



International  
Standard

**ISO 22073-1**

## Gas welding equipment —

Part 1:

### **Line pressure regulators and line pressure regulators with flow-metering devices for gas distribution pipelines up to 6 MPa (60 bar)**

*Matériel de soudage au gaz —*

*Partie 1: Détendeurs de canalisation et détendeurs de  
canalisation à débitmètre intégré pour les canalisations de  
distribution du gaz jusqu'à 6 MPa (60 bar)*

**First edition  
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CP 401 • Ch. de Blandonnet 8  
CH-1214 Vernier, Geneva  
Phone: +41 22 749 01 11  
Email: [copyright@iso.org](mailto:copyright@iso.org)  
Website: [www.iso.org](http://www.iso.org)

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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.

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 document 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](http://www.iso.org/directives)).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at [www.iso.org/patents](http://www.iso.org/patents). ISO shall not be held responsible for identifying any or all such patent rights.

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

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*.

A list of all parts in the ISO 22073 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html). Official interpretations of ISO/TC 44 documents, where they exist, are available from this page: <https://committee.iso.org/sites/tc44/home/interpretation.html>.

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# Gas welding equipment —

## Part 1:

# Line pressure regulators and line pressure regulators with flow-metering devices for gas distribution pipelines up to 6 MPa (60 bar)

## 1 Scope

This document specifies requirements for line pressure regulators and line pressure regulators with flow-metering devices to be connected to industrial gas distribution pipelines of:

- compressed gases and carbon dioxide up to 6 MPa (60 bar);
- acetylene up to 150 kPa (1,5 bar);
- liquefied petroleum gases (LPG);
- methylacetylene-propadiene mixtures (MPS);

for use in welding, cutting and allied processes.

This document does not apply to pressure regulators intended for direct use on cylinders or bundles, such regulators are addressed in ISO 2503 or ISO 7291, respectively.

**NOTE** Where there is no risk of ambiguity, both line pressure regulators and line pressure regulators with flow-metering devices are addressed with the collective term 'pressure regulators'.

## 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 2503, Gas welding equipment — Pressure regulators and pressure regulators with flow-metering devices for gas cylinders used in welding, cutting and allied processes up to 300 bar (30 MPa)

ISO 5171, Gas welding equipment — Pressure gauges used in welding, cutting and allied processes

ISO 7291, Gas welding equipment — Pressure regulators for manifold systems used in welding, cutting and allied processes up to 30 MPa (300 bar)

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 10225, Gas welding equipment — Marking for equipment used for gas welding, cutting and allied processes

ISO 11114-6, Gas cylinders — Compatibility of cylinder and valve materials with gas contents — Part 6: Oxygen pressure surge testing

ISO 15296, Gas welding equipment — Vocabulary

### 3 Terms and definitions

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

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

#### 3.1

##### **accuracy of a flow-metering device**

classification based on the *permissible error of the flow indication* (3.5) of the device

#### 3.2

##### **line pressure regulator**

device for regulating a generally stable inlet pressure of a pipeline gas distribution system to an outlet pressure that is as constant as possible

##### 3.2.1

##### **adjustable line pressure regulator**

line pressure regulator that is provided with a means of operator adjustment of the outlet pressure

##### 3.2.2

##### **preset line pressure regulator**

line pressure regulator that is not provided with a means of operator adjustment of the outlet pressure

#### 3.3

##### **flow-metering device**

device that measures and indicates the flow of a specific gas or gas mixture

#### 3.4

##### **indicated flow(s)**

flow(s) indicated on the measuring device of a *line pressure regulator with flow-metering devices* (3.7)

#### 3.5

##### **permissible error of the flow indication**

difference between the *indicated flow* (3.4) and the true flow, as a percentage of the *indicated flow* (3.4)

#### 3.6

##### **pressure gauge**

device that measures and indicates pressure

#### 3.7

##### **line pressure regulator with flow-metering devices**

device for regulating a generally stable inlet pressure of a pipeline gas distribution system to an outlet pressure that is as constant as possible, ensuring in addition a selected gas flow

Note 1 to entry: The device is generally a pressure regulator equipped with flow-adjusting and measuring devices which are not intended to be separated from the regulating device by the operator.

#### 3.8

##### **true flow**

flow measured with a calibrated measuring device

### 4 Symbols and abbreviated terms

The symbols used in this document are given in [Table 1](#).

Table 1 — Symbols and definitions

| Symbol | Definition                                                                                             |
|--------|--------------------------------------------------------------------------------------------------------|
| $p_1$  | Maximum inlet pressure specified by the manufacturer                                                   |
| $p_2$  | Nominal outlet pressure at the nominal discharge $Q_n$ specified by the manufacturer                   |
| $p_4$  | Closing outlet pressure measured 1 min after stopping the nominal discharge $Q_n$ , at $p_2$ and $p_1$ |
| $q_f$  | Maximum allowable internal leakage                                                                     |
| $Q_n$  | Nominal discharge at $p_2$ and $p_1$ , specified by the manufacturer                                   |
| $R$    | Coefficient of pressure increase upon closure defined by the Formula:<br>$R = \frac{p_4 - p_2}{p_2}$   |

## 5 Design requirements

### 5.1 Materials

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

### 5.2 Design and construction

#### 5.2.1 Oxygen pressure regulators

All components and accessories used on pressure regulators for oxygen shall be thoroughly cleaned and degreased before assembly.

The materials which come in contact with oxygen in normal condition shall be resistant to corrosion and compatible with oxygen.

If lubricants are used, they shall be compatible with oxygen. They shall be resistant to ignition up to the pressure they are intended to be exposed to under operating condition.

Pressure regulators for oxygen with a maximum inlet pressure equal or greater than 3 MPa (30 bar) shall not ignite or show evidence of burning when submitted to the ignition test in [9.7.4](#).

#### 5.2.2 Acetylene pressure regulators

If any of the connections' internal diameter is greater than 25 mm, an acetylene pressure regulator shall withstand a decomposition test according to [9.7.5](#).

#### 5.2.3 Connections

##### 5.2.3.1 Inlet connection

The inlet connection shall be different from the ones used for cylinder regulators.

##### 5.2.3.2 Outlet connection

In the absence of applicable national or regional regulations, it is recommended that the connection conform with ISO/TR 28821.

#### 5.2.4 Filter

A particle filter shall be fitted upstream of the pressure-regulator valve either inside or outside the pressure regulator.

The filter shall retain particles greater or equal to 150 µm.

### 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 prevention of the spring becoming fully compressed depends on the dimensions of the pressure-adjusting screw, then the screw shall be not removable.

### 5.2.6 Flow-control valve

A pressure regulator with flow-metering devices may be fitted with a flow-control valve. The flow-control knob and the valve spindle shall be captive such that they cannot be dismantled without the use of a tool.

### 5.2.7 Pressure gauges

If pressure gauges with a Bourdon-tube are used, they shall conform to ISO 5171.

### 5.2.8 Pressure relief valve

If a pressure relief valve is fitted, it shall conform to ISO 2503.

NOTE A pressure relief valve is intended to protect the line pressure regulator itself and not the downstream pipeline.

### 5.2.9 Leakage

#### 5.2.9.1 External leakage

Pressure regulators and pressure regulators with flow-metering devices shall be externally gas tight at  $p_1$  and  $p_2$ . Regulators shall not have a leakage rate greater than  $170 \text{ Pa} \cdot \text{l/min}$  ( $10 \text{ cm}^3/\text{h}$ ).

This requirement is given in ISO 9090, together with suitable test methods.

#### 5.2.9.2 Internal leakage

The test for internal leakage shall be performed according to [9.7.3.2](#). The maximum leakage rate allowed  $q_f$  is  $200 \text{ Pa} \cdot \text{l/min}$  ( $12 \text{ cm}^3/\text{h}$ ) for test [9.7.3.2](#) a)  $Q_n$  up to  $50 \text{ m}^3/\text{h}$ . For higher  $Q_n$  expressed in  $\text{m}^3/\text{h}$ , the maximum permissible internal leakage expressed in  $\text{cm}^3/\text{h}$  is specified by Formula (1).

$$q_f = 0,24 \times Q_n \quad (1)$$

### 5.2.10 Mechanical resistance

#### 5.2.10.1 Resistance to internal pressure

Pressure regulators and pressure regulators with flow-metering devices shall be designed and constructed in such a way that the application of a pressure equal to  $2,25 \times p_1$  or  $6 \text{ MPa}$  ( $60 \text{ bar}$ ) whichever is greater for  $5 \text{ min}$  in the high-pressure and low-pressure side chambers does not lead to permanent deformation.

Pressure regulators and pressure regulators with flow-metering devices shall comply with the test in [9.7.2.1](#).

#### 5.2.10.2 Pressure retention of the low-pressure side of the pressure regulator

Pressure regulators shall be designed and constructed so that, if the low-pressure chamber of the pressure regulator is in direct communication with the pipeline upstream pressure, for example, if the regulator pressure 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 to a safe location.

Pressure regulators and pressure regulators with flow-metering devices shall comply with the test in [9.7.2.2](#).

## 6 Operating characteristics

### 6.1 Operating-temperature range

The pressure regulators shall be capable of operating normally in the temperature range  $-20\text{ }^{\circ}\text{C}$  to  $+60\text{ }^{\circ}\text{C}$ .

### 6.2 Coefficient of pressure increase upon closure $R$ (applicable for line pressure regulators without flow-metering devices)

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

### 6.3 Accuracy classification (applicable for line pressure regulators with flow-metering devices)

The error in the flow indication shall remain within the limits defined by the classification indicated in [Table 2](#) or  $\pm 1\text{ l/min}$ , whichever is greater.

**Table 2 — Accuracy classification**

| Accuracy class                       | 10         | 20         |
|--------------------------------------|------------|------------|
| Maximum error of the flow indication | $\pm 10\%$ | $\pm 20\%$ |

For any indicated flow between 30 % of  $Q_n$  and  $Q_n$  or for the flows indicated on any fixed orifice of a flow measuring system, the error in flow indication shall not exceed that of the respective accuracy class in [Table 2](#).

**EXAMPLE 1** For a pressure regulator with flow-metering devices of class 10 and  $Q_n = 40\text{ l/min}$ , the allowed true flow at  $Q_n$  is  $(40 \pm 4)\text{ l/min}$ :

- at  $Q = 12\text{ l/min}$  (30 % of  $Q_n$ ), the allowed true flow is  $(12 \pm 1,2)\text{ l/min}$ ;
- at  $Q = 26\text{ l/min}$  (65 % of  $Q_n$ ), the allowed true flow is  $(26 \pm 2,6)\text{ l/min}$ .

**EXAMPLE 2** For a pressure regulator with flow-metering devices with fixed orifices of class 10 and flows of 10 l/min, 20 l/min, 30 l/min and 40 l/min, the allowed true flows are respectively  $(10,00 \pm 1)\text{ l/min}$ ,  $(20,00 \pm 2)\text{ l/min}$ ,  $(30,00 \pm 3)\text{ l/min}$  and  $(40,00 \pm 4)\text{ l/min}$ .

## 7 Marking

### 7.1 Line pressure regulators without flow-metering devices

The following information shall be clearly and permanently marked in accordance with [9.8](#) on the pressure regulator body or cover or on a label permanently fixed to the pressure regulator:

- the number of this document; i.e. ISO 22073-1:2024;
- the name or trademark of the manufacturer and/or distributor;
- the designation of the line pressure regulator model;
- $p_1$ ,  $p_2$  and  $Q_n$  of the pressure-regulator;
- the gas intended for use: when the full name of the gas cannot be imprinted, a letter code according to ISO 10225 shall be used;
- Inlet and outlet connections or the intended direction of the gas flow shall be clearly and permanently identified according to [5.2.3](#). The function of any other connection should also be identified in the same way.

## 7.2 Line pressure regulators with flow-metering devices

The following information shall be clearly and permanently marked in accordance with 9.8 on the pressure regulator body or cover or on a label permanently fixed to the pressure regulator:

- the number of this document; i.e. ISO 22073-1:2024;
- the name or trademark of the manufacturer and/or distributor;
- the designation of the line pressure regulator model;
- the accuracy class according to 6.3;
- the maximum inlet pressure,  $p_1$ , and  $Q_n$  of the pressure-regulator;
- the gas intended for use: when the full name of the gas cannot be imprinted, a letter code according to ISO 10225 shall be used;
- Inlet and outlet connections or the intended direction of the gas flow shall be clearly and permanently identified according to 5.2.3. The function of any other connection should also be identified in the same way.

## 8 Instructions for use

The manufacturer, supplier or distributor shall supply instructions for use with each pressure regulator, and with each pressure regulator with flow-metering devices, covering at least:

- a) the field of application of the pressure regulator; or
- b) the field of application of the pressure regulator with flow-metering devices; in particular the range of specific gravity of the gases or gas mixtures for which it can be used;
- c) a description of the pressure regulator, or of the pressure regulator with flow-metering devices and the meaning of the marking;
- d) the safe and correct installation of the pressure regulator, or of the pressure regulator with flow-metering devices;
- e) the commissioning tests that are necessary to prove safe and correct installation prior to service. To protect the pipeline system downstream of a line pressure regulator, a safety valve according to ISO 4126-1 should be considered by the installer;
- f) the use and maintenance of the pressure regulator, or of the pressure regulator with flow-metering devices (intended for the operator);
- g) hazards and safety precautions for the intended gas e.g. in the case of oxygen.

## 9 Type-test procedure

### 9.1 General

Checking conformity to this document of a pressure regulator, or a pressure regulator with flow-metering devices of a given type, consists of:

- tests, and
- checking of documents.

NOTE These are type tests applicable to pressure regulators only for verifying conformity with this document and are not intended as a program for production testing of all pressure regulators.

## 9.2 Test samples and necessary documents

The number of samples is given in [Table 3](#). For the tests, the following documents shall be available:

- two sets of drawings with material lists;
- two sets of detail drawings;
- if necessary, a declaration from the manufacturer giving the material specifications.

The tests shall be carried out with pressure regulators, and with pressure regulators with flow-metering devices, which are in accordance with the drawings.

**Table 3 — Number of samples**

| Test sequence | Test and relevant subclause for test procedure                                                                     | Condition of test sample | Numbering of test samples | For pressure regulators without flow-metering devices | For pressure regulators with flow-metering devices |
|---------------|--------------------------------------------------------------------------------------------------------------------|--------------------------|---------------------------|-------------------------------------------------------|----------------------------------------------------|
| 0             | Design requirements ( <a href="#">5</a> )                                                                          | As received              | —                         | x                                                     | x                                                  |
| 1             | Resistance to internal pressure ( <a href="#">9.7.2.1</a> )                                                        | As received              | 1                         | x                                                     | x                                                  |
| 2             | Pressure retention test of the low-pressure side ( <a href="#">9.7.2.2</a> )                                       | As received              | 2                         | x                                                     | x                                                  |
| 3             | Leakage tests ( <a href="#">9.7.3</a> )                                                                            | As received              | 3 to 5                    | x                                                     | x                                                  |
| 4             | Nominal discharge $Q_n$ ( <a href="#">9.5.2</a> )                                                                  | From test 3              | 3 to 5                    | x                                                     | —                                                  |
| 5             | Coefficient of pressure increase upon closure, $R$ ( <a href="#">9.5.3</a> )                                       | From test 4              | 3 to 5                    | x                                                     | —                                                  |
| 6             | Test for accuracy classification of pressure regulators with flow-metering devices ( <a href="#">9.6</a> )         | From test 5              | 3 to 5                    | —                                                     | x                                                  |
| 7             | Oxygen pressure surge test ( <a href="#">9.7.4</a> ) (Only for oxygen regulators)                                  | As received              | 6 to 8                    | x                                                     | x                                                  |
| 8             | Acetylene decomposition test ( <a href="#">9.7.5</a> ) (only for acetylene regulators with inner diameter > 25 mm) | As received              | 9 to 14                   | x                                                     | —                                                  |
| 9             | Test for durability of markings ( <a href="#">9.8</a> )                                                            | From test 6              | 3                         | x                                                     | x                                                  |
| 10            | Instructions for use ( <a href="#">8</a> )                                                                         | —                        | —                         | x                                                     | x                                                  |

## 9.3 Test conditions

### 9.3.1 General characteristics of the test installation

All the pipelines of the test installation, together with the valve controlling the flow, shall have a flow capacity greater than that of the pressure regulator or pressure regulator with flow metering devices to be tested.

### 9.3.2 Test gas

Tests shall be carried out with air or nitrogen, free from oil and grease, except for test in [9.7.4](#) and [9.7.5](#).

In all cases, tests shall be carried out with a gas with a maximum moisture content of 50 µg/g corresponding to a dew-point of -40 °C.

### 9.3.3 Accuracy of a flow-metering device

The accuracy of the flow-metering instruments shall be within  $\pm 3$  % of the measured value.

### 9.3.4 Pressure measurement

The accuracy of the pressure-measuring instruments shall be within  $\pm 1$  % of the measured value.

## 9.4 Units

### 9.4.1 Pressure

The pressures measured are gauge pressures and are expressed in MPa (bar).

### 9.4.2 Flow

Flow rates are measured in cubic metres per hour ( $\text{m}^3/\text{h}$ ) or in litres per minute ( $\text{l}/\text{min}$ ) under normal conditions taking into account the relevant conversion coefficient for the gas used (see [Table 4](#)).

NOTE Normal conditions are  $0^\circ\text{C}$  and  $101,3\text{ kPa}$  ( $1,013\text{ bar}$ ) (in accordance with IUPAC).

**Table 4 — Conversion coefficient,  $U$**

| Test gas | Conversion coefficient |        |          |       |          |        |           |                   |               |
|----------|------------------------|--------|----------|-------|----------|--------|-----------|-------------------|---------------|
|          | Air                    | Oxygen | Nitrogen | Argon | Hydrogen | Helium | Acetylene | LPG, e.g. propane | $\text{CO}_2$ |
| 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 based on Formula (2).

$$U = \sqrt{\frac{\gamma_0}{\gamma_1}} \quad (2)$$

where

$\gamma_0$  is the specific gravity of the test gas;

$\gamma_1$  is the specific gravity of the gas used.

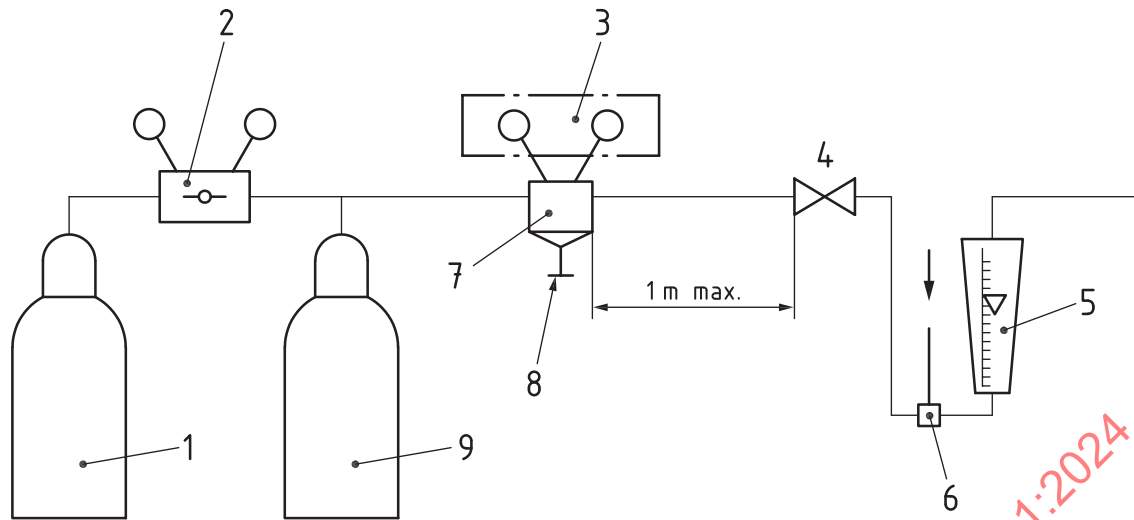
### 9.4.3 Temperature

Temperatures are measured in degrees Celsius.

## 9.5 Test for performance and operating characteristics of pressure regulators without flow-metering devices

### 9.5.1 General

An example of the test apparatus used for the measurement of performance and operating characteristics is shown in [Figure 1](#). The pressure regulator may, for example, be supplied by a buffer cylinder. The upstream pressure  $p_1$  is kept constant by means of an auxiliary pressure regulator or any equivalent device.



**Key**

- |   |                              |   |                                                |
|---|------------------------------|---|------------------------------------------------|
| 1 | gas supply                   | 6 | thermometer for measurement of gas temperature |
| 2 | auxiliary pressure regulator | 7 | pressure regulator (test sample)               |
| 3 | calibrated gauges            | 8 | adjusting screw                                |
| 4 | control valve for regulation | 9 | buffer cylinder                                |
| 5 | flow meter                   |   |                                                |

**Figure 1 — Example for the measurement of performance and operating characteristics**

### 9.5.2 Nominal discharge $Q_n$

The nominal discharge,  $Q_n$ , shall be obtained by adjusting the screw of the pressure-regulator sample under test and the valve for regulation shall be set to achieve an outlet pressure,  $p_2$ , and  $Q_n$  at an inlet pressure  $p_1$ .

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

With the pressure regulator set to nominal discharge conditions ( $Q_n, p_2, p_1$ ), proceed as follows:

- stop the flow by using the valve for regulation;
- after 1 min, record the stabilization pressure  $p_4$ ;
- determine the value of  $R$  (see [Table 1](#)).

## 9.6 Test for accuracy classification of pressure regulators with flow-metering devices

Connect the outlet of the pressure regulator with flow-metering devices to be tested to the flow-measuring apparatus.

With an inlet pressure of  $p_1$ , set the initial flow at  $Q_n$  or, for multiple calibrated orifices, select the orifice with the highest flow and record both the indicated flow of the measuring device of the pressure regulator with flow-metering devices and the true flow. The difference between the indicated flow and the true flow, as a percentage of the indicated flow, shall be recorded.

Repeat the above-mentioned test for 30 % of  $Q_n$  and 65 % of  $Q_n$ . Perform the above tests for all other fixed orifices.

## 9.7 Tests for mechanical resistance of pressure regulators or pressure regulators with flow-metering devices

### 9.7.1 General

**WARNING** — Precautions shall be taken to protect test personnel.

### 9.7.2 Test for mechanical resistance to internal pressure

#### 9.7.2.1 Resistance test to internal pressure

For this test (see [5.2.10.1](#)), the relief valve, diaphragm, pressure gauges and flow-metering devices shall be replaced by blind plugs. The low and high-pressure chambers shall be hydraulically pressurized for 5 min. After the test, check that there is no visible permanent deformation.

#### 9.7.2.2 Pressure retention test of the low-pressure side of the pressure regulator

For this test (see [5.2.10.2](#)), the pressure-regulator valve shall be held permanently open. This may be realized by removing the internal regulator valve before the test or kept permanently open during the test. The outlet connection shall be blanked off.

A pneumatic pressure  $p_1$  shall be applied to the pressure-regulator inlet through a valve which is manually opened quickly.

If no rupture occurs, the test is satisfactory.

If rupture occurs, no pieces shall be ejected. Venting of gas through pressure-relief devices, if fitted, is allowed.

### 9.7.3 Leakage tests

#### 9.7.3.1 External leakage

Gas tightness to the atmosphere shall be tested with the pressure  $p_1$  at the inlet side and  $p_2$  at the outlet side in accordance with ISO 9090. An example of the test apparatus used for the external leakage test is shown in [Figure 2](#).