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Gas welding equipment — Rubber hoses for welding, cutting and allied processes

Matériel de soudage aux gaz — Tuyaux souples en caoutchouc pour le soudage, le coupage et les techniques connexes

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 8, *Equipment for gas welding, cutting and allied processes*.

This fifth edition cancels and replaces the fourth edition (ISO 3821:2008), which has been technically revised with the following changes:

— the definition of *maximum working pressure* has been added;

— the title of 7.1.1 has been changed from "General" to "Light and normal duty hoses";

— Table 1 has been revised;

— 9.3.2 has been revised;

— 9.3.4.1 has been revised;

— requirements for marking have been revised;

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Gas welding equipment — Rubber hoses for welding, cutting and allied processes

1 Scope

This document specifies requirements for rubber hoses (including twin hoses) for welding, cutting and allied processes. It is applicable to rubber hoses for normal duty of 2 MPa (20 bar) and light duty [limited to hoses for maximum working pressure of 1 MPa (10 bar) and with bore up to and including 6,3 mm], operated at temperatures −20 °C to +60 °C used in

— gas welding and cutting,

— arc welding under the protection of an inert or active gas, and

— processes allied to welding and cutting, in particular, heating, brazing, and metallization.

This document does not specify requirements for hose assemblies, which are detailed in ISO 8207.

Nor does it apply to thermoplastics hoses or hoses used for high pressure [>0,15 MPa (>1,5 bar)] acetylene.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 37, *Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties*

ISO 188, *Rubber, vulcanized or thermoplastic — Accelerated ageing and heat resistance tests*

ISO 1307:2006, *Rubber and plastics hoses — Hose sizes, minimum and maximum inside diameters, and tolerances on cut-to-length hoses*

ISO 1402, *Rubber and plastics hoses and hose assemblies — Hydrostatic testing*

ISO 1817, *Rubber, vulcanized or thermoplastic — Determination of the effect of liquids*

ISO 4080, *Rubber and plastics hoses and hose assemblies — Determination of permeability to gas*

ISO 4671, *Rubber and plastics hoses and hose assemblies — Methods of measurement of the dimensions of hoses and the lengths of hose assemblies*

ISO 7326:2016, *Rubber and plastics hoses — Assessment of ozone resistance under static conditions*

ISO 8033:2006, *Rubber and plastics hoses — Determination of adhesion between components*

ISO 10619-1, *Rubber and plastics hoses and tubing — Measurement of flexibility and stiffness — Part 1: Bending tests at ambient temperature*

ISO 10619-2:2011, *Rubber and plastics hoses and tubing — Measurement of flexibility and stiffness — Part 2: Bending tests at sub-ambient temperatures*

ISO 11114-3, *Gas cylinders — Compatibility of cylinder and valve materials with gas contents — Part 3: Autogenous ignition test for non-metallic materials in oxygen atmosphere*

ISO 15296, *Gas welding equipment — Terminology — Terms used for gas welding equipment*

ISO 23529, *Rubber — General procedures for preparing and conditioning test pieces for physical test methods*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8033 and ISO 15296, and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
twin hose
two normal rubber hoses joined together longitudinally

3.2
universal fuel gas hose
hose which can be used for all fuel gases except fluxed fuel gas

Note 1 to entry: Fuel gases are listed in Table 4.

3.3
flux fuel gas hose
hose suitable for fuel gas containing a flux

3.4
maximum working pressure
maximum pressure to which the equipment may be subjected in service

4 Abbreviated terms

LPG liquefied petroleum gases

MPS methylacetylene-propadiene mixtures

5 Application

Hoses shall only be used for the gas service for which they are identified (see 10.2).

6 Hose designation

The hoses covered by this document are designated using the following information:

a) inside diameter, see Table 1;

b) light or normal duty (pressure rating), see Table 3;

c) colour and marking (gas service), see Table 4.

EXAMPLE 1 6,3 mm, light duty. Blue (Oxygen).

EXAMPLE 2 10 mm, normal duty. Red/Orange (Universal fuel gases).

EXAMPLE 3 6,3 mm, light duty, FLUX. Red (Fluxed fuel gases).

7 Materials

7.1 Construction

7.1.1 Light and normal duty hoses

The hose shall consist of the following:

a) a rubber lining of minimum thickness 1,5 mm;

b) reinforcement applied by any suitable technique;

c) a rubber cover of a minimum thickness of 1,0 mm.

7.1.2 Flux fuel gas hose

The flux fuel gas hose shall consist of the following:

a) a rubber lining with an additional inner plastic layer, which shall be of maximum thickness 0,5 mm, to give a minimum total thickness of 1,5 mm;

b) reinforcement applied by any suitable technique;

c) a rubber cover of minimum thickness 1,0 mm.

7.1.3 Twin hose

Each hose used for twin hose construction shall be as specified in 7.1.1 or 7.1.2. The two hoses shall be joined longitudinally during the extrusion and/or vulcanization process. They shall be capable of being separated free of damage to enable end fittings to be fitted. See 9.3.7.

7.2 Manufacture

The lining and cover shall be of uniform thickness and free from holes, porosity and other defects.

8 Dimensions and tolerances

8.1 Inside and outside diameters

The inside and outside diameters of the hoses shall be in accordance with the dimensions and tolerances shown in Table 1.

8.2 Concentricity (total indicator reading)

The concentricity of the hose, measured in accordance with ISO 4671, shall be in accordance with the values given in Table 1.

Table 1 — Wall thickness, inside diameter, tolerances and concentricity

<table>
<tr><th>Inside diameter

mm</th><th>Tolerance

mm</th><th>Outside diameter

mm</th><th>Tolerance

mm</th><th>Concentricity max.

mm</th></tr>
<tr><td>4,0</td><td rowspan="5">±0,3</td><td>10,0</td><td rowspan="5">±0,4</td><td rowspan="5">0,7</td></tr>
<tr><td>4,8</td><td>10,8</td></tr>
<tr><td>5,0</td><td>11,0</td></tr>
<tr><td>6,3</td><td>12,0</td></tr>
<tr><td>7,1</td><td>13,1</td></tr>
<tr><td>8,0</td><td rowspan="3">±0,4</td><td>14,0</td><td rowspan="3">±0,5</td><td rowspan="3">0,8</td></tr>
<tr><td>9,5</td><td>16,5</td></tr>
<tr><td>10,0</td><td>17,0</td></tr>
<tr><td>12,5</td><td rowspan="4">±0,5</td><td>20,0</td><td rowspan="4">±0,6</td><td rowspan="7">1,0</td></tr>
<tr><td>16,0</td><td>23,5</td></tr>
<tr><td>20,0</td><td>27,5</td></tr>
<tr><td>25,0</td><td>33,0</td></tr>
<tr><td>32,0</td><td rowspan="3">±0,8</td><td>44,0</td><td rowspan="3">±1,0</td></tr>
<tr><td>40,0</td><td>54,0</td></tr>
<tr><td>50,0</td><td>66,0</td></tr>
<tr><td colspan="5">For intermediate dimensions, numbers should be chosen from the R20 series of preferred numbers (see ISO 3) with tolerances as for the next larger inside diameter listed.

NOTE The tolerances and inside diameters (excluding inside diameter of 20 mm) do not comply with ISO 1307:2006, Table 1.</td></tr>
</table>

8.3 Cut lengths and tolerances

The tolerances for cut lengths shall be in accordance with ISO 1307.

9 Requirements and type tests

9.1 General

A summary of requirements and type tests with the corresponding number of samples is given in Annex D.

9.2 Basic requirements

9.2.1 Tensile strength and elongation at break

Measurements shall be made on test pieces cut from the hoses. The materials used in the lining and cover, when tested in accordance with ISO 37, shall have a tensile strength and elongation at break not less than the values given in Table 2.

Table 2 — Tensile strength and elongation at break

Rating	Tensile strength MPa	Elongation at break %
Rubber lining	5	200
Cover	7	250
Inner plastic layer	5	120

9.2.2 Accelerating ageing

Measurements shall be made on test pieces cut from the hoses. After ageing for 7 days at a temperature of (70 ± 2) °C as specified in ISO 188 (air oven), the tensile strength and elongation at break, respectively, of the lining and cover shall not decrease from the original values obtained by more than 25 % for the tensile strength and 50 % for elongation at break.

9.2.3 Adhesion

When tested in accordance with ISO 8033:2016 using the type 2 or type 4 test piece, the minimum adhesion between adjacent components of the hose shall be 1,5 kN/m. For flux fuel gas hoses, see 9.3.4. For flux fuel gas hoses, the inner plastic layer shall be removed prior to the test.

9.2.4 Hydrostatic requirements

The hose, when tested in accordance with ISO 1402 at ambient temperature, shall meet the requirements of Table 3.

Table 3 — Hydrostatic requirements

Rating	Light duty (inside diameter ≤6,3 mm)	Normal duty (all sizes)
Maximum working pressure	1 MPa (10 bar)	2 MPa (20 bar)
Proof pressure	2 MPa (20 bar)	4 MPa (40 bar)
Minimum burst pressure	3 MPa (30 bar)	6 MPa (60 bar)
Change in length at maximum working pressure	±5 %	
Change in diameter at maximum operating pressure	±10 %	

9.2.5 Flexibility at ambient temperature

When tested in accordance with ISO 10619-1 at standard laboratory temperature as defined in ISO 23529 using a diameter of curvature, D_c, of 10 d_i, where d_i is the inside diameter (with a minimum of 80 mm), the coefficient of deformation, K, shall not be less than 0,8. There shall be no kink in the curved portion of the hose.

9.2.6 Low-temperature flexibility

When tested in accordance with ISO 10619-2:2011, method B, at (−25 ± 3) °C, using a D_c of 10 d_i (with a minimum of 80 mm), the hose shall show no signs of leakage when subjected to the proof pressure (carried out at ambient temperature) stated in Table 3.

9.2.7 Protection against incandescent particles and hot surfaces

The cover of the hose shall have sufficient protection against contact with incandescent particles and hot surfaces. To meet this requirement, the test piece shall resist for 60 s the test conditions given in Annex D without leaking, i.e. no loss in pressure.

If the first test fails, the two subsequent tests shall meet the requirements to pass the test.

9.2.8 Ozone resistance

Hoses up to 25 mm inside diameter shall be tested in accordance with ISO 7326:2016, method 1, using a D_c as specified in 9.2.5. Hoses with above 25 mm inside diameter shall be tested in accordance with ISO 7326:2016 method 3 or method 4. For all methods, the cover shall show no evidence of cracking when viewed under two times magnification.

9.3 Special requirements

9.3.1 Non-ignition requirement for oxygen hoses

The non-ignition test shall be carried out either according to ISO 11114-3 or Annex A.

When tested according to ISO 11114-3, the initial conditions shall be set at 2 MPa (20 bar) (ambient temperature) and the self-ignition temperature shall be higher than 150 °C.

When tested by the method described in Annex A, three samples of the lining shall remain in the apparatus at a constant temperature of 360 °C to 365 °C for 2 min without ignition.

If more than one of the samples show evidence of ignition in less than 2 min, the hose shall be considered not to comply. If only one sample shows evidence of ignition in less than 2 min, three further samples shall be prepared and tested. If any of the three samples in this second series shows evidence of ignition in less than 2 min, the hose shall be deemed not to comply.

9.3.2 Resistance to acetone and dimethylformamide for acetylene hoses

A sample of the lining, when immersed in acetone at standard laboratory temperature as defined in ISO 23529 for 70 h, shall not increase in mass by more than 8 % when calculated in accordance with the method specified in ISO 1817.

A sample of the lining, when immersed in dimethylformamide at standard laboratory temperature as defined in ISO 23529 for 70 h, shall not increase in mass by more than 8 % when calculated in accordance with the method specified in ISO 1817.

9.3.3 Resistance to *n*-pentane for propane hoses

A sample of the hose lining, when tested as described in Annex B, shall show absorbed *n*-pentane not exceeding 15 % mass fraction (see B.1) and *n*-pentane extractable matter within 10 % mass fraction (see B.2).

9.3.4 Resistance to azeotrope of trimethylborate with methanol for flux fuel gas hoses

9.3.4.1 Adhesion after conditioning in trimethylborate-methanol azeotrope

Remove the inner plastic layer from the rubber lining.

Seal one end of the test hose and fill the hose with the test fluid and condition for (70 ± 2) h at (23 ± 2) °C. After this period, empty the test fluid from the hose and leave for 24 h.

An adhesion test in accordance with ISO 8033:2016 using the type 2 or type 4 test piece shall be carried out on three test pieces taken from the hose after the fluid has been removed.

The adhesion between the rubber lining and the reinforcement shall meet the specified requirements. The hose shall have a minimum adhesion between the rubber lining and the reinforcement of 1,5 kN/m.

9.3.4.2 Tensile strength and elongation at break after conditioning in trimethylborate-methanol azeotrope

The hose when tested in accordance with the following method shall have a variation in the tensile strength and elongation at break of less than 30 % from the original values obtained under 9.2.1.

Seal one end of the test hose and fill the hose with the test fluid and condition for (70 ± 2) h at (23 ± 2) °C. After this period, empty the test fluid from the hose and leave for 24 h.

Tensile strength and elongation at break tests in accordance with ISO 37 shall be carried out on five test pieces of inner plastic layer of the lining cut from a hose after the fluid has been emptied. The measurement shall be carried out 24 h after the emptying of the hose.

The variation of the tensile strength and elongation at break shall meet the specified requirements.

9.3.4.3 Change in mass and volume after immersion in trimethylborate-methanol azeotrope

A mass and volume variation test in accordance with ISO 1817 shall be carried out on three test pieces of inner plastic layer of the lining, cut from a hose and immersed in the test liquid for (70 ± 2) h at (23 ± 2) °C.

The mass and volume variation of the inner plastic layer of the lining shall not exceed 8 %. The measurement shall be carried out within 30 min after taking the test pieces out of the test liquid.

9.3.5 Flexibility of flux fuel gas hoses

One sample of hose shall be filled with trimethylborate-methanol azeotrope for 70 h at (23 ± 2) °C. The flux fuel gas hoses shall then be submitted to the same test as specified in 9.2.5. The test shall be carried out within 30 min after the emptying of the hose. In addition to the requirements of 9.2.5, the hose shall show no signs of leaks when subjected to the proof pressure (carried out at ambient temperature) specified in Table 3.

9.3.6 Permeability to LPG, MPS, and natural gas of methane hoses, universal fuel gas hoses, and flux fuel gas hoses

When tested in accordance with ISO 4080 using a test gas of 95 % volume fraction propylene at cylinder pressure [approximately 0,6 MPa (6 bar)] and standard laboratory temperature of (23 ± 2) °C as defined in ISO 23529, the gas permeance shall not exceed 25 $cm^3/m \cdot h$, irrespective of inside diameter.

9.3.7 Requirements for twin hoses

9.3.7.1 General

Both of the hoses from the twin hose construction shall, after separation by the following test method, conform to this document. Each individual hose shall meet all the requirements when subjected to the relevant tests for the specific hose type.

9.3.7.2 Separation test for twin hose

It shall be possible to separate twin hose into two single hoses with a force between 25 N to 100 N. The test shall be carried out using a tensile test machine. Initially separate using a knife, a sufficient length of the twin hose to enable each individual hose to be secured in the jaws. Mark 200 mm of unseparated hose. Execute the test over a length of 300 mm with a jaw separation speed of 100 mm/min. The value of the force to be taken into account is the mean value measured during the propagation phase of the notch, excluding the first 100 mm where the tension is not yet stable.

9.3.8 Requirements for universal fuel gas hose

Hoses shall comply with the requirements of 9.3.2, 9.3.3 and 9.3.6.

10 Hose colour and gas identification

10.1 General

The hose cover material shall be coloured throughout and marked as follows.

