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Road vehicles — Thermoplastics tubing for air braking systems

Véhicules routiers — Tuyauteries thermoplastiques de dispositifs de freinage pneumatique

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

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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 7628 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 2, *Braking systems and equipment*.

This first edition cancels and replaces the second edition of ISO 7628-1:1998, the first edition of ISO 7628-2:1998 and ISO 7628-2/Cor.1:1999, which have been technically revised.

Road vehicles — Thermoplastics tubing for air braking systems

WARNING — The use of this International Standard may involve hazardous materials, operations, and equipment. This International Standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this International Standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

1 Scope

This International Standard specifies the minimum requirements for mono wall and multilayer tubing used in air braking systems on road vehicles. The conformity of production is the responsibility of the tubing manufacturer.

The marking of the tubing does not automatically imply that the tube assembly (i.e. tube with end fittings) is appropriate for its use on a vehicle.

It is the responsibility of the tube assembler and/or the vehicle manufacturers to ensure that the tests described in Annex B, relating to the tube assembly itself, are successfully performed.

For the requirements on coiled tube assemblies refer to ISO 7375-1 and ISO 7375-2.

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 179-1, *Plastics — Determination of Charpy impact properties — Part 1: Non-instrumented impact test*

ISO 1043-1, *Plastics — Symbols and abbreviated terms — Part 1: Basic polymers and their special characteristics*

ISO 1183-1, *Plastics — Methods for determining the density of non-cellular plastics — Part 1: Immersion method, liquid pyknometer method and titration method*

ISO 4892-2:2006, *Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc lamps*

ISO 4892-4:2004, *Plastics — Methods of exposure to laboratory light sources — Part 4: Open-flame carbon-arc lamps*

ASTM B117, *Standard Practice for Operating Salt Spray (Fog) Apparatus*

3 Terms and definitions

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

3.1
tube
tubing which has been cut to its appropriate length

3.2
tube assembly
tube which has been equipped with suitable end fittings

3.3
tubing without fittings
tubing of unspecified length without end fittings

3.4
tubing with fittings
tubing of a specified length with end fittings

3.5
impact energy
energy determined by means of an impact bending test

4 Marking and identification

Tubings shall be indelibly marked along a generating line with letters of a minimum height of 2 mm and repeated at least every 350 mm as follows:

— ISO 7628;

— tubing category, i.e. either 1 000 kPa or 1 250 kPa for the temperature range –40 °C to 100 °C;

— tubing category, 1 250 kPa; for the temperature range –40 °C to 125 °C;

— outside diameter times wall thickness;

— symbol for the material type, in accordance with ISO 1043-1;

— manufacturer designation;

— date code of manufacture.

These seven indications shall be separated from each other by slashes.

5 Dimensions

The tubing defined in this International Standard belongs to four possible categories, as defined in Table 1.

Table 1 — Tubing categories for air braking systems

Category	Maximum working pressure kPa	Minimum temperature °C	Maximum temperature °C
0	1 000	–40	80
1	1 000	–40	100
2	1 250	–40	100
3[a]	1 250	–40	125

[a] For use in the engine compartment.

Tubing shall have the dimensions given in Table 2.

Table 2 — Dimensions

Nominal tubing size outside diameter mm	Tubing basic outside diameter mm	Outside diameter tolerances	Inside diameter basic mm	Inside diameter tolerances	Minimum wall thickness, *e* mm
4 × 1	4	±0,1	2	±0,1	0,9
6 × 1	6	±0,1	4	±0,1	0,9
8 × 1	8	±0,1	6	±0,1	0,9
9 × 1,5	9	±0,1	6	±0,1	1,4
10 × 1	10	±0,1	8	±0,1	0,9
10 × 1,25	10	±0,1	7,5	±0,1	1,15
11 × 1,5	11	±0,15	8	±0,15	1,35
12 × 1,5	12	±0,15	9	±0,15	1,35
14 × 2	14	±0,15	10	±0,15	1,85
15 × 1,5	15	±0,15	12	±0,15	1,35
16 × 2	16	±0,15	12	±0,15	1,85
18 × 2	18	±0,15	14	±0,15	1,85
19 × 2	19	±0,15	15	±0,15	1,85

6 Manufacture

6.1 Materials

The tubing shall be extruded from 100 % virgin material (not reground). The use of recycled material is not permitted, but own reworked material may be used as grinding stock, as long as it does not make up more than 20 % of the new material, is of the same material type and is from the manufacturer's own production, and the tubing meets all other requirements of this International Standard. If reinforcement is used, then the user must be satisfied that the reinforced tubing is suitable for the application. The materials used may have additives to enhance material performance provided the tubing produced complies with the requirements of this International Standard.

6.2 Tubing

6.2.1 Quality and appearance

The tubing shall comply with the requirements of this International Standard. The tube shall show no manufacturing faults, voids, scratches, cracks or lack of homogeneity which could affect service use. Additives shall be evenly distributed throughout the material.

6.2.2 Construction

6.2.2.1 General

Tubing shall consist of an extrudate of one or more layers.

6.2.2.2 Inner layer

The materials used in the inner layer should be able to withstand contact with chemicals found in a system environment. The inner layer of the tubing can be exposed to such an environment at the “ends” that are attached to the various connection points in a system.

6.2.2.3 Colour

The outermost layer may be of a different colour to the subsequent layers but must be the colour designated by the end user.

7 Installation on the vehicle

7.1 Use of tube assemblies on the vehicle

The choice of appropriate fittings and tube shall be approved by the vehicle manufacturer.

In order to allow its mounting on the vehicle, the tube assembly shall have been tested in accordance with Annex B.

7.2 Installation precautions

When installed on a vehicle, the tube shall be routed and supported so as to

— eliminate chafing, abrasion, kinking or other mechanical damage,

— minimize fatigue conditions and

— avoid excessive sag.

The tube should be stored inside a dry environment not exceeding a temperature of 40 °C.

8 Testing and requirements

For the purpose of these tests, the tube samples shall be at least two weeks (336 h) old. Unless otherwise stated, the tests shall be performed at an ambient temperature of (23 ± 2) °C, at a relative humidity between 45 % and 75 %, and unpressurized. All burst tests shall be conducted using the same type of fitting.

The list of appropriate tests to be performed on the tubing is given in Table 3. All the tests listed in Tables 3 and 4 shall be successfully completed before the marking of the tube.

Table 3 — List of tests

Test	Subclause	Tube size to test
Surface appearance	6.2.1	Every
Burst at 23 °C	9.1.2	Every
Burst at 100 °C	9.1.3	Every
Burst at 125 °C	9.1.4	Every
Deformation under pressure	9.2	Every
Cold impact	9.3	Every
Impact after ageing	9.4	Every
Layer adhesion	9.5	Sample
Moisture absorption	9.6	Sample
Low temperature flexural	9.7	Sample
Stress cracking	9.8	Sample
Resistance to ethanol	9.9	Sample
Resistance to battery acid	9.10	Sample
Resistance to oil	9.11	Sample
Resistance to urea	9.12	Sample
Heat ageing	9.13	Sample
Artificial weathering	9.14	Sample
Ozone	9.15	Sample
Tube assemblies	9.16	Every

Table 4 — Requirements

Test	Requirement	Subclause
Surface appearance	No manufacturing faults, voids, scratches, cracks or lack of homogeneity which could affect service use. Additives evenly distributed throughout the material.	6.2.1
Burst	All five samples:	9.1.2
at 23 °C	1 000 kPa (10 bar) tubes; > 4 000 kPa (40 bar) 1 250 kPa (12,5 bar) tubes; > 5 000 kPa (50 bar)	
at 80 °C	1 000 kPa (10 bar) tubes; > 2 500 kPa (25 bar)	9.1.3
at 100 °C	1 000 kPa (10 bar) tubes; > 2 500 kPa (25 bar) 1 250 kPa (12,5 bar) tubes; > 3 130 kPa (31,3 bar)	9.1.3
at 125 °C	1 250 kPa (12,5 bar) tubes; > 2 500 kPa (25 bar)	9.1.4
Deformation under pressure	All three samples Deviation between datum lines ⩽ 3 % Deviation outer diameter ⩽ 10 % initial mean diameter	9.2
Cold impact	All five samples No cracks or breaks One sample: cracks or breaks, further ten samples to be tested and pass.	9.3
Impact after ageing	All ten samples no cracks or breaks	9.4
Layer adhesion	All five samples no cracks or breaks	9.5
Moisture absorption	As agreed between customer and supplier	9.6
Low temperature flexural	All three samples No damage Rewound area; pass burst test at 23 °C	9.7
Stress cracking	All six samples No cracks or breaks Burst pressure at 23 °C > 80 % of the reference value measured on samples from the same batch	9.8
Resistance to ethanol	All three samples no evidence of cracking	9.9
Resistance to battery acid	All three samples No dimensional change exceeding ±2% Change in weight ⩽ 2% No evidence of cracking Tensile force > 80 % of the minimum applied tensile force in accordance with Annex B	9.10
Resistance to oil	Average volume change of three samples < 5 %	9.11
Resistance to urea	All three samples no evidence of cracking	9.12
Heat ageing	To be specified by the end user	9.13
Artificial weathering	All three samples Burst test at 23 °C Burst pressure at 23 °C > 80 % initially measured on samples from the same batch All three samples ductile burst area	9.14
Ozone	The samples shall show no evidence of cracks when visually inspected under seven-power magnification	9.15
Tube assemblies	Pull out strength; no loosening or pull off shall occur. Neither the tube nor the fittings shall fail Leak test; no leakage Vibration test; end user's specification Pulsating pressure fatigue test No sign of failure or leakage Burst test requirements mentioned above and at least 80 % of the reference value measured on samples from the same batch Salt spray test; no evidence of cracking	9.16

9 Test procedures and requirements

9.1 Burst test

9.1.1 Test procedure

The burst test shall be carried out on five tube assemblies for each temperature. The tube length between the end fittings shall be approximately 150 mm. The test procedure comprises the steps given in 9.1.2, 9.1.3 and 9.1.4.

9.1.2 Burst at 23 °C

Soak the tube assemblies in water at 23 °C for 10 min to 15 min. Before testing, keep the tube assemblies for the following times at 23 °C and (50 ± 10) % relative humidity:

a) 1 h minimum for tubes with a nominal wall thickness $e \leqslant 1{,}25$ mm (see Table 2);

b) 2 h minimum for tubes with a nominal wall thickness $e > 1{,}25$ mm (see Table 2).

Apply hydrostatic pressure at a constant rate by means of a hydraulic pump or accumulator system with a calibrated pressure gauge at such a speed that the tube will burst between 30 s and 60 s after starting to pressurize the tube.

The burst pressure at 23 °C is the maximum pressure obtained during the test.

NOTE Fittings can be specified in agreement with the customer.

9.1.3 Burst at 80 °C and 100 °C

This test shall be performed with an inert internal pressurizing medium and air outside.

Place the assemblies in an oven at (80 ± 2) °C or (100 ± 2) °C respectively and allow to condition for 1 h. Apply pressure at a constant rate by means of a pump or accumulator system with a calibrated pressure gauge at such a speed that the tube will burst between 30 s and 60 s after starting to pressurize the tube.

The burst pressure at 80 °C or 100 °C is the maximum pressure obtained during the test.

NOTE Fittings can be specified in agreement with the customer.

9.1.4 Burst at 125 °C

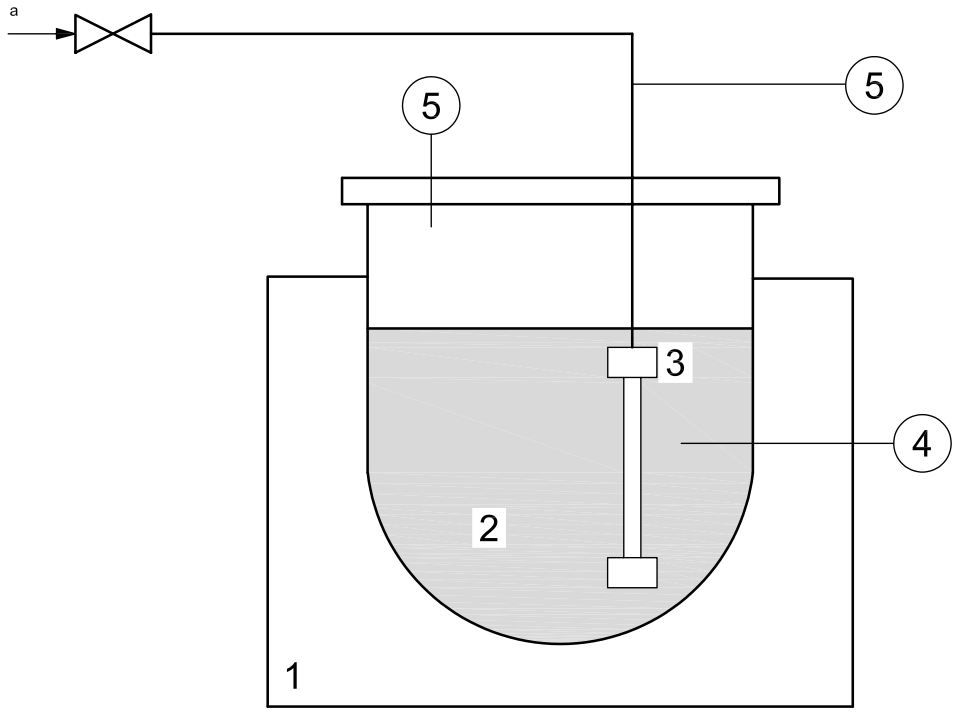
This test shall be performed with an inert internal pressurizing medium and heated air, water or silicon oil outside the tube.

Place the assemblies in an appropriate autoclave. The autoclave shall be equipped with a suitable coupling unit for fitting the tubes and connecting to the pressurizing equipment (Figure 1). Heat the medium, preferably water, in the autoclave to the required temperature and keep the temperature constant for 10 min. Apply pressure at a constant rate by means of a pump or accumulator system with a calibrated pressure gauge at such a speed that the tube will burst between 30 s and 60 s after starting to pressurize the tube.

The burst pressure at 125 °C is the maximum pressure obtained during the test.

NOTE 1 The autoclave should preferably be suitable for the different tube sizes specified in Table 2.

NOTE 2 Fittings can be specified in agreement with the customer.



Key

1 heating mantel
2 autoclave
3 pipe assembly
4 thermometer heating medium
5 pressure gauge
a Gas inlet.

Figure 1 — Burst test at 125 °C — Schematic figure

9.1.5 Requirements

The burst criterion is the burst of the tube itself.

All five samples shall have a burst pressure as specified in Table 5.

Table 5 — Burst pressure

Test temperature	Tube class	Burst pressure
23 °C	1 000 kPa (10 bar) 1 250 kPa (12,5 bar)	> 4 000 kPa (40 bar) > 5 000 kPa (50 bar)
80 °C	1 000 kPa (10 bar)	> 2 500 kPa (25 bar)
100 °C	1 000 kPa (10 bar) 1 250 kPa (12,5 bar)	> 2 500 kPa (25 bar) > 3 150 kPa (31,5 bar)
125 °C	1 250 kPa (10 bar)	> 2 500 kPa (25 bar)