# International Standard ISO 2503

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# Pressure regulators for gas cylinders used in welding, cutting and allied processes

*Détendeurs pour bouteilles à gaz utilisés pour le soudage, le coupage et les techniques connexes*

**Second edition — 1983-12-01**



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**Descriptors** : welding, gas cutting, gas cylinders, pressure regulators, characteristics, tests, marking.



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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 developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been authorized 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 2503 was developed by Technical Committee ISO/TC 44, *Welding and allied processes*, and was circulated to the member bodies in January 1982.

It has been approved by the member bodies of the following countries :

| | | |
|---|---|---|
| Austria | Finland | Korea, Rep. of |
| Belgium | France | Romania |
| Brazil | Germany, F.R. | Spain |
| Canada | India | Sweden |
| China | Italy | Switzerland |
| Czechoslovakia | Japan | USA |
| Egypt, Arab Rep. of | Korea, Dem. P. Rep. of | USSR |

The member bodies of the following countries expressed disapproval of the document on technical grounds :

Australia
Norway
United Kingdom

This second edition cancels and replaces the first edition (i.e. ISO 2503-1972).





Printed in Switzerland

# Pressure regulators for gas cylinders used in welding, cutting and allied processes



## 1 Scope and field of application

This International Standard specifies requirements for single or two-stage pressure regulators normally used for compressed gases at pressures up to 200 bar[1] (20 MPa) and for dissolved acetylene (with the exception of pipeline pressure regulators).

## 2 References

ISO 48, *Vulcanized rubbers — Determination of hardness (Hardness between 30 and 85 IRHD).*

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

ISO 2503/Add 1, *Pressure regulators for gas cylinders used in welding, cutting and allied processes.*[2]

ISO 3253, *Hose connections for equipment for welding, cutting and related processes.*

ISO 3821, *Welding — Flexible hoses for gas welding and allied processes.*

ISO 5171, *Pressure gauges used in welding, cutting and related processes.*

ISO/TR 7470, *Valve outlets for gas cylinders — List of standard provisions for those in use.*

## 3 Definition

**pressure regulator** : Device for regulating a generally variable inlet pressure to as constant as possible an outlet pressure.

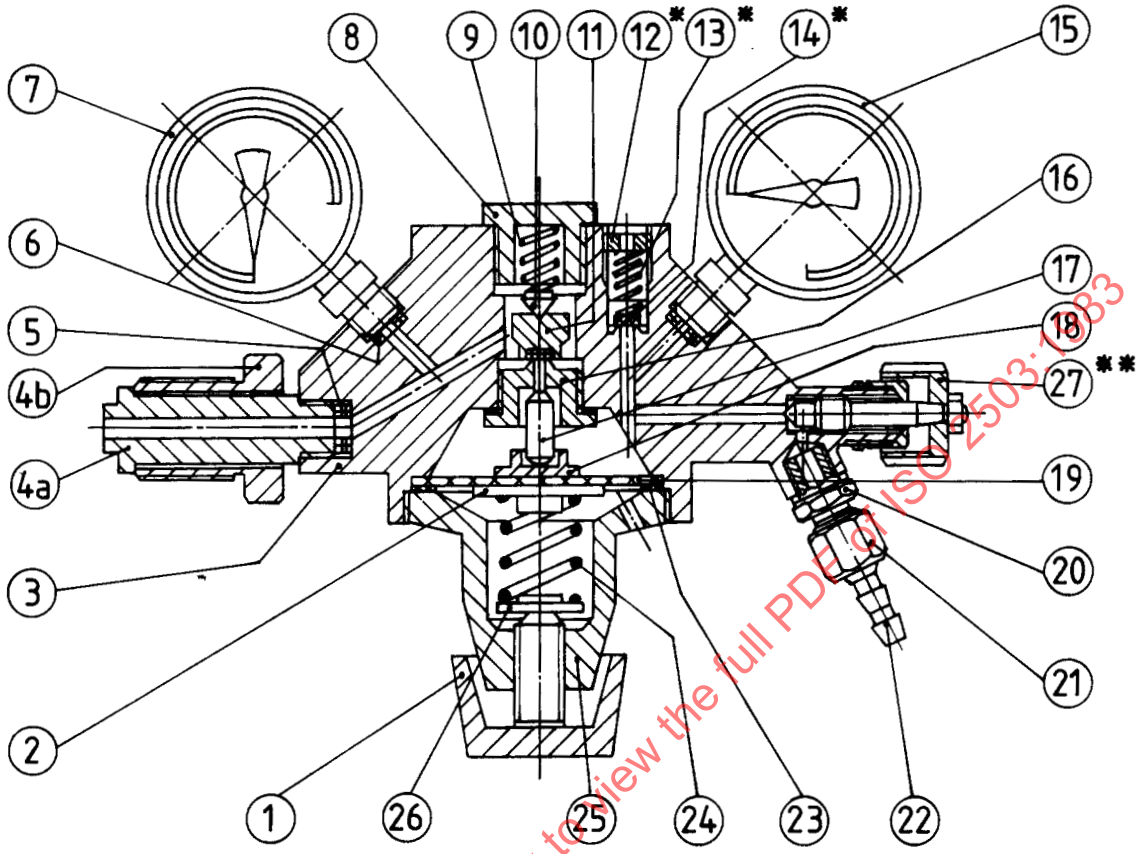
## 4 Terminology

Terminology for pressure regulators is given in the explanation of figure 1. The diagram of the pressure regulator is an example only.

NOTE — In addition to the terms given in the three official ISO languages (English, French and Russian), this International Standard gives the equivalent terms in German; these have been included at the request of ISO Technical Committee ISO/TC 44, and are published under the responsibility of the member body for Germany, F.R. (DIN). However, only the terms in the official languages can be considered as ISO terms.

1) 1 bar = $10^5$ Pa = 0,1 MPa

2) At present at the stage of draft.




* Relief valve.
Soupape de décharge.
Выпускной клапан.
Abblaseventil.

** Outlet valve optional, see 6.2.3.
Robinet de sortie optionnel, voir 6.2.3.
Запорный клапан, необязательный, см. 6.2.3.
Absperrventil freigestellt, siehe 6.2.3.

NOTE — Parts 4a and 4b of the drawing are examples and are not specified; other types of inlet connection pieces are also in use.

NOTE — Les dessins des pièces 4a et 4b, donnés à titre d'exemple, ne sont pas spécifiés; d'autres types de raccords d'entrée sont également utilisés.

ПРИМЕЧАНИЕ — Детали 4а и 4б даны в качестве примеров и не устанавливаются; другие типы впускных патрубков также применяются.

BEMERKUNG — Die Teile 4a und 4b der Skizze sind Beispiele und werden nicht vorgeschrieben; andere Typen von Eingangsstutzen sind auch gebräuchlich.

**Figure 1 — Diagram of a pressure regulator and quadrilingual designations of its components**
**Figure 1 — Schéma d'un détendeur et désignation quadrilingue de ses éléments**
**Фигура 1 — Схема регулятора и обозначение его элементов на четырех языках**
**Bild 1 — Schema eines Druckreglers und viersprachige Bezeichnung seiner Bauteile**

| No. | English |
|---|---|
| 1 | Pressure adjusting screw |
| 2 | Spring plate |
| 3 | Body |
| 4a | Inlet stem |
| 4b | Inlet nut |
| 5 | Inlet filter |
| 6 | Seating washer |
| 7 | High-pressure gauge |
| 8 | Pressure regulator valve cap |
| 9 | Pressure regulator valve spring |
| 10 | Spring rider |
| 11 | Pressure regulator valve |
| 12 | Relief valve adjusting screw |
| 13 | Relief valve spring |
| 14 | Relief valve seat |
| 15 | Low-pressure gauge |
| 16 | Pressure regulator valve seat |
| 17 | Pressure regulator valve pin |
| 18 | Diaphragm plate |
| 19 | Diaphragm |
| 20 | Outlet connection piece |
| 21 | Union nut |
| 22 | Hose sleeve |
| 23 | Diaphragm seal |
| 24 | Pressure regulator spring |
| 25 | Pressure regulator cover |
| 26 | Spring plate |
| 27 | Outlet valve |

| No. | French |
|---|---|
| 1 | Vis de réglage |
| 2 | Plateau de membrane |
| 3 | Corps |
| 4a | Raccord d'entrée |
| 4b | Douille filetée dite «écrou flottant» |
| 5 | Filtre d'entrée |
| 6 | Joint de manomètre |
| 7 | Manomètre haute pression (amont) |
| 8 | Bouchon de clapet |
| 9 | Ressort de clapet |
| 10 | Appui mobile de centrage du ressort de clapet |
| 11 | Clapet |
| 12 | Vis de réglage de la soupape de décharge |
| 13 | Ressort de soupape de décharge |
| 14 | Clapet de soupape de décharge |
| 15 | Manomètre basse pression (aval) |
| 16 | Siège |
| 17 | Poussoir |
| 18 | Plateau d'appui du poussoir |
| 19 | Membrane |
| 20 | Raccord de sortie (mamelon fileté) |
| 21 | Écrou de raccord |
| 22 | Douille porte tuyau |
| 23 | Joint de membrane |
| 24 | Ressort de détente |
| 25 | Couvercle |
| 26 | Appui mobile de centrage du ressort de détente |
| 27 | Robinet de sortie |

| No. | Russian |
|---|---|
| 1 | Регулировочный винт |
| 2 | Упругий диск |
| 3 | Корпус |
| 4a | Впускной патрубок |
| 4b | Болтовое соединение |
| 5 | Впускной фильтр |
| 6 | Уплотнительное кольцо манометра |
| 7 | Манометр высокого давления |
| 8 | Колпачок регулировочного клапана |
| 9 | Пружина регулировочного клапана |
| 10 | Центрирующий ниппель |
| 11 | Регулировочный клапан |
| 12 | Регулировочный винт выпускного клапана |
| 13 | Пружина выпускного клапана |
| 14 | Седло выпускного клапана |
| 15 | Манометр низкого давления |
| 16 | Седло регулировочного клапана |
| 17 | Штифт регулировочного клапана |
| 18 | Мембранный диск |
| 19 | Мембрана |
| 20 | Выпускной патрубок |
| 21 | Накидная гайка |
| 22 | Насадка рукава |
| 23 | Уплотнение мембраны |
| 24 | Спусковая пружина |
| 25 | Крышка |
| 26 | Диск спусковой пружины |
| 27 | Запорный клапан |

| No. | German |
|---|---|
| 1 | Einstellschraube |
| 2 | Federteller |
| 3 | Körper |
| 4a | Eingangsstutzen |
| 4b | Schraubverbindung |
| 5 | Eintrittsfilter |
| 6 | Manometeranschluß-Dichtungsring |
| 7 | Hochdruckmanometer |
| 8 | Regelventilkappe |
| 9 | Regelventilfeder |
| 10 | Zentriernippel |
| 11 | Regelventil |
| 12 | Einstellschraube des Abblaseventils |
| 13 | Feder für Abblaseventil |
| 14 | Abblaseventilsitz |
| 15 | Niederdruckmanometer |
| 16 | Regelventilsitz |
| 17 | Regelventilstift |
| 18 | Membranteller |
| 19 | Membrane |
| 20 | Abgangsstutzen |
| 21 | Überwurfmutter |
| 22 | Schlauchtülle |
| 23 | Membrandichtung |
| 24 | Stellfeder |
| 25 | Federdeckel |
| 26 | Stellfederteller |
| 27 | Absperrventil |

## 5 Units

### 5.1 Pressures

The pressures measured are gauge pressures[1]. They are expressed preferably in bar (or in pascals or multiples thereof).

### 5.2 Flows

Flows are measured in cubic metres per hour ($m^3/h$).

### 5.3 Temperatures

Temperatures are measured in degrees Celsius.

## 6 Manufacturing requirements

### 6.1 Materials

Materials liable to come in contact with the gases shall have adequate resistance to the chemical, mechanical and thermal action of these gases under operating conditions.

#### 6.1.1 Metallic materials

**6.1.1.1** Application of acetylene and gases having similar chemical properties

The copper content of materials liable to come in contact with such gases shall not exceed 70 % ($m/m$)[2], for the copper content for high pressure gauges for acetylene, see ISO 5171.

Where silver/copper solders or brazing alloys are used in construction, then the filler metal joint shall not exceed 0,3 mm thickness and the silver content shall not exceed 43 % ($m/m$) and the copper content shall not exceed 21 % ($m/m$).

Excessive silver/copper solder shall be avoided. Capillary joints shall be used.

**6.1.1.2** Oxygen application

All components in contact with oxygen shall be free of oil and grease. Springs and other (moving) parts liable to come in contact with oxygen shall be made from rust-proof materials.

#### 6.1.2 Non-metallic materials (Synthetic materials)

**6.1.2.1** Resistance to solvents

Non-metallic (synthetic) materials (seals, lubricants) liable to come in contact with acetylene shall have adequate resistance to the solvents acetone and dimethylformamide (DMF).

Adequate resistance means that the materials shall fulfil the conditions as follows : After storage for 168 h (7 d) in an atmosphere saturated with vapour of solvent at 23 °C and following redrying (70 h at 40 °C, 24 h at 23 °C), the change in weight (resistance to swelling) shall not exceed 15 % and the change in hardness shall not exceed ± 15 IRHD-units[3].

**6.1.2.2** Lubricants for oxygen

Only lubricants suitable for use in oxygen for the given pressure and temperature shall be used.

### 6.2 Design, machining and assembly

#### 6.2.1 Oxygen pressure regulators

Pressure regulators for oxygen shall be so designed, machined and assembled as to minimize the risk of internal burning. All components and accessories shall be thoroughly cleaned and degreased before assembly.

#### 6.2.2 Filter

A dust filter having an effective cross-section compatible with the discharge shall be mounted within the pressure regulator upstream of the pressure regulating valve.

#### 6.2.3 Outlet valve

Pressure regulators can be fitted with an outlet valve. When fitted, the valve spindle shall be captive.

#### 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, for example, as a consequence of the spring going solid.

If the dimensions of the pressure adjusting screw are related to the safe operation of the pressure regulator, then the pressure adjusting screw shall not be removable.

#### 6.2.5 Relief valve

The object of the valve is to ensure that the pressure regulator elements are protected against a minor failure of the pressure regulator mechanism. If fitted, the relief valve shall remain gas tight to a pressure above the maximum pressure achieved when the flow is set for the initial pressure $p_2$ and the actual coefficients $i$ and $R$ (see 8.4.1). It shall be fitted in such a way that the gas discharges safely.

The minimum discharge $Q_{RV}$ of the relief valve, if fitted, shall be equal to or greater than standard discharge $Q_1$ (see table 2) for a pressure $p_{RV}$ defined by the expression : $p_{RV} = 2p_2$. The discharge $Q_{RV}$ is obtained for an outlet pressure $p_A$ (atmospheric pressure).

1) Pressure exceeding the atmospheric pressure.

2) % ($m/m$) denotes percentage by mass.

3) See ISO 48.

NOTE — There are devices which release the gas at a higher pressure than $p_{RV}$; these are not considered as relief valves in the sense of this International Standard but they shall meet the requirements of gas tightness and safe discharge as specified above.

#### 6.2.6 Pressure gauges

When fitted externally, pressure gauges shall conform to ISO 5171. If pressure gauges are integral with the regulator, the relevant operational and safety requirements stipulated in ISO 5171 shall apply.

#### 6.2.7 Gas tightness

Pressure regulators shall be gas tight to the exterior, i.e., to the atmosphere and to the interior, i.e. between the high-pressure and low-pressure parts for all normal pressures for relevant gases.

#### 6.2.8 Mechanical resistance

Two aspects are envisaged :

##### 6.2.8.1 Fitness for service

Pressure regulators shall be designed and constructed in such a way that the application of pressure in the high-pressure and low-pressure chambers does not lead to permanent deformation.

##### 6.2.8.2 Safety

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

## 7 Characteristics of connections

### 7.1 Inlet connections

Pressure regulators shall be made in such a way that the inlet connection is compatible with the cylinder valve outlet designed for the gas contained[1].

### 7.2 Outlet connections

Outlet connections shall conform to ISO 3253 and comply with the following conditions :

— hose sleeve orientation : shall preferably point downwards and away from the cylinder;

— curved hose sleeves shall not be used.

## 8 Physical characteristics

**Table 1 — Notations used**

| Symbol | Designation |
|---|---|
| $p_1$ | rated (maximum) inlet pressure |
| $p_2$ | rated (maximum) outlet pressure |
| $p_3$ | upstream (critical) pressure [($p_3 = 2p_2 + 1$ bar (0,1 MPa)] for type testing |
| $p_4$ | stabilized outlet pressure (stabilization after flow ceases) |
| $p_5$ | the highest or lowest outlet pressure during a test |
| $Q_1$ | standard discharge |
| $Q_{max}$ | maximum discharge |
| $R$ | coefficient of pressure increase upon closure $R = \frac{p_4 - p_2}{p_2}$ |
| $i$ | irregularity coefficient $i = \frac{p_5 - p_2}{p_2}$ |

### 8.1 Pressures

#### 8.1.1 Rated (maximum) inlet pressure, $p_1$

Rated (maximum) upstream pressure for which the pressure regulator is designed.

#### 8.1.2 Rated (maximum) outlet pressure, $p_2$

Rated (maximum) downstream pressure for the standard discharge specified in the table of equipment classes given below.

NOTE — This maximum pressure is defined for tests, and is above the normal operating pressure of the pressure regulator.

### 8.2 Flows

#### 8.2.1 Maximum discharge $Q_{max}$

The maximum discharge of the gas concerned, expressed in cubic metres per hour[2], which the pressure regulator can provide for an upstream pressure $p_3$ defined by the expression :

$$p_3 = 2p_2 + 1 \text{ bar (0,1 MPa)}$$

This discharge is obtained for an outlet pressure $p_2$.

1) Conforming to ISO/TR 7470.

2) Reference conditions are : 23 °C and 1,013 bar (0,101 3 MPa) according to ISO 554.

#### 8.2.2 Standard discharge $Q_1$

The standard discharge is given in table 2.

### 8.3 Equipment classes

Performance is measured at a standard discharge $Q_1$, shown in table 2 of equipment classes.

### 8.4 Operating characteristics

#### 8.4.1 Coefficient of pressure increase upon closure, $R$

This coefficient is defined by

$$R = \frac{p_4 - p_2}{p_2}$$

where $p_4$ is the stabilized outlet pressure (stabilization pressure) noted 1 min after discharge ceases, with the pressure regulator set to the standard initial conditions $p_2$, $p_3$, $Q_1$.

For standard discharge, the coefficient of pressure increase upon closure, $R$, shall be less than 0,3.

#### 8.4.2 Irregularity coefficient, $i$

This coefficient is defined by

$$i = \frac{p_5 - p_2}{p_2}$$

where $p_5$ is the highest or lowest value of the outlet pressure (see figure 2) during a test in which the inlet pressure varies from $p_1$ to $p_3$ for a flow equal to the standard discharge $Q_1$ in accordance with table 2.

The limits shall be

$$-0{,}3 < i < +0{,}3$$

#### 8.4.3 Behaviour at operating temperatures

Under ordinary operating conditions, the pressure regulators shall be capable of operating normally at the temperatures to which they may be subjected.

## 9 Marking

The following information shall be clearly and permanently marked on the pressure regulator body or cover or on a plate permanently fixed to the pressure regulator :

— maker's name or symbol;

— pressure regulator class in accordance with 8.3;

— gas intended for use;

— rated inlet pressure (only for oxygen and other compressed gases).

The gas intended for use shall be identified, where necessary by abbreviations. When abbreviations for gases are used, they shall be :

— Acetylene A

— Oxygen O

— Hydrogen H

— Compressed air D

In addition, national marking specifications shall be respected.



**Table 2 — Equipment classes**

| Gas | Class | Rated (maximum) inlet pressure $p_1$ | Rated (maximum) outlet pressure $p_2$ | Standard discharge* $Q_1$ |
|---|---|---|---|---|
| | | bar (MPa) | bar (MPa) | $m^3/h$ |
| **Oxygen and other compressed gases at 150 or 200 bar (15 or 20 MPa)** | I | 150 or 200 (15 or 20) | 3,5 (0,35) | 5 |
| | II | 150 or 200 (15 or 20) | 8 (0,8) | 25 |
| | III | 150 or 200 (15 or 20) | 10,0 (1) | 30 |
| | IV | 150 or 200 (15 or 20) | 12,5 (1,25) | 40 |
| | V | 150 or 200 (15 or 20) | 20,0 (2) | 50 |
| **Dissolved acetylene** | O | 15 to 20 (1,5 to 2) | 0,625 (0,062 5) | 1 |
| | I | 15 to 20 (1,5 to 2) | 0,8 (0,08) | 1 |
| | II | 15 to 20 (1,5 to 2) | 1,5 (0,15) | 5 |

* A pressure regulator is considered to belong to one of the classes specified above if its maximum discharge $Q_{max}$ is not less than the standard discharge $Q_1$ of the class concerned.