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Third edition
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Gas welding equipment — Rubber and plastics hose and hose assemblies for use with industrial gases up to 450 bar (45 MPa)

Matériel de soudage aux gaz — Tuyaux souples et flexibles en caoutchouc et en plastique pour des gaz industriels jusqu'à 450 bar (45 MPa)

Reference number
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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. www.iso.org/directives

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The committee responsible for this document is ISO/TC 44, *Welding and allied processes*, Subcommittee SC 8, *Equipment for gas welding, cutting and allied processes*.

This third edition cancels and replaces the second edition (ISO 14113:2007), of which it constitutes a minor revision with the following changes:

— correction of temperature value in 7.5;

— editorial revision.

Requests for official interpretations of any aspect of this International Standard should be directed to the Secretariat of ISO/TC 44/SC 8 via your national standards body. A complete listing of these bodies can be found at www.iso.org.

Gas welding equipment — Rubber and plastics hose and hose assemblies for use with industrial gases up to 450 bar (45 MPa)

1 Scope

This International Standard specifies requirements for rubber and plastics hose and hose assemblies for use with compressed, liquefied, and dissolved gases up to a maximum working pressure of 450 bar (45 MPa), within the ambient temperature range of −20 °C to +60 °C.

This International Standard applies to hose assemblies used to connect industrial gas cylinders to manifolds or bundles prior to any pressure reduction stage.

This International Standard does not cover rubber or thermoplastic hoses for welding, cutting, and allied processes (see ISO 3821 and ISO 12170).

This International Standard does not apply to refrigerated liquefied gases or to liquefied petroleum gases (LPG).

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 105-A02:1993, *Textiles — Tests for colour fastness — Part A02: Grey scale for assessing change in colour*

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 1746:1998, *Rubber or plastics hoses and tubing — Bending tests*

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

ISO 4080:1991, *Rubber and plastic 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 4672:1997, *Rubber and plastics hoses — Sub-ambient temperature flexibility tests*

ISO 7326:2006, *Rubber and plastics hoses — Assessment of ozone resistance under static conditions*

ISO 8031, *Rubber and plastics hoses and hose assemblies — Determination of electrical properties*

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

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

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

ISO 30013:2011, *Rubber and plastics hoses — Methods of exposure to laboratory light sources — Determination of changes in colour, appearance and other physical properties*

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 in ISO 15296 and the following apply.

3.1
autogenous ignition temperature
temperature at which ignition of a sample occurs when subjected to oxygen pressure and heating and in the absence of a source of ignition other than the applied temperature

Note 1 to entry: The autogenous ignition temperature depends on the sample preparation, test apparatus, and test procedure employed.

3.2
burst pressure
pressure at which rupture of the hose occurs when tested to the relevant standard

[SOURCE: ISO 8330:2007, definition 2.1.21]

3.3
distance piece
length of metallic tubing at the end of a hose or hose assembly that serves to contain and cool the highest temperature gas that is formed by the effect of adiabatic compression, e.g. by the rapid opening of a cylinder valve

3.4
end fitting
sub-assembly of components enabling the hose to be safely connected to other pressurized equipment

3.5
hose assembly
length of hose with suitably attached end fittings

3.6
maximum working pressure
pressure to which a hose is designed to be subjected during service, including expected momentary surges

Note 1 to entry: This definition is consistent with that for a gas cylinder in ISO 10286:2007, A.2.4 maximum permissible operating pressure (the highest pressure permitted to be developed during service). ISO 10286:2007 defines "working pressure" as the "settled pressure ... at a uniform ... temperature of 15 °C in a full gas cylinder".

Note 2 to entry: Due to the peculiar characteristics of the acetylene cylinder, there is no clearly defined maximum working pressure for acetylene service. Applicable requirements for acetylene service are given in relevant clauses.

3.7
proof pressure
pressure applied during a non-destructive test and held for a specified period of time to prove the integrity of the construction

Note 1 to entry: It is expressed in bars.

[SOURCE: ISO 8330:2007, definition 2.1.104]

4 Construction

4.1 Hose

The hose should consist of either

— a rubber or plastics lining,

— reinforcement consisting of one or more layers, and

— an outer protective cover of permeable material or perforated rubber or plastics,

for flammable gas service, the hose shall also incorporate bonding wires to provide the electrical conductivity (see 7.8);

or

— a rubber or plastics lining, and

— reinforcement consisting of one or more layers of stainless steel wire braid and/or other corrosion and abrasion resistant material, which is also designed to act as an outer protective cover and provide electrical conductivity (see 7.8).

4.2 End fittings

Fittings shall be of permanent, swage, or crimp design.

The fitting design shall enable the hose assembly to attain its burst pressure without fitting pullout or separation from the hose.

End fittings shall be manufactured from materials that are compatible with the gases and the environment to which they will be subjected, e.g. according to ISO 9539.

4.3 Hose assemblies

Assemblies shall consist of a length of hose and permanently attached end fittings. Field-attachable or reusable-type fittings shall not be used. Distance pieces, when used as heat sinks as part of hose assemblies for oxygen service (see 7.1.3), shall not be readily detachable by the user.

For maximum working pressures in excess of 40 bar (4 MPa), hoses assembled should be provided with a suitable restraining cable or device, properly fitted to an anchor point to restrain the hose in the event of a hose assembly failure.

5 Dimensions and tolerances

5.1 Bore size

The bore of the hoses shall be in accordance with the nominal bore sizes and permitted ranges given in Table 1, except that the effective maximum bore of hoses for acetylene shall not exceed 25 mm.

NOTE In some countries, local regulations can restrict bores of acetylene hoses to less than 25 mm.

5.2 Concentricity

The internal diameter and concentricity of the hose, measured according to ISO 4671, shall be in accordance with the values given in Table 1.

Table 1 — Nominal bore size, internal diameter permitted range, and concentricity

Nominal bore size	Internal diameter permitted range mm	Concentricity mm
3,2	3,0 to 3,6	± 0,6
4	3,8 to 4,4	
5	4,5 to 5,4	
6,3	6,1 to 6,9	
8	7,7 to 8,5	
10	9,3 to 10,1	
11	10,8 to 11,6	
12,5	12,3 to 13,5	
13	12,8 to 14,0	
16	15,4 to 16,7	± 0,7
19	18,6 to 19,8	
20	19,6 to 20,8	
22	21,8 to 23,0	
25	25,0 to 26,4	
31,5	31,3 to 33,0	
32	31,7 to 33,4	
38	37,7 to 39,3	± 0,8
50	49,7 to 51,4	
51	50,4 to 52,0	

5.3 Cut lengths and tolerances

The tolerances for cut lengths of hoses shall be in accordance with ISO 1307:2006, Clause 3 (±1 % or ±3 mm, whichever is the greater).

5.4 Length of hoses assemblies

The tolerances for lengths of hose assemblies shall be +2 % of the specified length or +6 mm, whichever is the greater. The length shall be measured when the hose assembly is in the unpressurized state.

6 Physical properties of lining and cover — Type tests

6.1 General

The lining material shall be compatible with the gas or gases with which the hose is specified for use, under normal operating conditions. See ISO 11114-2 for guidance.

6.2 Resistance to ignition requirement for oxygen hose lining

The autogenous ignition temperature of the lining shall be according to Table 2 when tested at a minimum pressure of 130 bar (13 MPa) by the method of ISO 11114-3.

NOTE Suitable grades of fluorinated polymers and copolymers, e.g. polytetrafluoroethylene and polytetrafluoroethylene/perfluorinated vinyl ethers, normally meet this requirement, but some oil-treated grades may not.

Table 2 — Minimum autogenous ignition temperature

Maximum working pressure bar (gauge)	**Minimum autogenous ignition temperature** °C
40	300
100	350
150	375
207	400
Above 207 up to 450	400

6.3 Resistance to acetone (acetylene hose only)

A sample of the lining when immersed in the test solvents of acetone and dimethylformamide at standard laboratory temperature as defined in ISO 23529 for 70 h shall not increase in mass by more than 8 % for each test solvent when calculated by the method specified in ISO 1817.

7 Performance requirements — Type tests

7.1 Pressure resistance requirements

7.1.1 Hydrostatic testing

Hose and hose assemblies shall be tested for proof pressure at twice the maximum working pressure according to the test method specified in ISO 1402.

Hose and hose assemblies shall be tested for burst pressure at four times the maximum working pressure according to the test method specified in ISO 1402. The end fittings shall remain attached to the hose up to the burst pressure. Hoses and hose assemblies for acetylene shall have a minimum burst pressure of 1 000 bar (100 MPa).

NOTE The requirement for acetylene service is based on the extremely high pressures that could be generated in the case of an acetylene decomposition.

7.1.2 Special requirements for acetylene hose assemblies

Hose assemblies for acetylene service in direct contact with the contents of an acetylene cylinder shall resist an acetylene decomposition at an initial pressure of 26 bar (25 bar gauge), according to the test method in Annex A.

NOTE It is known that the decomposition of acetylene takes place as a reaction starting as deflagration and changing to stable detonation. The transition area is located at a distance of about 1 000 mm to 2 000 mm from the starting point of the deflagration (in general, the beginning of the hose) and depends on the diameter. This length is called critical length. In addition, there are other influencing factors (e.g. connector design).

7.1.3 Special requirements for oxygen hose assemblies

Hoses and hose assemblies for oxygen service above 30 bar (3 MPa) shall not ignite or show internal scorching damage when subjected to an oxygen pressure surge test according to Annex B.

When installing hose assemblies with rubber or plastics linings in oxygen systems in direct contact with the contents of the cylinder, the system shall be designed according to the requirements in Annex C, including consideration of the use of distance pieces or equivalent means.

7.2 **Adhesion** (rubber hoses only)

When tested in accordance with ISO 8033:2006 using the type 2 or type 4 test piece, the minimum adhesion between adjacent components shall be 2,5 kN/m.

7.3 Flexibility

When tested in accordance with ISO 1746:1998, method A, at standard laboratory temperature as defined in ISO 23529 using a diameter of curvature of 50 times the nominal bore size, the coefficient of deformation, *K*, shall be not less than 0,8, and there shall be no kink in the curved portion of the hose.

7.4 Low temperature flexibility

When tested in accordance with ISO 4672:1997, method B, at –25 °C using a diameter of curvature of 50 times the nominal bore size, the hose shall show no signs of cracking or leakage and not fail when subjected to the proof pressure test.

7.5 **Ozone resistance** (for hoses with an outer protective cover of rubber)

When tested in accordance with ISO 7326:2006, method 1, at 40 pphm and 40 °C for (120 ± 2) h, the rubber cover shall show no evidence of cracking under two times magnification.

7.6 **UV resistance** (for hoses with plastics cover)

When tested in accordance with ISO 30013:2011, method A, the plastics cover shall show no evidence of cracking or change in colour. After testing, when comparing the samples to the grey scale, the minimum acceptable degree shall be 4 (in accordance with ISO 105-A02:1993).

NOTE The default time period is 250 h and no water spray.

7.7 Permeability to gas

When tested in accordance with the requirements of ISO 4080:1991, method 1 or method 2, at a test pressure equal to the maximum working pressure except for acetylene where the test pressure shall be 30 bar (3 MPa), the permeability to gas of a sample of the hose shall not exceed 15 cm^3/m h.

For service with gases of high permeability, e.g. hydrogen or helium, the test shall be done with the intended gas.

7.8 Electrical conductivity

The resistance between end fittings of hose assemblies for flammable gases shall not exceed 10^6 Ω, when tested in accordance with ISO 8031.

7.9 End fitting integrity

Fittings shall be capable of withstanding a longitudinal pull force of 2 670 N while in a non-pressurized state without pulling out or separating from the hose.

8 Performance requirements — Production tests

8.1 Pressure tests for hose assemblies

Each hose assembly shall be subjected to a pressure test using oil-free water at a pressure equal to 1,5 times the maximum working pressure for 1 min. There shall be no visible signs of leakage, permanent deformation, or other signs of failure. Where hydraulic testing would result in unacceptable contamination of the hose assembly, the hydraulic test may be replaced by a pneumatic test using a compatible medium such as dry oil-free air or nitrogen. Appropriate safety measures should be taken to protect personnel and equipment during testing.

8.2 Leak test

Each hose or hose assembly shall be tested for leakage, by total immersion in water for 3 min at ambient temperature at a test pressure equal to the maximum working pressure except for acetylene where the test pressure shall be 30 bar (3 MPa). Hose or hose assemblies to be used with hydrogen or helium shall be tested with helium. Hose or hose assemblies to be used with other gases shall be tested with a compatible medium such as dry oil-free air or nitrogen. The test shall be in accordance with ISO 4080:1991.

8.3 Cleaning for oxygen service

Hose and hose assemblies for oxygen service shall be free from contamination by oil, grease, and particulate or fibrous matter, e.g. swarf, dust, textile fibres, or other polymeric substances. Cleaning shall be carried out by a recognized procedure, e.g. to ISO 15001, which includes degreasing with a suitable solvent. The degreased hose or hose assembly shall be thoroughly dried and purged with oil-free dry air or inert gas with a dew point of −40 °C or below at 1 013 mbar.

9 Marking

Each length of hose with a cover of rubber or plastic shall be permanently marked with the following information:

a) the number and date of this International Standard: ISO 14113:2013;

b) the maximum working pressure in bar and between brackets in megapascals;

c) the nominal bore size;

d) the manufacturer’s name or mark (in the example given as XYZ);

e) the year of manufacture;

f) the name of the gas or gases for which the hose or hose assembly is suitable;

g) for flammable gases only, the electrical “conductive” symbol, Ω.

Markings a) to g) shall be repeated at intervals of not greater than 1 m.

Hoses with metallic braided cover shall be identified by the use of a tag or sleeve giving the above information.

EXAMPLE ISO 14113:2013 - 400 bar (40 MPa) - 32 - XYZ - 2007 - HYDROGEN - Ω

The hose assemblies shall be marked in the end fitting or by attaching a tag which shall include at least the name or trademark of the manufacturer of the assembly or of its distributor and the year of manufacture.

10 Packaging

Fittings on hose assemblies shall be protected from external damage by suitable plugs or end caps. The degreased hose or hose assembly for oxygen service shall be labelled with the words “Cleaned for oxygen service” and sealed in a suitable container, e.g. a plastic bag.

11 Instructions

Instructions on the following shall be supplied by the manufacturer, supplier, or distributor of hoses or hose assemblies:

— need for careful handling to avoid contamination of oxygen hose and hose assemblies with dust, oil, grease, and particulate matter;

— safe and correct installation of all hoses and hose assemblies, especially for oxygen systems;

— commissioning tests necessary for safe use of all hoses and hose assemblies;

— advice on the need for periodic testing, examination, and maintenance of all hoses and hose assemblies.

Annex A
(normative)

Acetylene decomposition test for hose assemblies used in high pressure acetylene installations

A.1 General

Three samples of the acetylene hose assembly shall be tested for sufficient strength with decomposition of high pressure acetylene. The test assembly is shown in Figure A.1.

The nominal bore size of the test pipelines ahead and behind the hose assembly shall not be less than the nominal bore size of the hose.

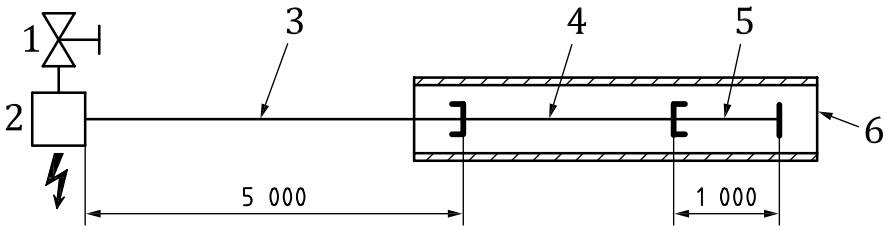
The temperature of the test system, especially of the acetylene, shall be at least 5 °C.

A.2 Test procedure

The assembled test system shall be evacuated to a pressure of at least 1 mbar and then filled with acetylene up to the test pressure of 25 bar gauge. Then the valve shall be closed. The acetylene decomposition is started by means of a fused wire.

The acetylene hose assembly shall not burst when tested and shall remain gas-tight afterwards up to a pressure of 25 bar gauge.

Dimensions in millimetres



Key

1 valve
2 ignition source
3 test pipeline
4 test sample hose assembly for high-pressure acetylene
5 test pipeline with closed end
6 safety pipe to catch parts flying away in case of failure of hose assembly

Figure A.1 — Test assembly for acetylene decomposition test with hose assembly for high-pressure acetylene

Annex B
(normative)

Oxygen pressure surge test

B.1 General

The tests shall be carried out on samples of oxygen hose assemblies of each nominal bore size and the shortest (three samples) and longest (three samples) hose assembly in each bore size. If the two end fittings of the hose assembly are different and both can be used as inlet connection, the test shall be carried out for each diameter and length (min. and max.) on six samples, three tested in one direction and three tested in the other.

The samples shall be exposed, through their inlets, to pressure surges from industrial oxygen (minimum purity by volume, 99,5 %; hydrocarbon volume fraction less than or equal to 0,004 %). The test system shall be provided with equipment for preheating the oxygen, an oxygen high-pressure vessel, and a quick opening valve. Figure B.1 gives an example of a test bench.

B.2 Test procedure

Prior to the test, the time required to increase the pressure from atmospheric up to the test pressure shall be $20^{\ 0}_{-5}$ ms , at measuring point 10 in Figure B.1.

At least every second pressure surge shall be recorded. All tests shall be carried out without a connecting tube between the quick-opening valve and the test sample. Before starting the test, the samples shall be at room temperature. The test pressure shall be, in all cases, the maximum working pressure of the hose assembly.

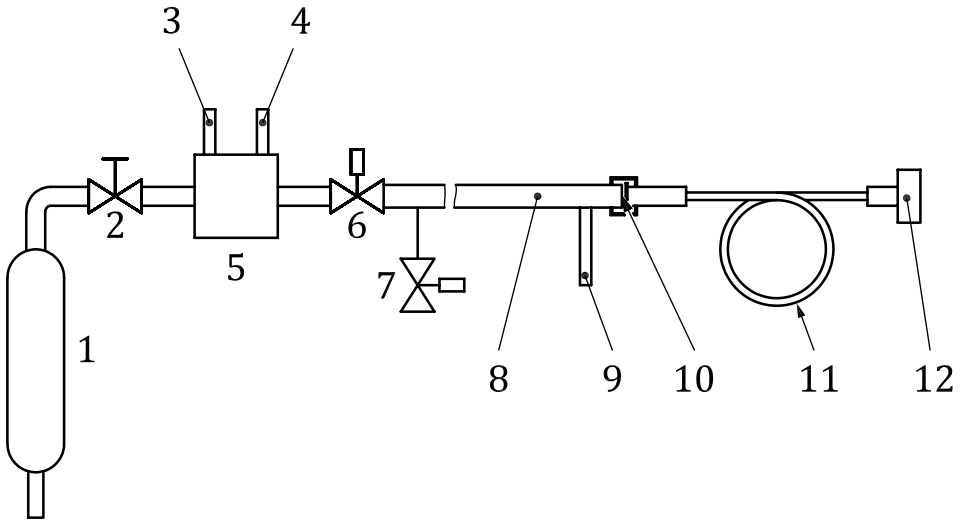
Each test series shall consist of 20 pressure surges at intervals of 30 s. See Figure B.2.

Each pressure surge is applied for at least 10 s. After each pressure surge, the hose assembly is brought back to atmospheric pressure. Between each pressure surge, atmospheric pressure shall be maintained for at least 3 s.

During a test series, the inlet pressure (test pressure) shall not decrease by more than 3 %.

Each sample shall be tested straight and curved in a single loop with an inner diameter equal to 50 times the nominal inside diameter. In total, each sample shall undergo 40 pressure surges (20 when straight and 20 when curved).

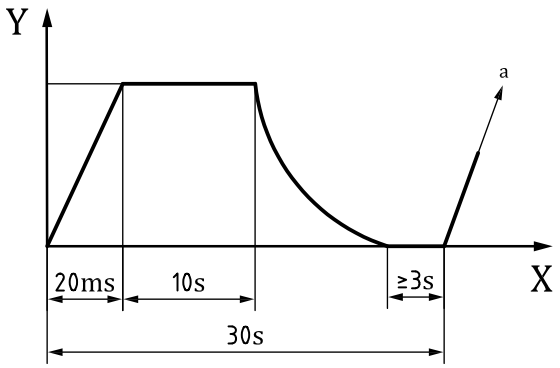
The hose assembly shall not burn out during the test. After the tests have been completed, each test sample shall be dismantled and all internal parts surfaces inspected. Internal damage and evidence of burning are not acceptable.



Key

1 oxygen supply
2 inlet valve
3 pressure transducer on the oxygen vessel
4 thermoelement
5 oxygen vessel with preheating device (e.g. water bath, electric heating)
6 quick-opening valve
7 outlet valve
8 test adapter (minimum volume)
9 pressure transducer
10 measuring point for the time of increase of pressure
11 sample hose assembly (shown curved in a single loop)
12 blanking plug

Figure B.1 — Test bench for oxygen pressure surge test



Key

X time
Y pressure (bar) (1,2 times max. working pressure)
a Next pressure shock.

Figure B.2 — Test interval

Annex C
(normative)

Oxygen system installation considerations

C.1 General

When installing hose assemblies in oxygen systems, the system shall be designed to avoid a dead end or plug at the end of the hose assembly. The combination of a dead end coupled with a rapid pressurization may lead to a high temperature at the end of a hose assembly caused by adiabatic compression of the contained oxygen and subsequent failure of the hose assembly by ignition.

Where valves, regulators, and other passage closure devices are present at the end of the hose assembly, a distance piece or equivalent means shall be used to lessen the effects of adiabatic compression.

CAUTION — Always open oxygen system supply valves slowly. Rapid pressurization causes the oxygen to heat and can result in ignition and fires. Maintain system cleanliness.

C.2 Use of distance pieces

Distance pieces, if used, shall have a volume of 3 280 mm^3 including the end fitting of the 6,4 mm nominal inside diameter hose assembly for a hose length of 910 mm for system pressure up to 200 bar (20 MPa).

NOTE The volume of the distance piece for a hose with 6,4 mm nominal inside diameter and 910 mm length has been taken from CGA E-9–1998 [7] and includes a safety factor of four. It is based on ASTM STP 1319 [8].

This distance volume can consist of the volume of the end fitting of the hose assembly in combination with the volume of the cylinder valve connection nipple, other extension nipples, and the valve or regulator inlet (or other device) before closure.

For hose assemblies longer or shorter than 910 mm, the volume of the distance piece should be increased or decreased in direct equal proportion to the increase or decrease in hose length.

For system pressures in excess of 200 bar (20 MPa), the distance piece volume should be increased in direct proportion to the increased system pressure.

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