INTERNATIONAL STANDARD

ISO 7291

Second edition
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Gas welding equipment — Pressure regulators for manifold systems used in welding, cutting and allied processes up to 300 bar

Matériel de soudage aux gaz — Détendeurs de centrales de bouteilles pour le soudage, le coupage et les techniques connexes jusqu'à 300 bar

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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 3.

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.

International Standard 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 second edition cancels and replaces the first edition (ISO 7291:1990) which has been technically revised.

Annex A of this International Standards is for information only.

Gas welding equipment — Pressure regulators for manifold systems used in welding, cutting and allied processes up to 300 bar

1 Scope

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

This International Standard is applicable to pressure regulators normally used for compressed gases up to 300 bar (30 MPa), for dissolved acetylene, methylacetylene-propadiene-mixtures (MPS) and carbondioxide (CO_2), to regulate the pressure at the outlet of high-pressure lines from manifold gas cylinders.

It is not applicable to pressure regulators fitted directly to the gas cylinders, as defined in ISO 2503 or to pressure regulators for liquefied petroleum gases.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 554:1976, *Standard atmospheres for conditioning and/or testing — Specifications*.

ISO 5171:1995, *Pressure gauges used in welding, cutting and allied processes.*

ISO 9090:1989, *Gas tightness of equipment for gas welding and allied processes.*

ISO 9539:1988, *Materials for equipment used in gas welding, cutting and allied processes*.

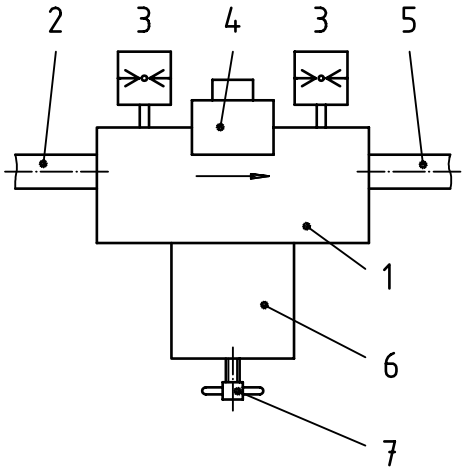
3 Terms and definitions

For the purposes of this International Standard, the following term and definition apply.

3.1
pressure regulator for manifold systems
device for regulating a generally variable inlet pressure to as constant as possible an outlet pressure, and intended to equip a manifold of cylinders

4 Terminology

Figure 1 shows a diagram of the pressure regulator as an example only. Optional design characteristics shall be compatible with the safety requirements specified in this International Standard.



Key

1 Pressure regulator housing
2 Inlet connection
3 Pressure gauges
4 Relief valve
5 Outlet connection
6 Pressure regulator bonnet
7 Pressure adjusting screw

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

5 Symbols and units

5.1 Symbols

The symbols used in this International Standard are listed in Table 1.

Table 1 — Symbols used

Symbol	Designation
i	Irregularity coefficient
p_1	Rated inlet pressure
p_2	Rated outlet pressure
p_{2i}	Acetylene outlet pressure used for calculation of i (see 9.4.5)
p_{2R}	Acetylene outlet pressure used for calculation of R (see 9.4.4)
p_3	Upstream pressure for type testing: $p_3 = 2p_2 + 1$ bar (0,1 MPa)
p_4	Stabilised outlet pressure (stabilisation 1 min after flow ceases)
p_5	Highest or lowest outlet pressure during a test of determination of irregularity coefficient in accordance with 9.4.5
Q_1	Nominal discharge
Q_{max}	Maximum discharge
Q_{RV}	Discharge of the relief valve
R	Coefficient of pressure increase upon closure
T_f	Internal leakage
U	Conversion coefficient

5.2 Units

5.2.1 Pressure

The pressures measured are gauge pressures[1)] and are expressed in bar (10^{-1} MPa).

5.2.2 Flow

Flow rates are measured in cubic metres per hour (m^3/h) at normal conditions[2)] taking into account the relevant conversion coefficient for the gas used (see Table 2).

Table 2 — Conversion coefficient, U

Test gas	Conversion coefficient for							
	air	oxygen	nitrogen	argon	hydrogen	helium	acetylene	CO_2
Air	1	0,95	1,02	0,851	3,81	2,695	1,05	0,808
Nitrogen	0,983	0,93	1	0,837	3,75	2,65	1,03	0,792

Conversion coefficient, U, based on the formula:

$$U\sqrt{\frac{\gamma_0}{\gamma_1}}$$

where

γ_0 is the specific weight of test gas;

γ_1 is the specific weight of gas used.

5.2.3 Temperature

Temperatures are measured in degrees Celsius (°C).

6 Manufacturing requirements

6.1 Materials

Materials for pressure regulators shall be in accordance with ISO 9539.

6.2 Design, machining and assembly

6.2.1 Oxygen pressure regulators

Pressure regulators for oxygen shall be designed, machined and manufactured to withstand an adiabatic compression test (see 11.5.3). All components and accessories shall be thoroughly cleaned and degreased before assembly.

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1) Pressure greater than atmospheric pressure.

2) Normal conditions are given in ISO 554.

6.2.2 Acetylene pressure regulators

Pressure regulators for acetylene shall be designed and constructed in such a way that they withstand any acetylene decomposition.

The test can be carried out in accordance with annex A. Other equivalent test can also be used.

The nominal outlet pressure, p_2, is a function of the nominal diameter of the distribution line. These values are specified in those standards and regulations used in each country.

In any event the outlet pressure shall not exceed 1,5 bar.

6.2.3 Filter

A dust 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 greater than or equal to 0,1 mm.

6.2.4 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, e.g., as a consequence of the spring being fully compressed (to its solid length).

If the dimensions of the pressure adjusting screw are such that the spring cannot be 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 relief valve vents.

6.2.5 Relief valve

6.2.5.1 General

All pressure regulators, except those for acetylene, shall be supplied with a relief valve designed to vent excess outlet pressure.

NOTE Pressure regulators for acetylene are excluded from the requirement for a relief valve to allow for alternative safety systems, e.g. safety shutt-off valves operating upstream of the pressure regulator.

6.2.5.2 Location

The relief valve shall be fitted downstream of the pressure regulator valve.

The relief valve may be fitted on the pressure regulator or be supplied as a separate unit for installation downstream of the pressure regulator outlet.

The relief valve shall be designed to allow venting of the gas into a vent pipe of a diameter greater than the relief valve seat orifice.

6.2.5.3 Operation

The relief valve shall be tight against a pressure greater than the maximum pressure attained when the flow rate is set for the initial pressure, p_2, plus an overpressure corresponding to the real coefficients i and R.

When the gas to be vented is at a pressure of $2p_2$, the flow rate, Q_{RV}, of the relief valve shall be equal to at least half the nominal discharge, Q_1, of the pressure regulator:

$$Q_{RV} \geqslant (0{,}5Q_1)$$

During its response, when the pressure falls, the relief valve shall seal when the downstream pressure is again equal to or slightly greater than value p_2.

NOTE Relief valves conforming to this International Standard may not provide adequate safety against excess pressure for all manifold systems. Designers and installers of manifold systems should consider whether additional relief valves are necessary.

6.2.6 Pressure gauges

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

Choice of threads of pressure gauges is left to the manufacturer's discretion.

The pressure gauges may be fitted directly to the pressure regulator or supplied separately for installation in the manifold pipework close to the pressure regulator.

6.2.7 Gas tightness

6.2.7.1 General

The pressure regulator shall be gas-tight to the exterior, e.g. to the atmosphere, and to the interior, i.e. between the high pressure and low-pressure parts, at all normal pressures for relevant gases the leakage shall not exceed the following limits.

6.2.7.2 External leakage

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

6.2.7.3 Internal leakage, T_f

Maximum allowable internal leakage, T_f, of the pressure regulator is a function of its nominal discharge, Q_1, (see Figure 2).

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

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

Between these two pairs of values the permissible leakage rate shall satisfy the conditions in the following formula:

$$T_f \leqslant \frac{5}{3} Q_1$$

where T_f and Q_1 are expressed in the same units as above.

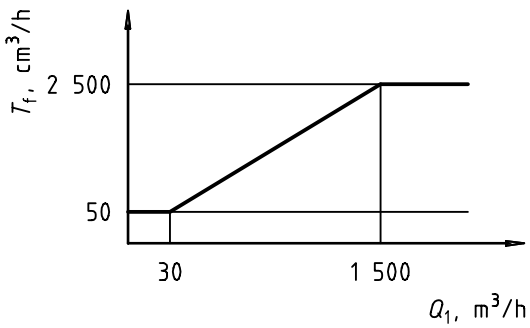


Figure 2 — Permissible internal leakage rates

6.2.8 Mechanical resistance

6.2.8.1 Fitness for service

Pressure regulators shall be designed and constructed in such a way that the application of pressures given in Table 4 in the high pressure and low pressure chambers does not lead to permanent deformation (see 9.5.1.1).

6.2.8.2 Safety

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, say, a full cylinder of gas, the pressure regulator valve is held in the open position and the outlet connection is closed, e.g., by an attached stop valve or a blind plug, the high-pressure gas shall either be safety retained or vented (see 9.5.1.2).

7 Types of connection

7.1 Inlet connections

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

7.2 Outlet connections

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

8 Physical characteristics

8.1 Pressures

8.1.1 Rated inlet pressure, p_1

The rated inlet pressure shall be that for which the pressure regulator is designed.

8.1.2 Rated outlet pressure, p_2

The rated outlet pressure shall correspond to the nominal discharge, Q_1, indicated by the manufacturer.

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

In the case of acetylene pressure regulators the nominal discharge will be measured at p_{2R}.

8.1.3 Stabilized outlet pressure, p_4, for acetylene pressure regulators

For acetylene pressure regulators the stabilized outlet pressure, p_4 shall not exceed 1,5 bar for all inlet pressures.

8.2 Flow rates

8.2.1 Maximum discharge, Q_{max}

The maximum discharge of the gas concerned is that which the pressure regulator can provide for an upstream pressure p_3 defined by the expression:

$$p_3 = 2p_2 + 1 \text{ bar}$$

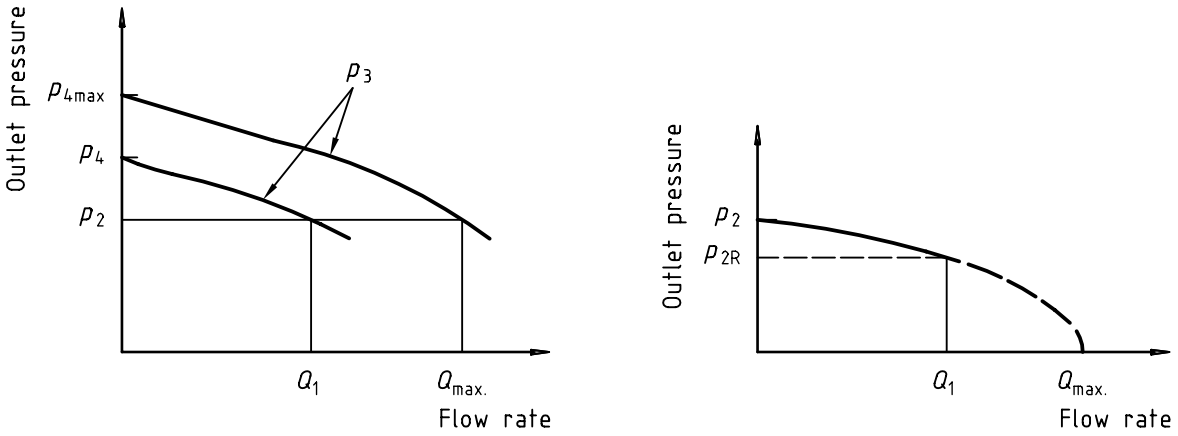
NOTE Q_{max} may be lower than the real flow, which the pressure regulator may permit under different conditions.

8.2.2 Nominal discharge, Q_1

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

Q_1 shall not be less than $0{,}5Q_{max}$.

In the case of acetylene pressure regulator the nominal discharge will be measured at p_{2R}.



a) for gases except acetylene b) for acetylene

Figure 3 — Flow rate characteristics

Table 3 — Pressures

Gas	Rated inlet pressure p_1 bar (10^{-1} MPa)	Rated oulet pressure p_2 bar (10^{-1} MPa)
Oxygene and other compressed gases up to 300 bar (30 MPa)	0 to 300[a]	2 4[b] 6 10 12,5 20
Dissolved acetylene	25	0,8 $\leqslant$ 1,5
MPS	25[c]	1,5 4
CO_2	200[d]	2 4 10

NOTE In the special case of acetylene, p_2, p_4 and p_5 shall be equal or less than 1,5 bar.

[a] Pressure relating to max. cylinder charging pressure at 15 °C.

[b] If other values for the application of pressure are required, they should be selected preferably from the R20 series containing the values given.

[c] Vapour pressure for MPS at 65 °C. This value shall change depending on components of the gas mixture.

[d] Pressure for CO_2 at 53 °C.