INTERNATIONAL STANDARD

# ISO 8829-1

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# Aerospace — Test methods for polytetrafluoroethylene (PTFE) inner-tube hose assemblies —

## Part 1:
## Metallic (stainless steel) braid

*Aéronautique et espace — Méthodes d'essai des tuyauteries flexibles à tube intérieur en polytétrafluoroéthylène (PTFE) —*

*Partie 1: Tresses métalliques (en acier inoxydable)*



Reference number
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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.

ISO 8829-1 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 10, *Aerospace fluid systems and components*.

ISO 8829 consists of the following parts, under the general title *Aerospace — Test methods for polytetrafluoroethylene (PTFE) inner-tube hose assemblies*:

— *Part 1: Metallic (stainless steel) braid*

— *Part 2: Non-metallic braid*



# Aerospace — Test methods for polytetrafluoroethylene (PTFE) inner-tube hose assemblies —

# Part 1: Metallic (stainless steel) braid

## 1 Scope

This part of ISO 8829 specifies test methods for flexible polytetrafluoroethylene (PTFE) inner tubes with metallic (stainless steel) braided hose and hose assemblies used in aircraft fluid systems, in the pressure and temperature ranges covered by pressure classes and temperature types, as specified in ISO 6771.

If performance requirements are not defined in this part of ISO 8829, they are defined in the performance specification.

This part of ISO 8829 is applicable when reference is made to it in a procurement specification or other definition document.



NOTE Fluids used for the tests are listed in Annex A. The requirements for non-metallic braid hose assemblies are given in ISO 8829-2.



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

ISO 6773, *Aerospace — Fluid systems — Thermal shock testing of piping and fittings*

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

## 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

**3.1**
**room temperature**
temperature in the test laboratory between 15 °C (59 °F) and 32 °C (90 °F)

**3.2**
**fire protection**
flame- and heat-retardant element over the hose assembly

# 4 Tests of PTFE inner tubes

## 4.1 Density and relative density

### 4.1.1 Principle

This test is intended to control the crystallinity of PTFE inner tubes.

### 4.1.2 Test methods

The relative density of the PTFE tubing shall be measured in accordance with ISO 7258, method A or method B. The density of the PTFE tubing shall be measured in accordance with ISO 7258, method C.

## 4.2 Tensile tests

### 4.2.1 Principle

This test is intended to determine the mechanical properties of the PTFE tubing.

### 4.2.2 Test conditions

Test specimens shall be conditioned for at least 2 h at room temperature prior to testing.

### 4.2.3 Apparatus



#### 4.2.3.1 Testing machine

The test shall be carried out using a power-driven machine which is capable of maintaining a uniform rate of jaw separation at 50 mm/min (2 in/min) and which has a suitable dynamometer and a device for measuring the force applied within ± 2 %. If the capacity range cannot be changed during a test, as in the case of pendulum dynamometers, the force applied at breaking point shall be measured within ± 2 %, and the smallest tensile force measured shall be accurate to within ± 10 %.



If the dynamometer is of the compensating type for measuring tensile stress directly, means shall be provided to make adjustments for the cross-sectional area of the test specimen. The response of the recorder shall be sufficiently rapid that the force applied is measured accurately during the elongation of the test specimen to breaking point. If the test machine is not equipped with a recorder, a device shall be provided that indicates, after fracture, the maximum force applied during elongation. Testing machines shall be capable of measuring elongation in increments of 10 %.

#### 4.2.3.2 Micrometer

The micrometer used for measuring flat test specimen thickness shall be capable of exerting a pressure of (25 ± 5) kPa [(3,63 ± 0,7) psi] on the test specimens and of measuring the thickness to within ± 0,025 mm (0,001 in).

NOTE Dial micrometers exerting either a force of (0,8 ± 0,15) N [(0,18 ± 0,034) lbf] on a circular foot 6,35 mm (0,25 in) in diameter, or a force of (0,2 ± 0,04) N [(0,045 ± 0,009) lbf] on a circular foot 3,2 mm (0,125 in) in diameter, conform to the pressure requirement specified above. It is not advisable to use a micrometer to measure the thickness of test specimens narrower in width than the diameter of the foot unless the contact pressure is properly adjusted.

### 4.2.4 Calibration of testing machine

The testing machine shall be calibrated.

If the dynamometer is of the strain-gauge type, the test machine shall be calibrated at one or more forces at regular intervals.

#### 4.2.5 Test specimens

The specimens shall be in accordance with Figure 1.

NOTE Careful maintenance of the cutting edges of the die is extremely important and can be achieved by light daily honing and touching up of the cutting edges with jeweller's hard honing stones. The condition of the die can be assessed by determining the breaking point on any series of broken test specimens. When broken test specimens are removed from the jaws of the test machine, it is advantageous to pile these test specimens and note if there is any tendency to break at or near the same portion of each test specimen. Breaking points consistently occurring at the same place can be an indication that the die is dull, nicked or bent at that particular position.

Dimensions in millimetres

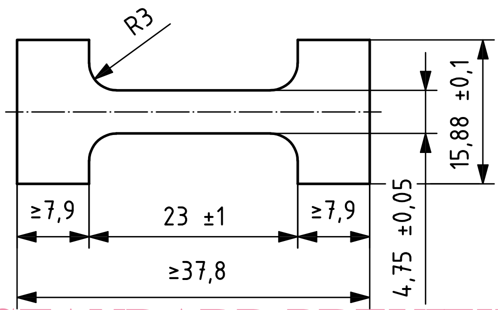





**Figure 1 — Test specimen for tensile test**

#### 4.2.6 Determination of tensile strength and elongation



##### 4.2.6.1 Procedure

Place the test specimens (see 4.2.5) in the jaws of the testing machine (see 4.2.3.1), taking care to adjust the specimen symmetrically so that the tension will be distributed uniformly over the cross-section. Start the machine and note continuously the distance between the jaws, taking care to avoid parallax. At fracture, measure and record the elongation to the nearest 10 % on the scale.

##### 4.2.6.2 Expression of results

Calculate the tensile strength, $R_\mathrm{m}$, expressed in newtons per square millimetre[1)], using Equation (1):

$$R_\mathrm{m} = \frac{F}{S} \tag{1}$$

where

$F$ is the measured force, in newtons, required to fracture the test specimens;

$S$ is the cross-sectional area, in square millimetres, of the test specimen before application of force.

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

Calculate the percentage total elongation at fracture, $A_t$, using Equation (2):

$$A_t = \left( \frac{L_u - L_o}{L_o} \right) \times 100 \qquad (2)$$

where

$L_u$ is the length measured between the jaws at fracture of the test specimen;

$L_o$ is the original length measured between the jaws before application of force.

## 4.3 Rolling and proof pressure tests

### 4.3.1 Principle

This test is intended to check that there are no flaws in the sintered tube.

### 4.3.2 Rolling test — Procedure

Pass each tube, in a single pass, through six sets of metal rollers, so that it is subjected to the sequence of diametral flexings specified in Table 1. Rollers shall be arranged to prevent inadvertent rotation in the tube. It is assumed that the tube is in a horizontal position and that pressure of the first set of rollers is exerted vertically. Angles given for the final three sets of rollers may be taken as either clockwise or counter clockwise from the vertical diameter of the tube. Roller angles shall be as specified in Table 1. A tolerance of ± 2° is allowed on each roller angle.



**Table 1 — Roller functions and angles**

| Set of metal rollers | Type of action | Roller angle |
|---|---|---|
| 1 | Flattening | 0° |
| 2 | Flattening | 90° |
| 3 | Rounding | 0° |
| 4 | Flattening | 45° |
| 5 | Flattening | 135° |
| 6 | Rounding | 45° |

The roller gap dimensions shall not be greater than those specified in Table 2 for each size.

**Table 2 — Roller gap dimensions**

| Hose size | | | | Maximum flattening gap | | | | Maximum rounding gap | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Metric part | Inch part<br>Equivalent outside diameter of tube | | | Class B<br>10 500 kPa<br>(1 523 psi)<br>hose | | Class D<br>21 000 kPa<br>(3 046 psi)<br>and higher hose | | Class B<br>10 500 kPa<br>(1 523 psi)<br>hose | | Class D<br>21 000 kPa<br>(3 046 psi)<br>and higher hose | |
| Size | Size | mm | (in) | mm | (in) | mm | (in) | mm | (in) | mm | (in) |
| DN05 | –3 | 4,762 | (0,187) | 5,2 | (0,205) | 5,2 | (0,205) | 5,5 | (0,216) | 6,4 | (0,252) |
| DN06 | –4 | 6,350 | (0,250) | 5,5 | (0,216) | 7,1 | (0,279) | 5,5 | (0,216) | 6,4 | (0,252) |
| DN08 | –5 | 7,937 | (0,312) | 5,5 | (0,216) | — | — | 6,4 | (0,252) | — | — |
| DN10 | –6 | 9,525 | (0,375) | 5,5 | (0,216) | 7,1 | (0,279) | 7,9 | (0,311) | 8,3 | (0,327) |
| DN12 | –8 | 12,700 | (0,500) | 5,9 | (0,232) | 8,3 | (0,327) | 9,5 | (0,374) | 11,9 | (0,468) |
| DN16 | –10 | 15,875 | (0,625) | 6,4 | (0,252) | 8,3 | (0,327) | 12,7 | (0,500) | 14,7 | (0,578) |
| DN20 | –12 | 19,050 | (0,750) | 6,4 | (0,252) | 8,3 | (0,327) | 12,7 | (0,500) | 17,5 | (0,689) |
| DN25 | –16 | 25,400 | (1,000) | 6,4 | (0,252) | 8,3 | (0,327) | 19,1 | (0,752) | 21 | (0,827) |
| DN32 | –20 | 31,750 | (1,250) | 7,9 | (0,311) | 11,1 | (0,437) | 22,2 | (0,874) | 25,4 | (1,000) |
| DN40 | –24 | 38,100 | (1,500) | 9,5 | (0,374) | — | — | 31,8 | — | — | — |

NOTE Special size high pressure hose assembly callout utilizes the lower hose size value noted.



### 4.3.3 Proof pressure test — Procedure

After the roll test, hold the tube for not less than 2 min at proof pressures as shown in Table 3, using water or air as the test medium.

**Table 3 — Proof pressures**

| Hose size | | | | Proof pressures | | | |
|---|---|---|---|---|---|---|---|
| Metric part | Inch part<br>Equivalent outside diameter of tube | | | Class B<br>10 500 kPa (1 523 psi)<br>hose | | Class D<br>21 000 kPa (3 046 psi)<br>and higher hose | |
| Size | Size | mm | (in) | kPa | (psi) | kPa | (psi) |
| DN05 | –3 | 4,762 | (0,187) | 2 690 | (390) | 2 690 | (390) |
| DN06 | –4 | 6,350 | (0,250) | 2 480 | (360) | 2 620 | (380) |
| DN08 | –5 | 7,937 | (0,312) | 2 000 | (290) | — | — |
| DN10 | –6 | 9,525 | (0,375) | 1 590 | (230) | 1 930 | (280) |
| DN12 | –8 | 12,700 | (0,500) | 1 240 | (180) | 1 520 | (220) |
| DN16 | –10 | 15,875 | (0,625) | 1 170 | (170) | 1 170 | (170) |
| DN20 | –12 | 19,050 | (0,750) | 965 | (140) | 890 | (130) |
| DN25 | –16 | 25,400 | (1,000) | 621 | (90) | 660 | (95) |
| DN32 | –20 | 31,750 | (1,250) | 448 | (65) | 660 | (95) |
| DN40 | –24 | 38,100 | (1,500) | 310 | (45) | — | — |

NOTE Special size high pressure hose assembly callout utilizes the lower hose size value noted.

## 4.4 Electrical conductivity test

### 4.4.1 Preconditioning

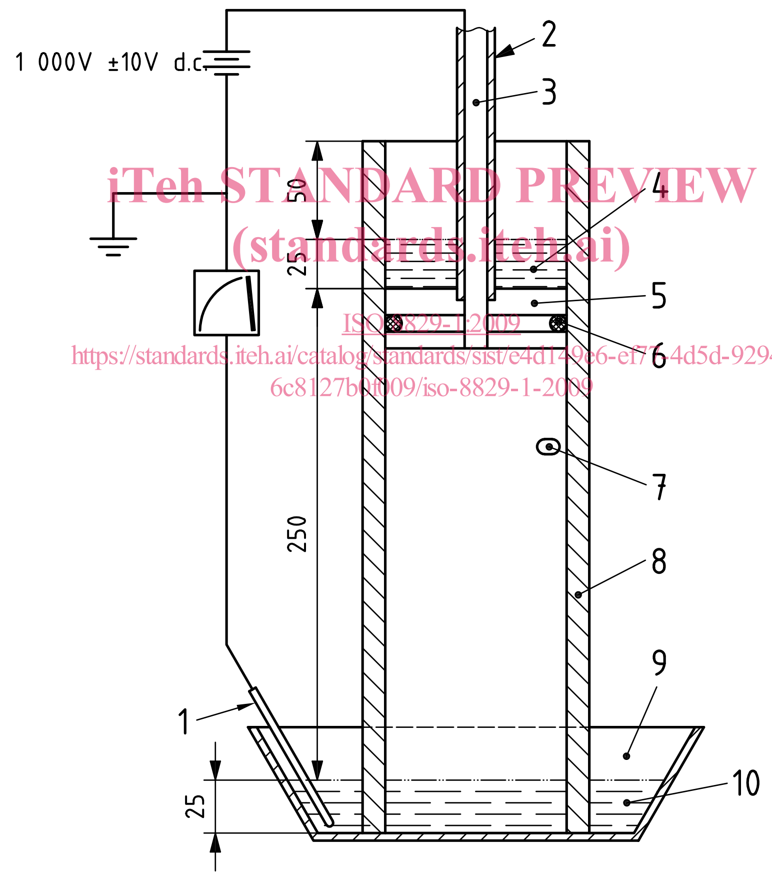
The test specimen shall be a 350 mm (13,78 in) length of PTFE hose tube, with braid removed. The inner surface of the tube shall be washed first with solvent (test fluid No.1; see Annex A) and then with isopropyl alcohol (test fluid No.2; see Annex A) to remove surface contamination. The inside of the tube shall then be thoroughly dried at room temperature.

### 4.4.2 Procedure

Arrange the test specimen vertically as shown in Figure 2. The relative humidity shall be kept below 70 %. Apply (1 000 ± 10) V d.c. between the upper and lower electrodes (salt water solution). The salt water solution shall be a solution of sodium chloride in chemically pure water [$\rho$(NaCl) = 450 g/l].

Measure the current with an instrument having a sensitivity of at least 1 µA[2].

Dimensions in millimetres






**Key**

1 probe
2 conductor tube
3 vent
4 upper electrode (mercury or salt water solution)
5 non-metallic plug
6 O-ring
7 vent (if any)
8 polytetrafluoroethylene (PTFE) (tube hose inner liner)
9 non-metallic container
10 lower electrode (mercury or salt water solution)

**Figure 2 — Test set-up for electrical conductivity test on inner tubes**

2) 1 µA = 1 × $10^{-6}$ A.

# 5 Tests on hoses and hose assemblies

## 5.1 Stress degradation test

### 5.1.1 Principle

This test is intended to verify that the hose inner tube has been sintered and quenched to the proper crystallinity to eliminate stress cracking or creep with subsequent leakage.

### 5.1.2 Class D 21 000 kPa (3 046 psi) and higher hose — Procedure

**5.1.2.1** Fill the hose assemblies with a high-temperature test fluid (test fluid No.3; see Annex A) and place in an oven maintained at (204 ± 5) °C [(400 ± 9) °F]. Apply to the hose assemblies the nominal working pressure specified in the procurement specification.

Precautions shall be taken to ensure that the hose assemblies do not come into contact with parts of the oven that are at a higher temperature.

**5.1.2.2** After at least 20 h at 204 °C (400 °F), gradually release the pressure, remove the assemblies from the oven, drain and cool to room temperature. Then flush the assemblies with a quantity of fresh high-temperature test fluid (test fluid No.3; see Annex A), equivalent in volume to at least twice the volume of the test specimen volume, and drain.

**5.1.2.3** Fill the hose assemblies with hydraulic test fluid (test fluid No.4; see Annex A). Apply to the hose assemblies the nominal working pressure specified in the procurement specification and hold that pressure for at least 2 h at room temperature.



**5.1.2.4** Repeat the procedure specified in 5.1.2.1 to 5.1.2.3 a total of three times.



**5.1.2.5** Within 4 h after the final pressurization period of 2 h, drain the hose assemblies, flush with trichlorotrifluoroethane (test fluid No.5; see Annex A) and place in an oven for at least 1 h at a temperature of (70 ± 5) °C [(158°± 9) °F].

**5.1.2.6** Within 8 h after the drying process has been completed, remove the hose assemblies from the oven, cool to room temperature, and then subject to a pneumatic effusion (air under water) test. For this test, install the hose assemblies in a test set-up constructed similarly to that shown in Figure 3.

**5.1.2.7** Immerse the test set-up with the hose assemblies installed in water. Apply nominal pressure for at least 15 min to allow any entrapped air in the hose to escape.

**5.1.2.8** Hold the pressure for a further period of 5 min, during which time collect the gas escaping from the test specimen, including the juncture of the hose and the fitting, but not including the fitting nut. After the pressurization period of 5 min, calculate the average rate of effusion through the hose and two fittings expressed as millilitres per minute per metre of the hose length.

### 5.1.3 Class B 10 500 kPa (1 523 psi) hose – Procedure

The hose assemblies shall be tested in the same manner as specified in 5.1.2, except that the test temperature shall be (232 ± 5) °C [(450 ± 9) °F].

## 5.2 Pneumatic effusion test

### 5.2.1 Principle

This test is intended to show that the hose inner tube does not have excessive porosity.