INTERNATIONAL STANDARD

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Third edition
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Gas welding equipment — Pressure regulators for manifold systems used in welding, cutting and allied processes up to 30 MPa (300 bar)

Matériel de soudage aux gaz — Détendeurs de centrale de bouteilles pour le soudage, le coupage et les techniques connexes jusqu'à 30 MPa (300 bar)

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.

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 7291 was prepared by Technical Committee 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 7291:1999), which has been technically revised.

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 — Pressure regulators for manifold systems used in welding, cutting and allied processes up to 30 MPa (300 bar)

1 Scope

This International Standard specifies requirements and test methods for pressure regulators in manifold systems used in welding, cutting, and allied processes for:

a) compressed gases up to 30 MPa[1)] (300 bar);

b) dissolved acetylene;

c) liquefied petroleum gases (LPG);

d) methylacetylene-propadiene-mixtures (MPS);

e) carbon dioxide (CO_2).

It is not applicable to pressure regulators fitted directly to the gas cylinders, as defined in ISO 2503[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 5171, *Gas welding equipment — Pressure gauges used in welding, cutting and allied processes*

ISO 9090, *Gas tightness of equipment for gas welding and allied processes*

ISO 9539, *Gas welding equipment — Materials for equipment used in gas welding, cutting and allied processes*

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

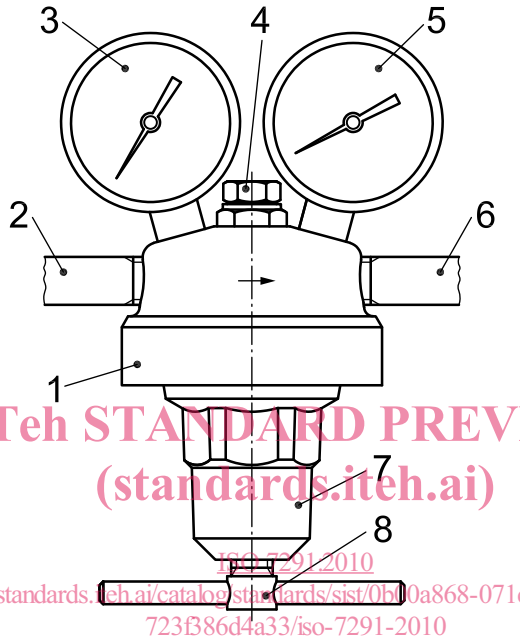
1) The value 30 MPa relates to maximum cylinder filling pressure at 15 °C.

3 Terms and definitions

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

3.1
pressure regulator for manifold systems
device for regulating a generally variable inlet pressure to as constant as possible an outlet pressure when controlling the output of a manifold of cylinders

NOTE The diagram of the pressure regulator is an example only. Optional design characteristics are to be compatible with the safety requirements specified in this International Standard. See Figure 1.



Key

1 pressure regulator body
2 inlet connector
3 upstream pressure gauge
4 relief valve
5 downstream pressure gauge
6 outlet connector
7 pressure regulator cover
8 pressure adjusting screw

Figure 1 — Example of pressure regulators and designation of its components

3.2
manifold
assembly of devices generally linking two or more gas sources coupled to a user pipeline system, delivering a regulated pressure under specified safe conditions

NOTE A manifold can include components like collectors, safety devices, and pressure regulators.

4 Units

4.1 Pressure

The pressures measured are gauge pressures[2] and are expressed in megapascals or bars.

4.2 Flow

Flow rates are measured in cubic metres per hour corrected to a standard atmosphere[3], taking into account the relevant conversion coefficient for the gas used (see Table 1).

Table 1 — Conversion coefficient, U

Test gas	Conversion coefficient								
	air	oxygen	nitrogen	argon	hydrogen	helium	acetylene	LPG, e.g. propane	CO_2
air	1	0,950	1,02	0,851	3,81	2,695	1,05	0,800	0,808
nitrogen	0,983	0,930	1	0,837	3,75	2,65	1,03	0,784	0,792

The conversion coefficient, U, is given by Equation (1):

$$U = \sqrt{\frac{\gamma_0}{\gamma_1}} \tag{1}$$

where

γ_0 is the density of test gas;

γ_1 is the density of gas used.

4.3 Temperature

Temperatures are measured in degrees Celsius.

5 Manufacturing requirements

5.1 Materials

Materials for pressure regulators shall conform to the requirements of ISO 9539.

2) Pressure exceeding atmospheric pressure.

3) A standard atmosphere at 23 °C and 0,101 3 MPa (1,013 bar), ISO 554[1].

5.2 Design, machining and assembly

5.2.1 Oxygen pressure regulators

Pressure regulators for oxygen shall be designed and manufactured giving consideration to the possibility of internal ignition. Pressure regulators for oxygen shall not ignite or show evidence of burning when submitted to the ignition test in 9.4.4.

All components and accessories shall be thoroughly cleaned and degreased before assembly.

5.2.2 Acetylene pressure regulators

Pressure regulators shall be designed and constructed in such a way that they withstand acetylene decomposition. The test shall be carried out in accordance with 9.4.6.

5.2.3 Connections

5.2.3.1 Inlet connections

Choice of inlet connections is left to the manufacturer's discretion.

5.2.3.2 Outlet connections

Choice of outlet connection is left to the manufacturer's discretion.

5.2.4 Filter

A particle filter, having an effective cross-section compatible with the discharge, shall be mounted within or directly fitted to the pressure regulator upstream of the pressure regulator valve. The filter shall not be removable without the use of a tool. The filter shall retain particles of size greater than or equal to 0,1 mm.

5.2.5 Pressure-adjusting device

This device shall be designed in such a way that it is not possible for the pressure regulator valve to be held in the open position, for example, as a consequence of the spring being compressed fully (to its solid length).

If the dimensions of the pressure-adjusting screw are such as to prevent the spring becoming fully compressed, then the pressure-adjusting screw shall not be removable.

Using the adjusting device, it shall not be possible to obtain a pressure at which the pressure relief device vents.

5.2.6 Pressure gauges

The pressure regulator shall be supplied with upstream and downstream pressure gauges complying with the functions and safety requirements specified in ISO 5171.

Inlet connection threads shall conform to international, regional or national standards for pressure gauges.

Pressure gauges shall be designed and constructed in such a way that they withstand acetylene decomposition. The test shall be carried out in accordance with 9.4.7.

5.2.7 Gas leakage

5.2.7.1 General

The pressure regulator shall be gastight to the exterior, e.g. to the atmosphere, and internally, i.e. between the high-pressure and low-pressure parts. At all normal pressures for relevant gases, the leakage shall not exceed the limits specified in 5.2.7.2 and 5.2.7.3.

5.2.7.2 External leakage

Pressure regulators shall be gastight to the atmosphere and shall conform to the requirements of ISO 9090. The total leakage shall be less than 10 cm^3/h.

5.2.7.3 Internal leakage, q_f

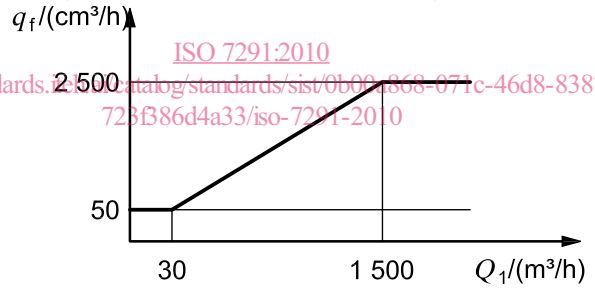
Maximum allowable internal leakage, q_f, in cubic centimetres per hour, of the pressure regulator is a function of its standard discharge, Q_1, in cubic metres per hour (see Figure 2).

For $Q_1 < 30$ m^3/h, $q_f < 50$ cm^3/h and

for $Q_1 > 1\,500$ m^3/h, $q_f < 2\,500$ cm^3/h.

Between these two pairs of values the allowable leakage rate shall satisfy Condition (2):

$$q_f \leqslant \frac{5}{3} Q_1 \qquad (2)$$



Key

q_f internal leakage

Q_1 standard discharge

Figure 2 — Allowable internal leakage rates

5.2.8 Mechanical resistance

5.2.8.1 Resistance to internal pressure

Pressure regulators shall be designed and constructed in such a way that the application of pressures given in Table 2 in the high-pressure and low-pressure chambers does not lead to permanent deformation (see 9.4.2.1).

Table 2 — Test pressures

Gas	High-pressure chambers	Low-pressure chambers
Oxygen and other compressed gases, $p_2 \leqslant 1$ MPa (10 bar)	$1{,}2 \times 1{,}5 \times p_1$	3 MPa (30 bar)
Acetylene		
MPS		
Oxygen and other compressed gases, 1 MPa (10 bar) $< p_2 \leqslant 2$ MPa (20 bar)		6 MPa (60 bar)
Oxygen and other compressed gases, $p_2 > 2$ MPa (20 bar)		$3p_2$

5.2.8.2 Pressure retention of the low-pressure side

Pressure regulators shall be designed and constructed so that if the low-pressure chamber of the pressure regulator, or intermediate chamber in the case of two-stage pressure regulators, is in direct communication with a full cylinder of gas, for example, the pressure regulator valve is held in the open position and the outlet connection is closed by an attached stop valve or a blind plug, the high-pressure gas shall either be safely retained or vented (see 9.4.2.2).

A pressure relief device may be fitted to the manifold pressure regulator to fulfil this requirement. For flammable gases, a means of safely venting shall be provided.

6 Physical characteristics

6.1 General

The symbols used are given in Table 3.

Table 3 — Symbols used

Symbol	Explanation
i	irregularity coefficient
p	pressure
p_1	nominal inlet pressure
p_2	nominal outlet pressure
p_{2R}	acetylene outlet pressure used for calculation of R (see 9.3.3.3)
p_{2i}	acetylene outlet pressure used for calculation of i (see 9.3.5.3)
p_3	upstream pressure for type testing: $p_3 = 2\,p_2 + 1$ (0,100 MPa)
p_4	stabilized outlet pressure (stabilization after flow ceases)
p_5	highest or lowest outlet pressure during a test of determination of irregularity coefficient according to 6.4.2
p_i	inlet pressure
p_o	outlet pressure
Q_1	standard (nominal) discharge
Q_{max}	maximum discharge
q_f	internal leakage
R	coefficient of pressure increase upon closure
t	time

6.2 Pressures

6.2.1 Nominal inlet pressure, p_1

Nominal inlet pressure specified by the manufacturer.

6.2.2 Nominal outlet pressure, p_2

Nominal outlet pressure for the standard discharge, Q_1, specified by the manufacturer.

NOTE This nominal pressure is defined for testing, and can be above the normal operating pressure of the pressure regulator.

For acetylene pressure regulators, the standard discharge is measured at p_{2R}.

6.2.3 Outlet pressure for acetylene pressure regulators

For acetylene pressure regulators the outlet pressures p_2, p_4, and p_5 shall not exceed 0,150 MPa (1,5 bar) in any case, but lower values may be applicable depending on the intended maximum pipeline diameter.

NOTE The nominal outlet pressure, p_2, is a function of the nominal diameter of the distribution line. It is possible that maximum values for the outlet pressures are specified in national standards and regulations.

6.3 Flow rates

6.3.1 Maximum discharge, Q_{max}

The maximum discharge which the pressure regulator can provide for an upstream pressure, p_3, in megapascals, which is given by the expression:

$$p_3 = 2\,p_2 + 1 \quad (3)$$

NOTE It is possible that Q_{max} is lower than the actual flow, which the pressure regulator can allow under different conditions.

6.3.2 Standard discharge, Q_1

The standard discharge for the pressure regulator is defined by the manufacturer for a particular gas (see Figure 3) at the rated outlet pressure p_2 (see Table 4).

The following condition shall be satisfied: $Q_1 \geqslant 0{,}5\,Q_{max}$.

For acetylene pressure regulators, the standard discharge is measured at p_{2R}.