lengths as shown in ISO 8829 shall be used for electrical conductivity tests (3.10.17).

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 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 6.

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).

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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 with braid removed (see 3.4.1);

b) internal cleanliness (see 3.9.3);

c) leakage tests (see 3.10.10);

d) burst pressure at room temperature (see 3.10.13).

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 con-

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[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	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	X	X	X		X	X
3.10.2	Elongation and contraction						X							X											
3.10.3	Volumetric expansion						X							X											
3.10.4	Pneumatic effusion									X	X														
3.10.5	Pneumatic surge									X	X														
3.10.6	Fuel resistance					X	X																		
3.10.7	Impulse	Unaged																X	X						
		Air-aged																		X	X				
		Oil-aged																				X	X		
3.10.8	Stress degradation											X	X												
3.10.9	Low-temperature flexing				X								X	X											
3.10.10	Leakage									X	X														
3.10.11	Corrosion							X	X																
3.10.12	Repeated installation		X	X																					
3.10.13	Burst pressure at room temperature							X		X															
3.10.14	Burst pressure at high temperature								X		X														
3.10.15	Vacuum				X								X	X											
3.10.16	Pneumatic leakage														X	X									
3.10.17	Electrical conductivity																						X		
3.10.18	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.

iTeh STANDARD PREVIEW
(standards.iteh.ai)
ISO 10502:1992
https://standards.iteh.ai/catalog/standards/sist/bb551ca8-f119-4421-9754-34b7af0d33a9/iso-10502-1992