INTERNATIONAL STANDARD ISO 2503-1983/ADDENDUM 1

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Welding — Regulators for gas cylinders used in welding, cutting and related processes

ADDENDUM 1

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

Addendum 1 to International Standard ISO 2503-1983 was developed by Technical Committee ISO/TC 44, *Welding and allied processes*, and was circulated to the member bodies in November 1982.

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

Belgium
Brazil
Bulgaria
Canada
Czechoslovakia
Egypt, Arab Rep. of
Finland
France
Germany, F. R.
India
Italy
Korea, Rep. of
Mexico
New Zealand
Norway
Poland
Sweden
Switzerland
USSR

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

Australia
Japan
United Kingdom
USA

This addendum forms clause 10 of ISO 2503-1983.

10 Test procedure

10.1 General

Checking conformity to ISO 2503 of a regulator of a given type consists of

— tests;

— checking of documents.

Conformity to the requirements of ISO 2503 can be confirmed by a neutral test institute.

10.2 Test samples and necessary documents

For the tests the following samples and documents shall be submitted :

— 3 samples of the regulator (an additional 10 pressure regulator valve seats for oxygen regulators);

— 3 sets of general arrangement drawings with material lists;

— 2 sets of detail drawings;

— 1 certificate of the manufacturer giving the material specifications and fitness for purpose.

The test shall be carried out with new regulators which are in good condition and in accordance with the drawings.

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

Price based on 6 pages

10.3 Test conditions

10.3.1 General characteristics of the test installation

All the pipelines of the testing installation together with the valve controlling the flow shall have a passage greater than that of the regulator to be tested.

10.3.2 Type of gas

Tests shall be carried out according to ISO 554[1] with air or nitrogen free from oil and grease.

In all cases tests shall be carried out with dry gas with a maximum moisture content of 50 ppm corresponding to a dew point of −48 °C. Oxygen regulators may be tested with oxygen.

10.3.3 Units of measurement and rating test

Flow and pressure measuring data shall be established in accordance with the specifications contained in ISO 554, i.e. 23 °C and 1,013 bar (0,101 3 MPa).

The measuring apparatus shall have an accuracy of at least ± 3 %.

10.3.4 Pressure measurement

The test bench shall be constructed in such a way that upstream and downstream pressures can be regulated. The equipment can be operated by remote control.

The gas supply for the rated (maximum) inlet pressure p_1 and p_3 shall have sufficient capacity.

Gauges of a standard class 1,0 or better shall be used for the pressure measurement. In such a case, the pressure gauges of the regulators can be included in the testing.

10.4 Performance and functional tests

10.4.1 Maximum discharge Q_{max}

The maximum discharge Q_{max} shall be measured. A method of measurement is shown in figure 3.

The regulator may for example be supplied by a buffer cylinder. The upstream pressure p_3 (see 8.2.1 in ISO 2503) is held constant by means of an auxiliary regulator or any equivalent device.

The adjusting screw of the device under test is tightened and the valve is opened so that :

— the downstream pressure gauge indicates the rated (maximum) outlet pressure p_2 corresponding to the class of the regulator; and

— the flowmeter indicates the maximum discharge Q_{max} taking into account the corrections in 10.3.3 and the temperature measured by the thermometer.

NOTE — Q_{max} defined in ISO 2503 is a conventional value. It may be lower than the real flow, which the regulator may permit under different conditions.

10.4.2 Standard discharge Q_1

The test conditions are the same as above but the initial discharge is adjusted to correspond to standard discharge Q_1.

10.4.3 Irregularity coefficient, i, and mechanical function check

For the determination of the irregularity coefficient, i (see 8.4.2 in ISO 2503) and correct mechanical functioning, plot a dynamic expansion curve. This curve indicates the downstream pressure as a function of the upstream pressure. During this test the upstream pressure varies from the rated (maximum) inlet pressure p_1 to pressure p_3.

An example of conditions for this test is given in figure 4.

The regulator is equipped with two calibrated gauges, preferably recording gauges[2]. The regulator is supplied by two gas cylinders, where at any given time only one cylinder is in operation. Both cylinders are filled with test gas under the rated (maximum) inlet pressure p_1. The regulator discharge is controlled by the valve and measured by a flowmeter.

a) Pretest adjustment

With the regulator supplied by the auxiliary cylinder, operate the adjusting screw and the valve to obtain the standard discharge Q_1 under the pressure p_2, values of which are given in table 2 of ISO 2503 in terms of the class corresponding to the regulator marking, taking into account the corrections given before (see table 3). These are calculated taking into consideration the regulated gas temperature measured by a thermometer.

Table 3

Test gas	Conversion coefficient						
	Air	Oxygen	Nitrogen	Argon	Hydrogen	Helium	Acetylene
Air	1	0,950	1,02	0,852	3,81	2,695	1,05
Nitrogen	0,983	0,930	1	0,837	3,75	2,65	1,03

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

2) Or any other recording device, which produces the dynamic expansion curve directly.

b) Tests

Without changing the preceding setting, the cylinder valve of the auxiliary cylinder is closed and that of the primary cylinder is opened. From this moment, the values of the upstream and downstream pressures are recorded. The capacity of the primary cylinder shall be sufficient for a test period of at least 15 min. However, if the pretest adjustments can be carried out in less than 30 s and the auxiliary gas cylinder has sufficient capacity, the test can be carried out without switching to the primary gas cylinder.

c) Results

During this test there shall be no evidence of oscillation or sticking of the regulator and there shall be a smooth regular dynamic expansion curve, either rising to a maximum (see figure 5) or falling (see figure 6).

The pressure p_5 for the irregularity coefficient i is the highest or lowest value of the outlet pressure during the test in which the inlet pressure varies from p_1 to p_3.

$$i = \frac{p_5 - p_2}{p_2}$$ (see 8.4.2 in ISO 2503)

10.4.4 Coefficient of pressure increase upon closure, R

With the regulator settings the same as in 10.4.2, proceed as follows.

With discharge stopped by supply pressure, the pointer of the low pressure gauge (standard class 0.6) moves to a higher value and stabilizes.

Note the stabilization pressure p_4 after 1 min and from it determine the value of R :

$$R = \frac{p_4 - p_2}{p_2}$$ (see 8.4.1 in ISO 2503)

10.5 Mechanical tests

10.5.1 Internal pressure tests

10.5.1.1 Fitness test

For this test (see 6.2.8.1 of ISO 2503 for specifications) the relief valve, diaphragm and pressure gauges shall be replaced by plugs. The low and high pressure chambers shall be hydraulically pressurized for 5 min. After the test check that there is no permanent deformation (for example measured by comparator).

The test pressures are given in table 4.

Table 4

High pressure	Low pressure	
300 bar (30 MPa)	Oxygen and other compressed gases class I and II Acetylene class 0, I and II	30 bar (3 MPa)
	Oxygen and other compressed gases class III, IV and V	60 bar (6 MPa)

10.5.1.2 Safety test

For this test (see 6.2.8.2 in ISO 2503 for specifications), the regulator shall be initially set for pressures p_1 and p_2. The pressure gauges and the relief valve shall be replaced by plugs and the high pressure inlet blanked off.

An increasing pressure is applied through the outlet orifice (the regulator valve shall be open or removed), if possible up to the pressure p_1. If no rupture occurs the test is satisfactory. If rupture occurs then it shall be verified that no pieces are ejected when the test is performed pneumatically.

10.5.2 Leakage tests

Internal and external gas tightness (see 6.2.7 in ISO 2503 for specifications) shall be checked during the functional tests.

The test shall be carried out with air, except for regulators intended for hydrogen or helium which are tested with the gas intended.

a) Gas tightness of regulating valve assembly

The tightness of the regulator valve seat is tested at the maximum inlet pressure, p_1, for 5 min. The regulator valve shall be closed (pressure adjusting screw completely unscrewed) and the outlet open. No escape of gas is allowed.

The tightness of the regulator valve is also tested with the outlet closed and the pressure in the low pressure chamber adjusted to the value p_2 with the pressure-adjusting screw. The value p_2 shall be constant during the test period of 5 min. The tests shall be repeated with the critical test pressure (p_3).

b) External gas tightness

The tightness of the regulator is checked at pressure p_1. The pressure adjusting screw is screwed in up to the pressure p_2 and the outlet closed. During the test period of 2 min, no leakage at the pressure gauge connections or other connections is allowed.

10.5.3 Ignition test (oxygen regulators) (See figure 7)

NOTE — In case of multistage regulators, it is also necessary to test the first stage valve.

The regulator with its valve completely closed (pressure adjusting screw completely unscrewed) is exposed through the inlet to pressure shocks from industrial oxygen (minimum 99,5 % purity without hydrogen). The test system shall be provided with equipment for preheating of the oxygen to (60 ± 3) °C at a minimum pressure of 200 bar (20 MPa). It shall be equipped with a quick-opening valve, with a bore of not less than 3 mm. The time for pressure increasing from atmospheric pressure up to the test pressure of 200 bar (20 MPa) shall be 20 ms. The connection between the quick-opening valve and the regulator under test shall be as short as possible.

Each test series consists of 20 pressure shocks at intervals of 30 s. Each pressure shock is applied for 10 s.

After each pressure shock the test regulator is brought back to atmospheric pressure. This is done not by the regulator but by an upstream tap.

During one test series the inlet pressure shall not decrease by more than 3 %.

The regulator shall not burn out during this test and shall suffer no internal damage such as scorching.

For all tests given in 10.5.2 and 10.5.3, the equipment shall be provided with the filter described in 6.2.2 in ISO 2503.

10.5.4 Relief valve

For the test, the regulator valve shall be held open or removed. The outlet of the regulator shall be blanked off. An increasing pressure is applied through the inlet orifice up to pressure p_4. At this pressure the relief valve shall be leak-tight. The pressure shall then be increased up to the opening pressure of the relief valve which will be noted. The pressure shall be increased up to the pressure $p_{RV} = 2\,p_2$. At this pressure the discharge Q_{RV} of the relief valve shall be measured. With decreasing pressure, the relief valve shall close at a pressure greater than p_2.

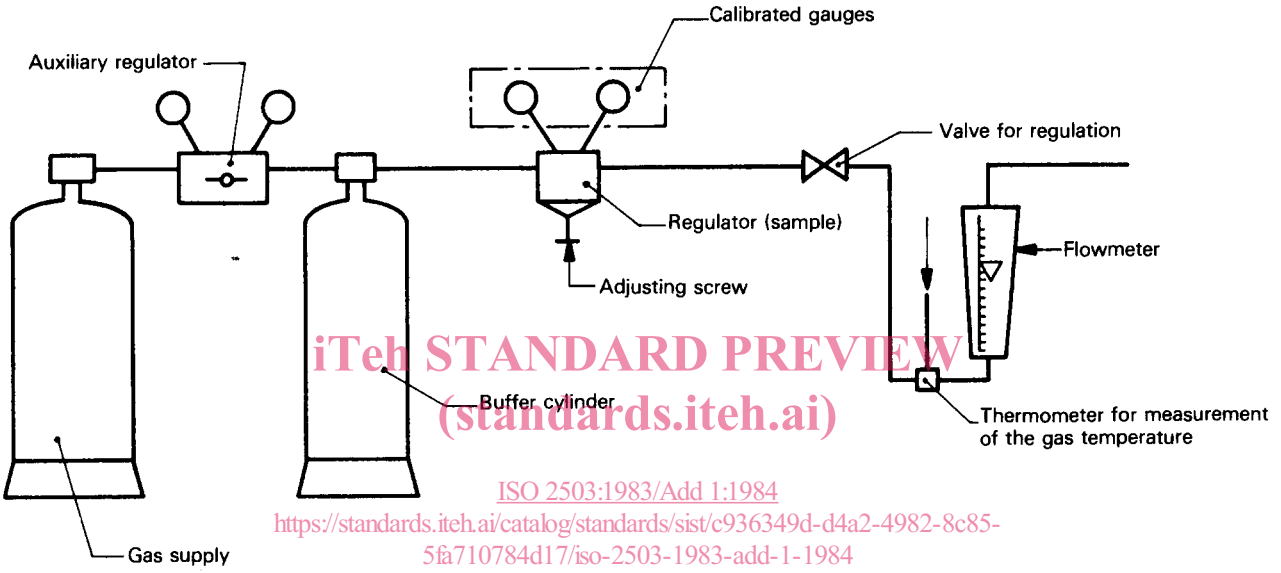

Figure 3 — Example for the measurement of the maximum discharge, Q_{max}

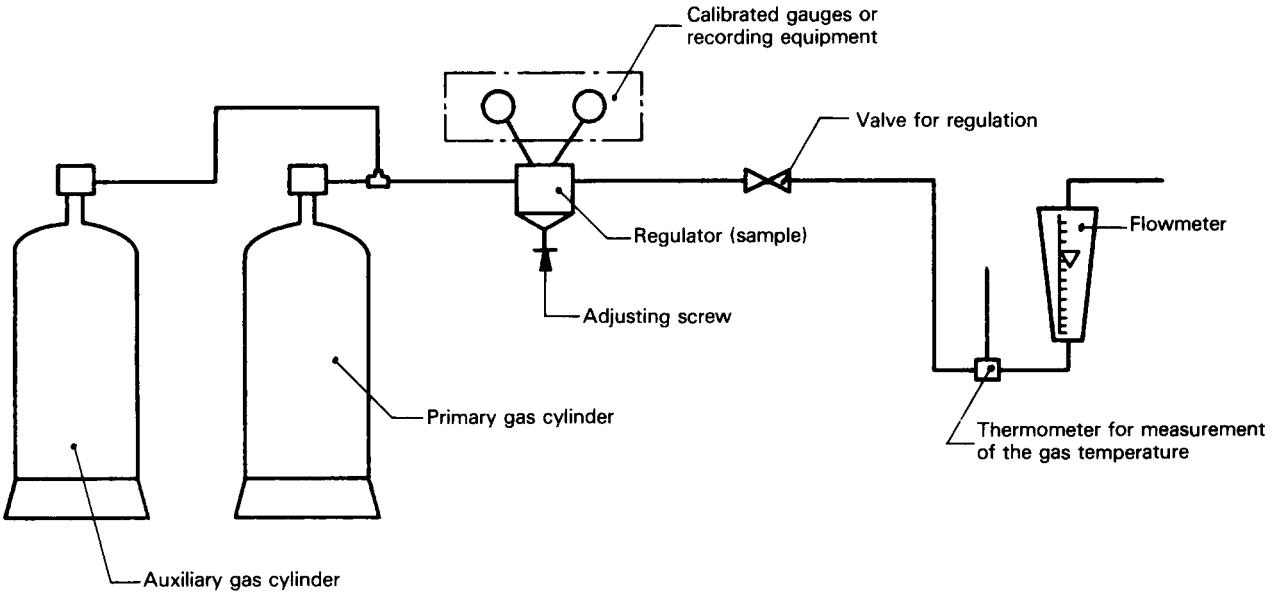

Figure 4 — Example for the measurement of the dynamic expansion curves

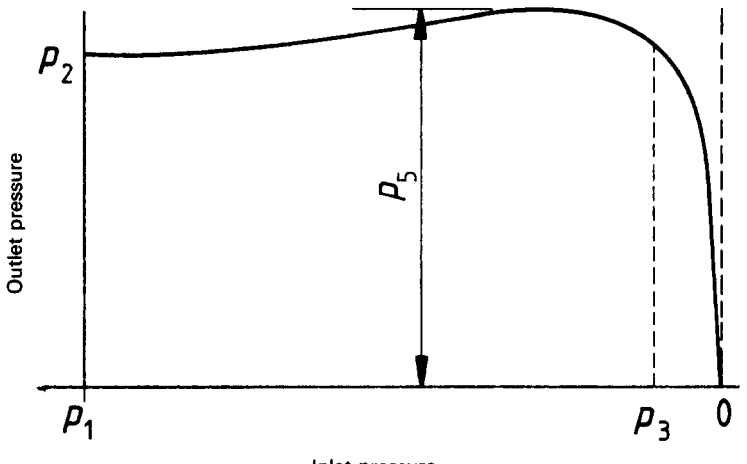

Figure 5 — Dynamic expansion curve with rising characteristic and maximum

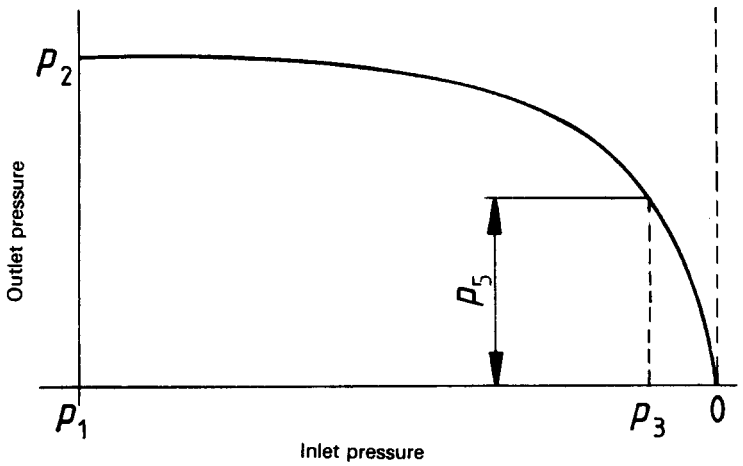

Figure 6 — Dynamic expansion curve with falling characteristic

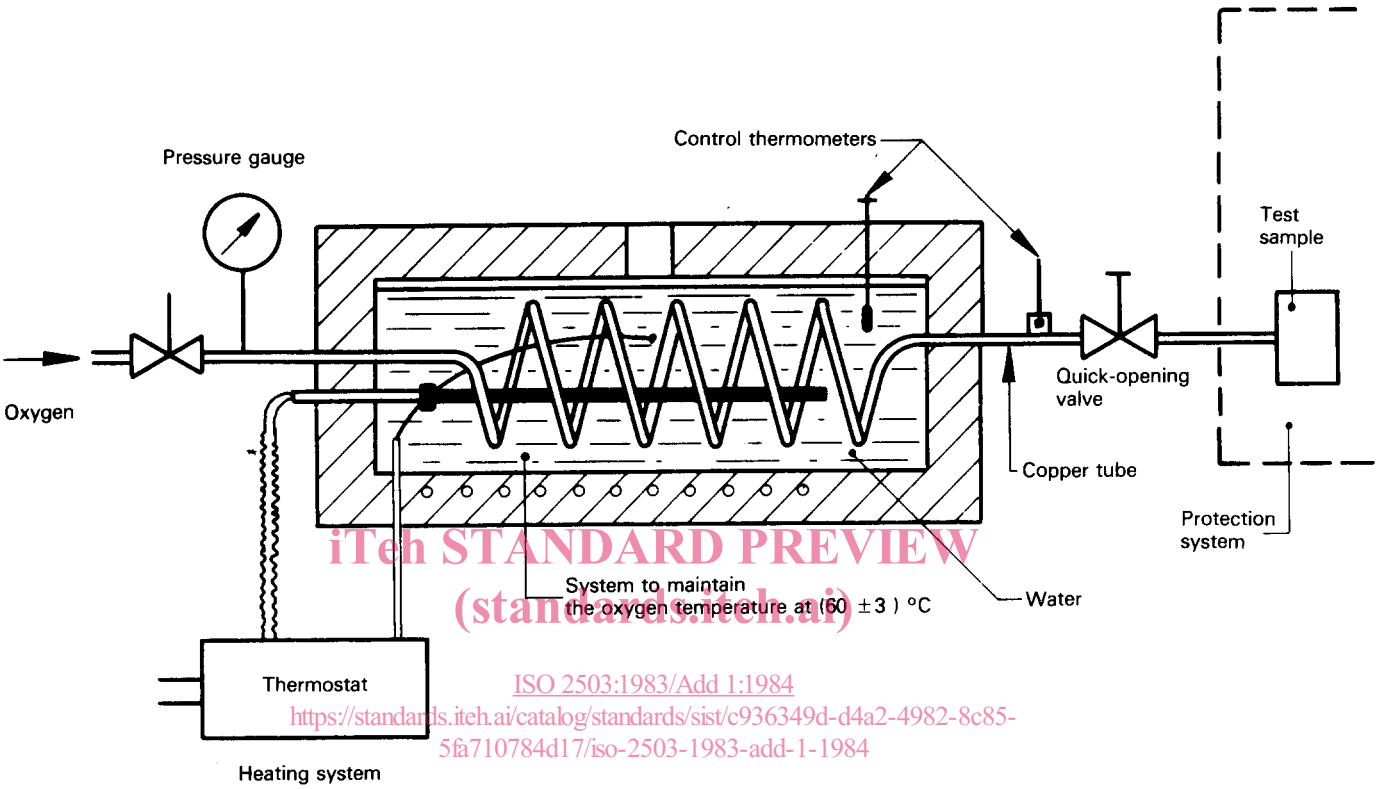

Figure 7 — Example for ignition test (oxygen regulators)