
**Aerospace — Aramid reinforced
lightweight polytetrafluoroethylene
(PTFE) hose assemblies, classification
135 °C/20 684 kPa (275 °F/3 000 psi) and
135 °C/21 000 kPa (275 °F/3 046 psi) —
Procurement specification**

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*Aéronautique et espace — Tuyauteries flexibles en
polytétrafluoroéthylène (PTFE) renforcement aramide, série légère,
classification 135 °C/20 684 kPa (275 °F/3 000 psi) et
135 °C/21 000 kPa (275 °F/3 046 psi) — Spécification
d'approvisionnement*

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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 23933 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 10, *Aerospace fluid systems and components*.

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Aerospace — Aramid reinforced lightweight polytetrafluoroethylene (PTFE) hose assemblies, classification 135 °C/20 684 kPa (275 °F/3 000 psi) and 135 °C/21 000 kPa (275 °F/3 046 psi) — Procurement specification

1 Scope

This International Standard specifies requirements for aramid reinforced lightweight polytetrafluoroethylene (PTFE) hose assemblies for use in aircraft hydraulic, oil and fuel systems at temperatures between – 55 °C and 135 °C (– 65 °F and 275 °F) and at a nominal pressure of 21 000 kPa (210 bar) (3 046 psi) or 20 684 kPa (3 000 psi). 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.

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 2685:1998, *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 3161:1999, *Aerospace — UNJ threads — General requirements and limit dimensions*

ISO 5855-3:1990, *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 8829-2, *Aerospace — Test methods for polytetrafluoroethylene (PTFE) innertube hose assemblies — Part 2: Non-metallic braid*

SAE AS 150, *Hose assembly, type classifications of, basic performance and fire resistance*

SAE AS 1055, *Fire testing of flexible hose, tube assemblies, coils, fittings and similar system components*

SAE AS 1241, *Fire resistant phosphate ester hydraulic fluid for aircraft*

3 Classification

Hose assemblies furnished under this International Standard shall be classified as follows:

- Type A: 20 684 kPa (3 000 psi) nominal pressure;
- Type B: 21 000 kPa (210 bar) (3 046 psi) nominal pressure.

When no classification is specified by reference to this standard, type B shall apply.

4 Requirements

4.1 Limits of application

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.

4.2 Qualification

4.2.1 General

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.

4.2.2 Manufacturer qualification

Manufacturer approval shall be granted by outside agency procedure (see Table B.1, Procedure no. 1).

4.2.3 Product qualification

Product approval shall be granted by outside agency procedure (see Table B.1, Procedure no. 2).

4.3 Materials

4.3.1 General

The hose assembly materials shall be as described in this International Standard. All materials not specifically described in this International Standard shall be of the highest quality and suitable for the purpose intended.

4.3.2 Metals

Metals used in the fittings shall conform to the applicable specifications described in Table 1 (or equivalent specifications; see Annex A). Welded and redrawn tubing shall not be used. Material no. 1 shall not be used for welded assemblies.

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	CPTi	8
	Austenitic, seamless or welded, annealed, corrosion-resistant steel	9
	Austenitic, seamless or welded, stabilized, corrosion-resistant steel	10 and 11
	Cold-worked, stress-relieved titanium alloy	12

4.4 Construction

4.4.1 General

To meet the construction and performance requirements laid down in this International Standard and as required for its intended use, the hose assembly shall consist of:

- a seamless PTFE inner tube (see 4.4.2);
- treated para-aramid reinforcement (see 4.4.3);
- outer cover or braid protection to meet qualification and usability requirements;
- corrosion-resistant steel and/or titanium end-fittings (see 4.4.4).

4.4.2 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 3 % of such additives being retained in the mixture.

4.4.3 Reinforcement

The reinforcement shall consist of a treated para-aramid braid and an outer braid or other coverage to protect the para-aramid.

The reinforcement 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, damaged, slack or missing reinforcement yarn shall be cause for rejection.

The outer cover, or braid, shall provide 100 % coverage to protect the para-aramid reinforcement from exposure to ultraviolet light when bending to minimum radius specified in Table 4.

A continuous lay line which can be interrupted with hose manufacturer's name or trademark, shall be permanently marked in contrasting colour along the hose length.

4.4.4 Fittings

4.4.4.1 General

It shall be proven that all fittings comply with the requirements laid down in this International Standard. Hose assemblies supplied under this International Standard shall be equipped with fittings qualified for their intended use.

4.4.4.2 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 or titanium tubing.

4.5 Inner tube requirements

4.5.1 Density and relative density

The relative density of the hose inner tube shall not exceed 2,155 g/cm³, when tested in accordance with ISO 7258, either method A or method B (as specified in ISO 8829-2). The density shall not exceed 2,204 g/cm³, when tested in accordance with ISO 7258, method C (as specified in ISO 8829-2).

4.5.2 Tensile strength

When tested in accordance with ISO 8829-2, 4.2, the longitudinal tensile strength for all sizes of tubes shall be at least 15,1 N/mm² (1 N/mm² = 1 MPa) (2 200 psi).

When tested in accordance with ISO 8829-2, 4.2, the transverse tensile strength for sizes DN 16 (– 10) and larger shall be at least 12,4 N/mm² (1 800 psi); for sizes under DN 16 (– 10), the transverse strength need not be tested.

4.5.3 Elongation

When tested in accordance with ISO 8829-2, 4.2, elongation shall be at least 200 %.

4.5.4 Tube roll

The tube shall not leak, split, burst or show any signs of malfunction, when tested through the sequence as specified in 4.3.2 of ISO 8829-2.

4.5.5 Tube proof pressure

After being subjected to the tube roll test sequence (see 4.5.4), the tube, without reinforcing yarns, shall not leak, burst or show any signs of malfunction, when tested as specified in 4.3.3 of ISO 8829-2.

4.5.6 Electrical conductivity

When tested in accordance with 4.4 of ISO 8829-2, the electrical current shall be equal to or greater than:

- 10 µA for sizes DN 06 to DN 12 inclusive (–04 to –08 inclusive);
- 20 µA for sizes DN 16 (–10) and over.

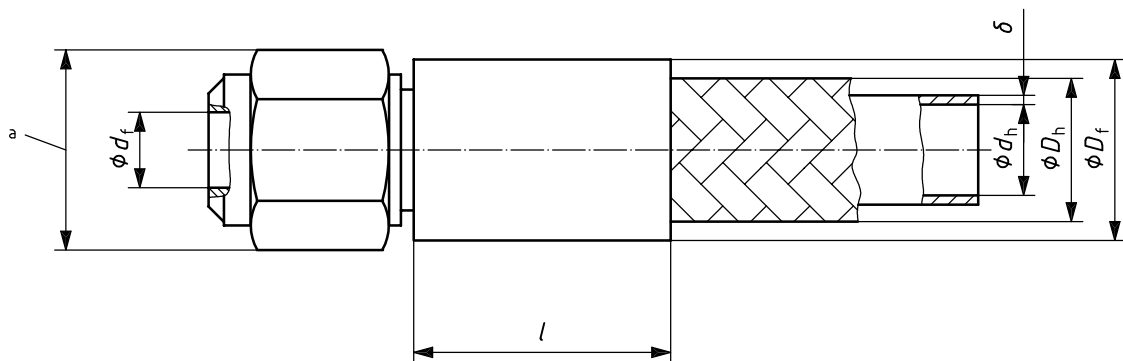
4.6 Hose assembly

4.6.1 Dimensional requirements

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

4.6.2 Physical requirements

The hose assembly shall comply with the physical and linear density (weight) requirements specified in Table 4.



Key

^a width across corners of nut and socket hexagon

d_h inside diameter (hose)

D_h outside diameter (hose)

d_f inside diameter (fitting)

D_f outside diameter (fitting)

l attachment length

δ wall thickness of inner tube

Figure 1 — Hose and fitting dimensions

4.6.3 Bore check

When bent to appropriate minimum bend radius as specified in Table 4, the hose assembly shall permit the free passage of a solid rigid sphere throughout its length. The minimum diameter of the sphere is given in Table 2A or Table 2B, as useful.

4.6.4 Assembly length

Tolerances on hose assembly lengths shall be as follows (unless otherwise specified):

- $\pm 3,20$ mm ($\pm 0,125$ in) for lengths under 500 mm (19,6 in);
- $\pm 6,35$ mm ($\pm 0,250$ in) for lengths from 500 mm to 1 000 mm (19,6 in to 39,4 in) exclusive;
- $\pm 12,70$ mm ($\pm 0,500$ in) for lengths from 1 000 mm to 1 500 mm (39,4 in to 59 in) exclusive;
- ± 1 % for lengths of 1 500 mm (59 in) and over.

4.7 Fitting threads

Unless otherwise specified (see 4.4.4), fitting threads shall be in accordance with ISO 5855-3 for SI (metric series) fittings and ISO 3161 for imperial (inch series) fittings. A 10 % increase in the tolerance of the fitting thread of the nut following proof pressure test shall not be cause for rejection of the hose assembly.

Table 2A — Hose and fitting dimensions as shown in Figure 1 — SI units

Dimensions in millimetres

Metric part	Hose size (nom.)			Hose (braided)			Fitting		Attachment length <i>l</i> max.	Wall thickness of inner tube δ min.	Spherical ball size for hose assembly inside diameter ^b	
	Inch part			Inside diameter <i>d_h</i> min.	Outside diameter <i>D_h</i> min. max.		Inside diameter <i>d_f</i> min.	Outside diameter ^a <i>D_f</i> max.			Straight fittings min.	Elbow fittings min.
	Size	Size	mm		(in)							
DN 06	- 04	6,350	(0,250)	5,4	10,0	11,0	3,4	14	22	0,89	3,06	2,89
DN 10	- 06	9,525	(0,375)	7,6	12,6	14,0	6,1	18	35	0,89	5,49	5,19
DN 12	- 08	12,700	(0,500)	9,9	15,5	16,5	8,6	20	40	1,02	7,74	7,31
DN 16	- 10	15,875	(0,625)	12,3	19,0	20,0	10,4	24	47	1,14	9,36	8,84
DN 20	- 12	19,050	(0,750)	15,3	22,5	23,5	12,9	28	54	1,14	11,61	10,97
DN 25	- 16	25,400	(1,000)	21,6	31,4	32,5	19,3	37	66	1,14	17,37	16,41

^a Width across corners of nut and socket hexagon may exceed the values given for *D_f*.

^b Minimum specified inside diameter shall be verified by passing a spherical ball through the hose assembly (see 4.6.3).

Table 2B — Hose and fitting dimensions as shown in Figure 1 — Imperial units

Dimensions in inches

Metric part	Hose size (nom.)			Hose (braided)			Fitting		Attachment length <i>l</i> max.	Wall thickness of inner tube δ min.	Spherical ball size for hose assembly inside diameter ^b	
	Inch part			Inside diameter <i>d_h</i> min.	Outside diameter <i>D_h</i> min. max.		Inside diameter <i>d_f</i> min.	Outside diameter ^a <i>D_f</i> max.			Straight fittings min.	Elbow fittings min.
	Size	Size	mm		(in)							
DN 06	- 04	6,350	(0,250)	0,213	0,394	0,433	0,134	0,551	0,866	0,035	0,120	0,114
DN 10	- 06	9,525	(0,375)	0,299	0,496	0,551	0,240	0,709	1,378	0,035	0,216	0,204
DN 12	- 08	12,700	(0,500)	0,390	0,650	0,650	0,339	0,787	1,575	0,040	0,305	0,288
DN 16	- 10	15,875	(0,625)	0,384	0,787	0,787	0,409	0,945	1,850	0,045	0,369	0,348
DN 20	- 12	19,050	(0,750)	0,602	0,886	0,925	0,508	1,102	2,126	0,045	0,457	0,432
DN 25	- 16	25,400	(1,000)	0,850	1,236	1,280	0,760	1,457	2,598	0,045	0,684	0,646

^a Width across corners of nut and socket hexagon may exceed the values given for *D_f*.

^b Minimum specified inside diameter shall be verified by passing a spherical ball through the hose assembly (see 4.6.3).

4.8 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.

4.9 Identification of products

4.9.1 General

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

4.9.2 Fittings

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

4.9.3 Hose assembly

A permanent marking shall be applied on a permanent rigid part and/or on a permanent band or bands securely attached to the hose. Bands shall be no wider than 25,4 mm (1 in) and shall not impair the flexibility or the performance of the hose. Unless otherwise specified by the purchaser, the marking on the fitting or band shall include the following information:

- the hose assembly manufacturer's name, trademark (optional);
- the hose assembly manufacturer's CAGE/NATO code;
- the complete hose assembly part number;
- the number of this International Standard followed by either the applicable type (A or B) or the applicable nominal pressure ("21 000 kPa" or "3 000 psi");
- the maximal operating temperature "135 °C" (275 °F) if and as required by the purchaser;
- the pressure test symbol "PT" or quality control label;
- the date of hose assembly manufacture or batch number as required by the purchaser;
- the fire resistance type per ISO 2685, SAE AS 1055 or SAE AS 150 if applicable and as required by the purchaser.

4.10 Workmanship

4.10.1 General

Workmanship shall be of such quality as to assure that hose assemblies furnished under this International Standard 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.

4.10.2 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.