BRITISH STANDARD

BS 3016:1989
Incorporating Amendments Nos. 1 and 2

Specification for

Pressure regulators for liquefied petroleum gases

ICS 23.060.40; 75.180.99

BSI
British Standards

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Gas Standards Policy Committee (GSE/-) to Technical Committee GSE/22, upon which the following bodies were represented:

Association of Control Manufacturers — TACMA (BEAMA Ltd)

British Combustion Equipment Manufacturers Association

British Gas Plc

British Non-Ferrous Metals Federation

Chief and Assistant Chief Fire Officers' Association

Department of Trade and Industry (Consumer Safety Unit, CA Division)

Liquefied Petroleum Gas Industry Technical Association (UK)

Society of British Gas Industries

The following bodies were also represented in the drafting of the standard, through sub-committees and panels:

Calor Gas Limited

Consumer Policy Committee of BSI

Health and Safety Executive

This British Standard, having been prepared under the direction of the Gas Standards Policy Committee, was published under the authority of the Board of BSI and comes into effect on 31 December 1989

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The following BSI references relate to the work on this standard:
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Contents

Foreword

This British Standard has been prepared under the direction of the Gas Standards Policy Committee and supersedes BS 3016:1983 which is withdrawn. It is the third revision of BS 3016 which was previously revised in 1972 and 1983.

The start and finish of text introduced or altered by amendment is indicated in the text by tags [A1] ⟨A1⟩. Tags indicating changes to text carry the number of the amendment. For example, text altered by Amendment No. 1 is indicated by [A1] ⟨A1⟩.

This standard is intended to establish minimum levels of material, construction and performance for low pressure regulators and high pressure regulators for use with liquefied petroleum gases (3rd family gases) in the vapour phase. It covers screwed, threaded and clip-on connections.

This edition includes for the first time requirements for limited capacity relief valves and underpressure and overpressure shut-off devices when they are an integral part of the regulator.

Requirements for low-pressure, non-adjustable regulators having a maximum outlet pressure of less than or equal to 200 mbar, with a capacity of less than or equal to 4 kg/h, and their associated safety devices for butane, propane and their mixtures are now covered by BS EN 12864. The purpose of Amendment No. 1 is to modify the scope of BS 3016 to exclude such low-pressure non-adjustable regulators.

The scope of BS EN 13786 now covers the requirements for automatic change over devices having a maximum outlet pressure of up to and including 4 bar with a capacity of up to and including 100 kg/h, and their associated safety devices for butane, propane or their mixtures. The purpose of Amendment No. 2 is to modify the scope of BS 3016 to exclude such automatic change over devices.

BS 3016 with be withdrawn on publication of BS EN 13785, *Regulators with a capacity of up to and including 100 kg/h, having a maximum nominal outlet pressure of up to and including 4 bar, other than those covered by EN 12864 and their associated safety devices for butane, propane or their mixtures.*

It has been assumed in the drafting of this British Standard that the execution of its provisions is entrusted to appropriately qualified and experienced people.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 29 and a back cover.

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Section 1. General

1.1 Scope

[A2] This British Standard specifies requirements for materials, construction, performance and testing of low and high pressure regulators [A2] with screwed and clip-on connectors for use with butane and propane in the vapour phase up to a maximum vapour pressure of 20 bar[1)] and a maximum capacity of 20 kg of gas per hour where storage and operational temperatures are within the range of –20 °C to +50 °C.

[A2] Diagrammatic sectional illustrations of typical low and variable high pressure regulators are shown in Figure 3 and Figure 4 respectively. [A2] A typical clip-on regulator is shown in Figure 6. Figure 7 shows a diagrammatic representation of a regulator with an integral limited pressure relief valve and overpressure shut-off (OPSO) and underpressure shut-off (UPSO) devices.

NOTE 1 All pressures quoted in this standard are related to atmospheric pressure, i.e. gauge pressures are used throughout.

NOTE 2 It is UK practice for domestic appliances (e.g. BS 5482) for use with butane and propane gas to have inlet pressures of 28.0 mbar and 37.0 mbar, respectively. This does not preclude designs for higher operating pressures where necessary.

NOTE 3 The titles of the publications referred to in this standard are listed on the inside back cover.

[A1] NOTE 4 This British Standard does not cover low-pressure non-adjustable regulators having a maximum outlet pressure of less than or equal to 200 mbar, with a capacity of less than or equal to 4 kg/h, and their associated safety devices for butane, propane or their mixtures. Requirements for such regulators are covered in BS EN 12864. [A1]

[A2] NOTE 5 This British Standard does not cover automatic changeover devices. Requirements for such devices are now covered in BS EN 13786. [A2]

1.2 Definitions

For the purposes of this British Standard the definitions given in BS 1179 apply together with the following.

1.2.1
butane and propane
[A2] the appropriate gases for which the regulator is intended [A2]

NOTE Requirements for commercial butane and propane are given in BS 4250.

1.2.2
test gas
gas used for testing the [A2] regulator [A2]

NOTE For the purposes of this standard the appropriate test gases are specified in BS 4947.

1.2.3
high pressure regulator
a device that maintains the outlet pressure constant at a nominal value in excess of 50 mbar, independent, within specified limits, of inlet pressure, temperature and/or flow rate

1.2.4
low pressure regulator
a device that maintains the outlet pressure constant at a nominal value up to and including 50 mbar, independent, within specified limits, of inlet pressure, temperature and/or flow rate (see Figure 3)

1.2.5
variable high pressure regulator
a high pressure regulator fitted with a means of outlet pressure adjustment intended to be operated by the user (see Figure 4)

1.2.6
single-stage regulation
an arrangement whereby a reduction of the supply pressure is effected by one regulator in one stage (see Figure 3, Figure 4 and Figure 6)

1) The SI unit of pressure is the pascal. 1 bar = 10^5 N/m^2 = 10^5 Pa.

1.2.7
two-stage regulation
an arrangement whereby the supply pressure is regulated in two stages. Two stages may be housed in one body

1.2.8
[A2] *Text deleted* [A2]

1.2.9
[A2] *Text deleted* [A2]

1.2.10
[A2] *Text deleted* [A2]

1.2.11
standard reference conditions
reference conditions for gas of 15 °C, 1 013.25 mbar and dry

1.2.12
inlet connection
the means by which the high pressure side of the regulator is designed to connect to the gas supply

1.2.13
outlet
the free end of an integral outlet connector

1.2.14
outlet connector
the means by which the outlet pipe is connected to the regulator

1.2.15
set outlet pressure
[A2] the gas pressure measured at the outlet of the regulator at the flow and inlet pressure specified in **2.2**, **3.2** or **4.2** [A2]

1.2.16
rated capacity
a flow rate declared by the manufacturer, that can be achieved under all the temperature and pressure conditions given in Table 4 to Table 8 as appropriate

1.2.17
nominal flow
[A2] a flow rate, declared by the manufacturer, at which the regulator is set [A2]

1.2.18
lock-up
the action of the regulator valve to seal and prevent an excessive rise in outlet pressure under conditions of zero flow

1.2.19
clip-on system
a system that enables the non-threaded union of regulator and cylinder valve to be easily effected without the use of tools, and ensuring a free flow of gas automatically when in the normal "in use" position

1.2.20
overpressure shut-off (OPSO)
a manually resettable device that closes to prevent the flow of gas when pressure on the downstream side of the regulating member rises to a predetermined value. This device is an integral part of the regulator

1.2.21
underpressure shut-off (UPSO)
a manually resettable device that closes to prevent the flow of gas when the pressure on the downstream side of the regulating member falls to a predetermined value. This device is an integral part of the regulator

1.2.22
high capacity relief valve
a device, actuated by excess outlet pressure of the regulator, designed to permit more than 5 % of the rated capacity of the regulator to be discharged to atmosphere and to reseat as the outlet pressure decreases, at a pressure in excess of the maximum lock-up pressure

1.2.23
limited capacity relief valve
a device, actuated by excess outlet pressure of the regulator, designed to permit a maximum of 5 % of the rated capacity to be discharged to atmosphere at an outlet pressure not exceeding the lower limit of the OPSO and to reseat as the outlet pressure decreases, at a pressure in excess of the maximum lock-up pressure

1.3 Materials

1.3.1 General

All component parts shall be manufactured from, or be treated with, materials that are not adversely affected by mechanical, chemical or thermal influences that may be encountered in normal use.

1.3.2 Metal components

Metal components shall be made from the materials listed in Table 1 or other materials that ensure the standards of performance, durability and safety of regulators and devices are not less than those attainable by the use of any of the materials listed in Table 1.

Table 1 — Material specification

Material	Specification
Brass (cast)	BS 1400 SCB3-C
Brass for hot pressings	BS 2872 CZ 122
Brass bars for screwing and turning	BS 2874 CZ 121 and CZ 128
Brass sheet	BS 2870 CZ 108
Aluminium castings	BS 1490
Grey cast iron	BS 1452
Zinc alloy die castings	BS 1004 and BS 5338

1.3.3 Brass parts

Brass parts shall not be susceptible to season cracking. The susceptibility to season cracking shall be determined by the method given in BS 2871-2.

1.3.4 Zinc alloys

Zinc alloys shall only be used if they comply with BS 1004, the castings being made in accordance with BS 5338, and if the parts will not be exposed to a temperature higher than 80 °C. For gas-carrying parts and parts which could affect the safe operation of the regulator only alloy A is permitted.

1.3.5 Solder

Solder which has a melting point below 450 °C after application shall not be used for gas-carrying parts except for additional sealing.

1.3.6 Rubber type material for diaphragms, valve pads and seals

1.3.6.1 Rubber type material for diaphragms, valve pads and seals shall comply with the appropriate requirements of classifications 3A1, 3B1 and 3C1 of BS 6505.

1.3.6.2 Materials of classification 3D of BS 6505 shall not be used.

1.3.6.3 Materials which may be exposed to ozone concentrations above normal and/or sunlight in use or storage shall comply with the ozone resistance requirements of BS 6505.

1.3.7 Valve pads and diaphragms

1.3.7.1 *General*

No sample shall be taken into use after test.

1.3.7.2 *Material requirements*

A2 The material shall be such that, when the assembled regulator is subjected to the test described in **1.3.7.3** the diaphragm will not pull out or burst at a pressure lower than 3.0 bar for low pressure regulators or 10.5 bar for high pressure regulators. After this test the regulator shall comply with the soundness requirements of this standard. A2

1.3.7.3 *Method of test*

NOTE 1 The test is designed to give a practical result on an assembled regulator, and is intended as a simple check method that may be applied by the regulator manufacturer to diaphragm material, which will usually have been previously tested by some other method by the supplier.

Apply pressure (air or nitrogen is suitable) through the outlet connection to the underside of the diaphragm mounted in a regulator in the fully assembled condition (i.e. as it would be supplied by the manufacturer to a buyer). Block the inlet, if required.

NOTE 2 Where fitted, relief valves should have vents sealed for the purpose of these tests. OPSO devices, where fitted, may require overriding to achieve the tests.

For adjustable regulators, carry out the test at the minimum outlet pressure adjustment. Incorporate a gauge in the test rig between the air and the regulator to indicate the applied pressure.

Apply the pressure at a rate of approximately 0.7 bar/s up to the level specified and hold it for not less than 60 s.

1.3.7.4 *Reinforced diaphragms*

A2 Reinforced diaphragms shall be used in high pressure regulators and shall comply with BS 6505. A2

NOTE Reinforced diaphragms provide additional protection against rupture in the event of mechanical damage or chemical degradation. This type of diaphragm is recommended for use on other types of regulator.

1.3.7.5 *Swelling*

The valve pad fitted in its housing shall show no evidence of being forced out of position due to swelling or other cause, when immersed for 72 h in test gas LPGE (see BS 4947) at 20 ± 5 °C.

1.4 Assembly and workmanship

1.4.1 All parts of a regulator shall be free from sharp edges, corners and any defects or design features which might cause damage, injury or incorrect operation. The parts shall be clean internally and externally.

1.4.2 Holes used in the assembly of the device, e.g. for fixing screws, shall be at least 1 mm from gasways. Holes communicating with gasways and used for manufacturing purposes shall be closed mechanically with a metallic seal so as to ensure a permanent gas-tight seal and shall be treated in such a way that any unauthorized interference can be detected.

1.4.3 Any jointing compound used shall comply with BS 5292.

1.5 Screw threads

1.5.1 Sealing threads

Where a pressure tight joint is made on the thread, the thread shall comply with either:

a) BS 21; or

b) other threads such as N.P.T. (specified in ANSI/ASME B1.20.1 – 1983).

1.5.2 Fastening threads

Threads required for fastening or assembly shall comply with BS 1580, BS 2779, BS 3643 or any other appropriate British Standard. Self-tapping screws that cut a thread and produce swarf shall not be used for connecting gas-carrying parts or parts that may be removed in servicing. Where self-tapping screws are used for such purposes, only those that form a thread shall be used and they shall permit replacement by machine screws complying with the appropriate British Standard.

NOTE For the purposes of this requirement metal dust produced during the insertion and removal of the screw is not regarded as swarf.

The application of such self-tapping screws shall be limited to malleable materials, and to prevent cracking of the material they shall be positioned such that the centres are no closer to an edge than one major diameter of the thread.

1.6 Connections

A1 NOTE A2 1 A2 This British Standard does not cover low-pressure non-adjustable regulators having a maximum outlet pressure of less than or equal to 200 mbar, with a capacity of less than or equal to 4 kg/h, and their associated safety devices for butane, propane or their mixtures. Requirements for connections for such regulators are covered in BS EN 12864. A1

A2 NOTE 2 This British Standard does not cover automatic changeover devices. Requirements for such devices are now covered in BS EN 13786. A2

1.6.1 General

1.6.1.1 Any screwed inlet unions designed for direct connection to gas cylinder valves shall comply with BS 341.

1.6.1.2 Threaded connections shall comply with **1.5**.

1.6.1.3 Integral hose connectors shall be designed to accept flexible hose and tubing complying with BS 3212.

1.6.1.4 Low pressure nozzles shall be as shown in Figure 8. High pressure nozzles shall be as shown in Figure 9 or Figure 10.

1.6.1.5 Factory fitted hose nozzles not intended to be interchangeable shall comply with **1.6.1.3**.

1.6.1.6 Interchangeable hose nozzles or other non-integral fittings shall be removed prior to any tests.

1.6.1.7 Second stage regulators shall not have inlet connections suitable for direct connection to gas cylinders.

1.6.2 Torque and bending moment

1.6.2.1 *Requirements*

A2 The regulator shall be of sufficient mechanical strength to resist the stresses and conditions of normal use. A regulator A2 that withstands the connection torque and bending moment tests described in **1.6.2.2** without showing any sign of cracking or any significant permanent distortion and which remains functional and subsequently complies with the soundness requirements of this standard shall be deemed to have sufficient mechanical strength.

A2 *Text deleted* A2

No sample shall be taken into use after any of the tests described in **1.6.2.2**.

1.6.2.2 ***Methods of test***

1.6.2.2.1 *Screwed inlet connection torque test method*

With the body of the regulator or device rigidly clamped, apply the appropriate test torque given in Table 2 to the inlet connector for 10 s in each rotational direction.

Table 2 — Torque and bending moment requirements for screwed connections

Rated capacity kg/h	Torque N·m	Bending moment N·m
up to 1	30	30
above 1 to 2	35	35
above 2 to 3	40	40
above 3	50	50

1.6.2.2.2 *Screwed inlet connection bending moment test method*

A2 Fit a pipe 300 ± 25 mm in length terminated with a screwed inlet union complying with BS 341-1 to the inlet connection of the regulator. A2 Apply the force required to give the appropriate test bending moment given in Table 2 to the pipe. Apply the force for 10 s in each of four directions, perpendicular to each other and to the axis of the pipe (see Figure 1).

1.6.2.2.3 *Threaded connection torque test method*

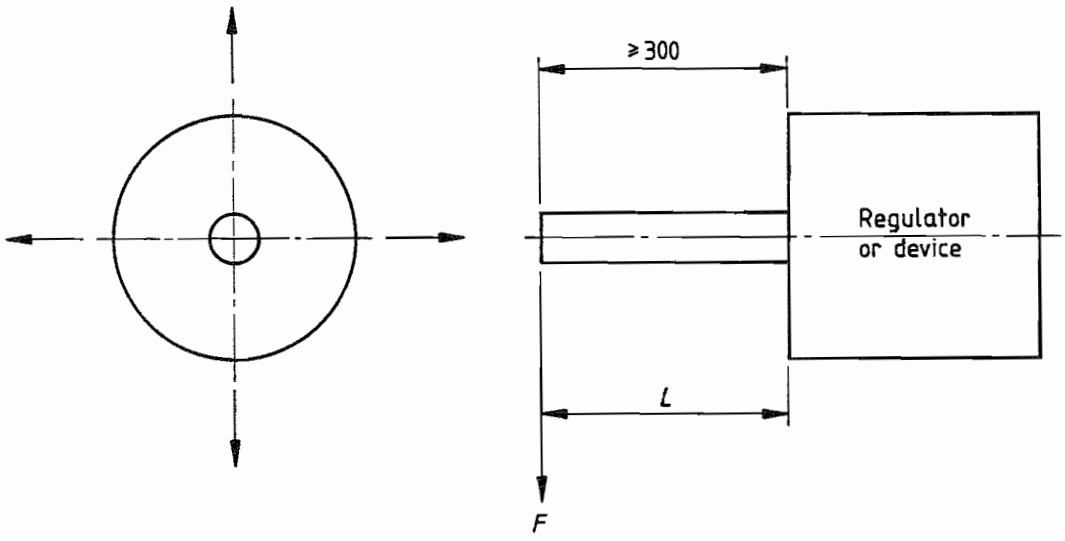
A2 Fit a suitably threaded pipe 300 ± 25 mm in length to the connections of the regulator. With the body of the regulator rigidly clamped apply the appropriate test torque given in Table 3 to the pipe for 10 s. A2

Table 3 — Torque and bending moment requirements for threaded connections

Nominal pipe thread size	Metric threads o.d. mm	DN	Torque N·m	Bending moment N·m
1/8	10	6	15	25
1/4	12	8	20	35
3/8	16	10	35	70
1/2	20	15	50	105
3/4	24	20	85	225
1	30	25	125	340

1.6.2.2.4 *Threaded connection bending moment test method*

Following the torque test of **1.6.2.2.3**, apply the force required to give the appropriate test bending moment given in Table 3 to the pipe. Apply the force for 10 s in each of four directions, perpendicular to each other and to the axis of the pipe (see Figure 1).



Dimension is in millimetres

Bending moment = $F \times L$

Figure 1 — Bending moment test: schematic

1.6.2.2.5 *Integral hose connections bending moment test method*

[A2] Rigidly clamp the body of the regulator and apply the force required to give the test bending moment of 10 N·m to the connector. [A2] Apply the force for 10 s in each of four directions perpendicular to each other and to the axis of the outlet connector (see Figure 1).

For the purpose of carrying out the test it is permissible to extend the effective length of the outlet connector by the use of a length of close fitting steel tube fitted over the full useful length of the connector.

1.6.3 Clip-on connections

1.6.3.1 External soundness (see **2.1.1**) shall be maintained during complete operation of the system including connection and disconnection of the regulator to the cylinder valve. It is permissible for there to be a minimum momentary escape of gas during connection.

1.6.3.2 If the regulator is capable of pointing in different directions when attached to the cylinder valve, soundness of the connection shall be assured in all positions even during rotation.

1.6.3.3 The inlet of the regulator shall contain a manual means of opening and closing the flow of gas.

1.6.3.4 The direction of operation of rotary controls shall be clearly indicated on the regulator.

1.6.3.5 With the regulator connected, 10 000 operations of opening and closing the gas supply shall be effected after which the regulator shall comply with **1.6.3.1** and **1.6.3.2**.

1.6.3.6 The regulator shall be connected and disconnected 5 000 times to a cylinder valve which it is designed to fit, after which it shall comply with **1.6.3.1**, **1.6.3.2**, **1.6.3.7**, and **1.6.3.8** when connected to a new valve.

1.6.3.7 The regulator attached to the cylinder valve shall be able to resist a force of 400 N applied in the opposite direction to the direction of coupling without disconnecting and shall still comply with **1.6.3.1** and **1.6.3.2** during the test.

1.6.3.8 The regulator attached to the cylinder valve shall comply with **1.6.3.1** and **1.6.3.2** when a bending moment of 50 N·m is applied to the inlet connection in the least favourable direction for 10 s.

1.6.3.9 Means shall be provided to ensure that the regulator will itself meet the soundness requirements of this standard when it is in the "gas off" position.

1.6.3.10 It shall not be possible to connect or disconnect the regulator from the cylinder valve with the gas supply in the "on" position.

1.6.3.11 Where turning off the gas and disconnecting the regulator is combined in a single control, a single continuous movement of the control shall be prevented by a mechanism which shall be separately operated before the regulator can be disconnected.

1.6.3.12 The open and closed positions of gas flow shall be clearly marked and detectable by feel.

The gas supply valve shall be readily accessible and easily operable when in use.

[A1] *Text deleted* [A1]

1.7 Vents

1.7.1 General

Breather holes and vents shall be protected against blockage or shall be located so that they do not easily become blocked. They shall be so arranged that the diaphragm cannot be damaged by a sharp device inserted through the breather hole or vent.

1.7.2 External use

1.7.2.1 [A2] First [A2] and 2nd stage regulators which are designed for unprotected use outdoors and which may be subjected to temperatures below 0 °C shall in their design orientation have vents pointing downwards and shall discourage the ingress of rain.

1.7.2.2 Low pressure, single stage propane regulators shall have vents designed to discourage the ingress of rain when the regulator is in its designated orientation or shall be marked "Protect from rain" with suitable guidance as to how this can be achieved provided in the user's instructions [see **1.15**f) and n)].

1.7.3 Screens

Protection against insects shall be provided where applicable, e.g. by a vent screen.

1.8 Range of adjustment

The range of outlet pressure over which variable pressure regulators comply with this standard shall be declared by the manufacturer, and performance at other outlet pressure settings shall comply with the manufacturer's claims [see **1.15**c)]. The tolerance on the maximum of this range shall be $^{+0.2}_{-0.1}$ bar or $^{+20}_{-10}$ % whichever is the greater.

In the case of regulators fitted with direct-reading means of adjustment, the markings shall be clear, legible and durable.

1.9 Pressure gauges and indicators

[A2] If an outlet pressure gauge is fitted as an integral part, it shall cover the full range of outlet pressure adjustment of the regulator. [A2] Bourdon tube pressure gauges shall comply with BS 1780.

1.10 Valves

1.10.1 Valve pad fixing

A valve pad shall be so retained that it cannot work out of position under service conditions.

Compliance shall be checked by examination of the valve pad after carrying out the tests described in **1.3.7.5**, **1.11.1.6** and **1.11.1.7**.

1.11 Performance

[A1] NOTE [A2] 1 [A2] This British Standard does not cover low-pressure non-adjustable regulators having a maximum outlet pressure of less than or equal to 200 mbar, with a capacity of less than or equal to 4 kg/h, and their associated safety devices for butane, propane or their mixtures. Performance requirements for such regulators are covered in BS EN 12864. [A1]

[A2] NOTE 2 This British Standard does not cover automatic changeover devices. Performance requirements for such devices are now covered in BS EN 13786. [A2]

1.11.1 General

NOTE Compliance of the regulator with this standard does not imply that gas will be available from cylinders at the pressures and temperatures used in the test [see **1.15** f)].

1.11.1.1 *Gases used for testing*

[A2] The performance tests shall be carried out using the appropriate gas for which the regulator is designed, i.e. butane or propane or, if this is not practicable, such alternative gases as air or nitrogen, etc. may be used provided that the regulator has been previously exposed for 72 h to the gas for which the regulator is designed. [A2]

1.11.1.2 *Test temperature*

Unless otherwise specified, setting and performance tests shall be carried out at 20 ± 5 °C.

1.11.1.3 *Chatter*

[A2] A regulator shall not chatter or vibrate while being tested. If chattering occurs when using air or nitrogen, etc., the test shall be repeated using the gas for which the regulator is designed. [A2]

The test shall be up to a maximum of:

a) single-stage propane and butane regulators: 12 bar and 3 bar respectively;

b) second-stage propane regulators: 4 bar.

1.11.1.4 *Orientation*

[A2] The tests shall be carried out with the regulator in its recommended orientation.

NOTE In other orientations the regulator may give a reduced performance. [A2]

The regulator shall comply with **1.11.1.9** in all orientations.

1.11.1.5 *Rated capacity*

The rated capacity shall be obtained with both:

a) the maximum designed bore size of outlet pipe or nozzle (see **1.6**);

b) the maximum designed bore of inlet pipe or connection (see **1.6**).

[A2] *Text deleted* [A2]

NOTE The use of connectors with restricted bores may reduce the rated capacity.

1.11.1.6 *Drop test*

[A2] A complete regulator shall be dropped from a height of 1 m in any position on to a hard surface (e.g. concrete). [A2] After the test the regulator shall remain functional and comply with the following at 20 °C only.

[A2] *Lock-up:* **1.11.1.9** and Table 4 to Table 8 as appropriate.

Outlet pressure setting: **2.2**, **3.2** or **4.2** as appropriate.

Soundness: **2.1.1**, **3.1.1** or **4.1.1** as appropriate. [A2]

1.11.1.7 *Endurance test*

1.11.1.7.1 *Requirement*

A regulator shall withstand 50 000 cycles of complete opening and closing of the valve as described in **1.11.1.7.2** without mechanical failure or the development of leakage. At the completion of the test the lock-up pressure shall not exceed 110 % of that given in [A2] Table 4 to Table 8 [A2] as appropriate (see **1.11.1.9**).

1.11.1.7.2 *Method of test*

Supply the regulator inlet with air at 7 bar for first stage propane regulators, 4 bar for second stage propane regulators and 1.4 bar for butane regulators and at a temperature of 20 ± 5 °C.

Install quick-acting valves upstream and downstream of the regulator and the downstream valve exhausts to atmosphere.

Connect the valves to a suitable time switch so that as one opens the other closes with a complete cycle time of approximately 5 s. Arrange the test so that the diaphragm is fully flexed and the valve is held on its seat for a minimum of 1 s.

1.11.1.8 ***Outlet pressure measurement.***

[A2] The pipe between the outlet of the regulator and the outlet pressure test gauge shall be of the same bore as the outlet of the regulator and between 8 and 12 bore diameters long. [A2] Readings shall be taken at time intervals of 10 s after completion of the necessary adjustments.

1.11.1.9 ***Lock-up***

The [A2] regulator [A2] shall lock-up when flow is reduced to zero from nominal flow conditions over a period of 2 s. Lock-up shall be achieved at not more than 60 s after cessation of flow.

1.12 Sealing

[A2] After testing by the manufacturer, the body and cover of each regulator shall be sealed to discourage interference with the internal mechanism and pressure setting (when not intended to be adjustable) in such a way that unauthorized interference can be detected. [A2]

1.13 Marking

1.13.1 Permanent

[A2] A regulator shall be clearly and permanently marked with the following. [A2]

a) Manufacturer's name, mark or symbol and country of origin if made outside the UK.

b) Unique type reference.

c) The year and month of manufacture.

d) The direction of flow if this is not permanently established by the design of the connections.

e) Type of gas (butane and/or propane).

f) [A2] The maximum inlet pressure for which the regulator complies with this standard. [A2] Regulators with maximum inlet pressure lower than 6 bar for butane or 20 bar for propane shall be marked "Second stage" (see **1.6.1.7**).

g) Nominal outlet pressure or pressure range.

h) Regulators fitted with relief valves shall be marked "Vent outdoors" [see **1.15**f)].

i) Low pressure, single-stage propane regulators shall be marked "Protect from rain" where this is appropriate (see **1.7.2.2**).

j) The number of this standard, i.e. BS 3016[2)].

All markings shall be indelible as defined in Appendix B of BS 3955:1986. It is permissible to use self-adhesive labels provided they remain intact during the testing of the control and show no evidence of lifting after test.

1.13.2 Additional markings

Additional marking or means of identification shall be permitted.

[2)] Marking BS 3016 on or in relation to a product represents a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of such a claim is therefore solely the responsibility of the person making the claim. Such a declaration is not to be confused with third party certification of conformity which may also be desirable.

1.14 Packaging

1.14.1 Protection from damage

A2 A regulator shall be so packed as to minimize risk of damage in transit. A2

1.14.2 Protection from foreign matter

A2 A regulator shall be protected to prevent the entry of foreign matter. A2 Where plastics bags are used the minimum thickness of plastics shall be 0.05 mm.

1.15 Instructions[3)]

Instructions shall be provided for the user and the installer. They shall be clear and unambiguous with warnings clearly shown and grouped together. A2 They shall be packed with the regulator and shall contain at least the following information, as applicable. A2

a) Name and address of manufacturer and country of origin if made outside the UK. Where the manufacturer is not a UK company the name and address of the UK agents/distributors.

b) Unique type reference.

c) A2 The outlet pressure or pressure range over which the regulator complies with this standard. A2

d) The rated capacity: where outlet connectors with restricted bores are supplied, the capacities obtainable with each connector size.

e) A warning showing the type or types of gas for which the regulator is designed. A warning that the regulator may only be connected to the type of valve designed to accommodate it. For clip-on regulators, the valve size and/or system.

f) Advice on external use, storage and external venting of relief valve where applicable. Attention shall be drawn to the practical limitations of gas supplied from cylinders in cold and/or high gas flow conditions. A warning that adequate ventilation should be provided.

g) Warning regarding unauthorized interference.

h) Details of servicing arrangements.

i) An instruction to the consumer that the regulator shall not be disconnected from the gas cylinder whilst the appliance remains alight and that in the event of the appliance failing to extinguish when the gas valve is turned off it is essential that the regulator is not disconnected from the cylinder.

j) Instructions for any user-resettable device.

k) Instructions for fitting outlet connectors.

l) Where outlet connectors for flexible hoses are employed, the required size and type of hose and detailed instructions for fitting including the correct use of hose clips.

m) Instructions for making the connections, including diagrams, paying particular attention to condition of any washer or seal where required.

n) Instructions for connecting, orientation, protection from rain[4)], turning on and turning off the regulator including diagrams if required. Instructions for leak testing and the correct procedure in the event of a leak.

NOTE 1 Attention is drawn to the requirements of the Consumer Protection Act, 1987 and Section 6 of the Health & Safety at Work etc. Act, 1974.

NOTE 2 Attention is drawn to DTI publication "Instructions for Consumer Products — Guidelines for Better Instructions and Safety Information for Consumer Products" available from HMSO.

3) Consideration should be given to language/languages other than English in which the instructions may be given. However, the final decision rests with the manufacturer.

4) It is important to note that if water enters the vent of a regulator it may freeze in cold weather and cause gas pressure from the storage vessel to pass into the pipework and appliances. It is essential that the instructions give clear guidance on how this should be prevented.

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Section 2. Low pressure, single stage regulators

[A1] NOTE This British Standard does not cover low-pressure non-adjustable regulators having a maximum outlet pressure of less than or equal to 200 mbar, with a capacity of less than or equal to 4 kg/h, and their associated safety devices for butane, propane or their mixtures. Requirements for such regulators are covered in BS EN 12864. [A1]

2.1 Soundness

2.1.1 Requirement

A regulator shall be considered to be leaktight if the leakage rate does not exceed 4 mm^3/s (15 cm^3/h) when tested as described in **2.1.2**.

NOTE When fitted, relief valves should have vents sealed for the purpose of these tests. OPSO devices, where fitted, may require overriding to achieve the tests.

2.1.2 Methods of test

2.1.2.1 Test the completed regulator at a pressure of 150 mbar applied through the outlet connection and held for a period of not less than 60 s.

2.1.2.2 Test those parts of butane and propane regulators normally subjected to cylinder pressure at a pressure of 14 bar and 20 bar, respectively, applied through the inlet connection and held for a period of not less than 120 s with the outlet connection sealed.

2.2 Outlet pressure setting

At the nominal flow at an inlet pressure of 1.4 bar for butane and 7.0 bar for propane, the set outlet pressure shall be as declared by the manufacturer ±2.0 mbar (see Note 2 to **1.1**).

2.3 Measurement of capacity

It shall be possible to vary the flow between 10 % and 100 % of the rated capacity under the conditions given in Table 4 or Table 5 as appropriate.

Table 4 — Low pressure, single stage regulators for butane

Gas and regulator temperature °C	Inlet pressures applied bar	Permissible deviation of set outlet pressure mbar	Permissible deviation of set outlet pressure at lock-up mbar
0 ± 2	0.2 to 1.0	±5	+10
20 ± 5	0.2 to 3.0	±5	+10
50 ± 2	1.0 to 6.0	±5	+10

Table 5 — Low pressure, single stage regulators for propane

Gas and regulator temperature °C	Inlet pressures applied bar	Permissible deviation of set outlet pressure mbar	Permissible deviation of set outlet pressure at lock-up mbar
−20 ± 2	1.0 to 2.0	$^{+10}_{-5}$	+15
20 ± 5	1.0 to 12.0	±5	+15
50 ± 2	3.0 to 20.0	$^{+10}_{-5}$	+15

blank

Section 3. Low pressure, second stage regulators for propane

3.1 Soundness

3.1.1 Requirement

A regulator shall be considered to be leaktight if the leakage rate does not exceed 4 mm^3/s (15 cm^3/h) when tested as described in **3.1.2**.

NOTE Where fitted, relief valves should have vents sealed for the purpose of these tests. OPSO devices, where fitted, may require overriding to achieve the tests.

3.1.2 Methods of test

3.1.2.1 Test the completed regulator at a pressure of 150 mbar applied through the outlet connection and held for a period of not less than 60 s.

3.1.2.2 Test the regulator at a pressure of 12 bar applied through the inlet connection and held for a period of not less than 120 s without the outlet connection sealed.

3.2 Outlet pressure setting

At the nominal flow and at an inlet pressure declared by the manufacturer the set outlet pressure shall be as declared by the manufacturer ±2.0 mbar (see Note 2 to **1.1**).

3.3 Measurement of capacity

It shall be possible to vary the flow between 10 % and 100 % of the rated capacity under the conditions given in Table 6.

Table 6 — Low pressure, second stage regulators for propane

Gas and regulator temperature °C	Inlet pressures applied bar	Permissible deviation of set outlet pressure mbar	Permissible deviation of set outlet pressure at lock-up mbar
−20 ± 2	Minimum inlet pressure to 2.0	±5	+10
20 ± 5	Minimum inlet pressure to 4.0	±5	+10
50 ± 2	Minimum inlet pressure to 4.0	±5	+15

3.4 Minimum inlet pressure

The minimum inlet pressure shall be declared by the manufacturer but shall not be greater than 1.0 bar.

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Section 4. High pressure regulators

4.1 Soundness

4.1.1 Requirement

A regulator shall be considered to be leaktight if the leakage rate does not exceed 4 mm^3/s (15 cm^3/h) when tested as described in **4.1.2**.

NOTE Where fitted, relief valves should have vents sealed for the purpose of these tests. OPSO devices, where fitted, may require overriding to achieve the tests.

4.1.2 Methods of test

4.1.2.1 [A2] Test the completed regulator at a pressure of 1.5 times the maximum outlet pressure obtainable from the regulator, applied through the outlet connection and held for a period of not less m than 60 s. [A2]

4.1.2.2 Test those parts of butane and propane regulators normally subjected to cylinder pressure at a pressure of 14 bar and 20 bar respectively applied through the inlet connection and held for a period of not less than 120 s with the outlet connection sealed.

4.2 Outlet pressure setting(s)

Adjustment of the outlet pressure shall be made at a nominal flow(s) at an inlet pressure declared by the manufacturer. The tolerance on the outlet pressure setting(s) shall be ±0.1 bar or ±10 % whichever is greater (see **1.8**).

4.3 Measurement of capacity

It shall be possible to vary the flow between 10 % and 100 % of the rated capacity under the conditions given in Table 7 or Table 8 as appropriate.

Table 7 — [A2] High pressure regulators for butane [A2]

Gas and regulator temperature °C	Inlet pressures applied	Permissible deviation of set outlet pressure	Permissible deviation of set outlet pressure at lock-up
0 ± 2	From minimum inlet pressure[a] to 2.0 bar	$^{+0.2}_{-0.3}$ bar or $^{+20}_{-30}$% if greater	$^{+0.3}_{-30}$% bar or if greater
20 ± 5	From minimum inlet pressure[a] to 3.0 bar	$^{+0.2}_{-20}$% bar or if greater	$^{+0.3}_{-30}$% bar or if greater
50 ± 2	From minimum inlet pressure[a] to 6.0 bar	$^{+0.2}_{-0.3}$ bar or $^{+20}_{-30}$% if greater	$^{+0.3}_{-30}$% bar or if greater

[a] The minimum inlet pressure is equal to the set outlet pressure +0.5 bar.

Table 8 — [A2] High pressure regulators for propane [A2]

Gas and regulator temperature °C	Inlet pressures applied	Permissible deviation of set outlet pressure	Permissible deviation of set outlet pressure at lock-up
−20 ± 2	Minimum inlet pressure[a]	$^{+0.2}_{-0.3}$ bar or $^{+20}_{-30}$% if greater	$^{+0.3}_{+30}$ % bar or if greater
20 ± 5	From minimum inlet pressure[a] to 12 bar	$^{+0.2}_{-0.3}$ bar or if greater	$^{+0.3}_{+30}$ % bar or if greater
50 ± 2	From minimum inlet pressure[a] to 20.0 bar	$^{\pm 0.2}_{\pm 20}$ % bar or $^{+20}_{-30}$% if greater	$^{+0.3}_{-30}$ % bar or if greater

[a] The minimum inlet pressure is equal to the set outlet pressure +0.5 bar.

Section 5. Automatic changeover devices

A2 NOTE This British Standard does not cover automatic changeover devices. Requirements for such devices are now covered in BS EN 13786.

5.1 *Clause deleted*

5.2 *Clause deleted*

Table 9 — *Deleted*

Table 10 — *Deleted*

5.3 *Clause deleted* A2

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Section 6. Integral safety devices

[A1] NOTE [A2] 1 [A2] This British Standard does not cover low-pressure non-adjustable regulators having a maximum outlet pressure of less than or equal to 200 mbar, with a capacity of less than or equal to 4 kg/h, and their associated safety devices for butane, propane or their mixtures. Requirements for integral safety devices for such regulators are covered in BS EN 12864. [A1]

[A2] NOTE 2 This British Standard does not cover automatic changeover devices. Requirements for such devices are now covered in BS EN 13786. [A2]

6.1 General

The means of adjustment of settings shall be sealed in such a way that unauthorized interference can be detected.

NOTE Attention is drawn to the Gas Safety Installation and Use Regulations 1984 (SI 1984 No 1358), specifically Regulation 13.

6.2 Relief valves

6.2.1 High capacity relief valves

6.2.1.1 Where a high capacity relief valve is incorporated it shall be set to start discharging at a pressure not less than twice and not more than three times the outlet pressure setting and to reseat as the outlet pressure decreases, at a pressure in excess of the maximum lock-up pressure.

6.2.1.2 The vent outlet shall be threaded.

NOTE It is recommended that provision should be made for venting to outside the building in which the cylinder(s) may be stored or in which the valve may be fitted. It is not recommended that relief valves be incorporated in high pressure regulators for indoor use.

6.2.2 Limited capacity relief valves

NOTE The relief valve may be integral with or independent of the main diaphragm assembly.

6.2.2.1 The relief valve shall vent gas to atmosphere when the outlet pressure of the regulator exceeds the relief pressure declared by the manufacturer and shall reseat before the pressure returns to the maximum lock-up pressure.

NOTE The relief will normally operate at $55\ ^{+7}_{-5}$ mbar.

6.2.2.2 The capacity of the relief valve shall not be greater than 5 % of the rated capacity of the regulator measured at a pressure of 2 mbar above the initial opening as described in **6.2.3**.

6.2.2.3 The relief valve shall be set by the manufacturer before despatch and shall be so designed as to deter unauthorized interference.

6.2.2.4 The relief valve outlet shall be threaded.

6.2.3 Relief valve test

Set up the regulator as shown in Figure 2 with the nominal flow valve open and the air bleed valve closed. Operate the regulator under the conditions given in **2.2** or **3.2** as appropriate and then lock it up. Then gradually increase the outlet pressure by not more than 2 mbar/s to a point when the relief valve operates. Check that the relief valve reseats before the pressure is reduced to the maximum lock-up outlet pressure.

Repeat test five times to confirm that the relief pressure remains consistently within the manufacturer's tolerances.

6.3 Underpressure shut-off device

6.3.1 Requirements

6.3.1.1 The device shall close when the outlet pressure of the regulator is between 25 mbar and 32 mbar when tested as described in **6.3.2**.

6.3.1.2 At an inlet pressure of 4 bar and with the UPSO closed the leakage through the regulator shall not exceed 4 mm^3/s (15 cm^3/h).

6.3.1.3 Pressure shut-off shall be achieved by a valve pad and seat which are separate from the regulator control valve pad and seat.

6.3.1.4 The adjustment of the device shall be sealed by the manufacturer before despatch.

6.3.1.5 The device shall be designed for manual reset only.

6.3.2 Method of test

6.3.2.1 Set up the regulator as shown in Figure 2 with the nominal flow valve and the air bleed valve closed.

6.3.2.2 With no pressure in the system ensure that the UPSO is closed and the OPSO is open.

6.3.2.3 Gradually increase the inlet pressure of the regulator up to a maximum of 4 bar and check that the UPSO does not open during the test.

6.3.2.4 Manually reset the UPSO and open the nominal flow valve to operate the regulator under the conditions specified in **2.2** or **3.2** as appropriate.

6.3.2.5 Reduce the inlet pressure of the regulator at a rate of 1 mbar/s until the UPSO closes. Repeat the test five times to confirm that the shut-off pressure remains consistently within the specified tolerance (see **6.3.1.1**).

6.3.2.6 Confirm that the inlet pressure at which the UPSO closes is less than the minimum inlet pressure applied at 20 °C in Table 5 or Table 6 as appropriate.

6.4 Overpressure shut-off device

6.4.1 Requirements

6.4.1.1 The mechanism of the device shall be completely independent of the main regulator mechanisms.

6.4.1.2 The device shall be set to close when the outlet pressure of the regulator exceeds the normal outlet pressure by a pressure declared by the manufacturer when tested as described in **6.4.2**. The device shall close the supply upstream of the regulator control valve.

NOTE The device will normally operate at a pressure of 75 ± 5 mbar.

6.4.1.3 Adjustable overpressure shut-off devices shall be sealed by the manufacturer before despatch.

6.4.1.4 The device shall be designed for manual reset only.

6.4.1.5 The reset of an overpressure shut-off device shall only be accessible by means of tools and shall have provision for sealing.

6.4.2 Method of test

Set up the regulator as shown in Figure 2 with the nominal flow valve open and the air bleed valve closed. Operate the regulator under the conditions given in **2.2** or **3.2** as appropriate and then lock it up. Then gradually increase the outlet pressure by not more than 2 mbar/s to a point when the overpressure shut-off device operates.

The limited relief, when fitted, shall continue to vent during the test.

Repeat the test five times to confirm that the shut-off pressure remains consistently within the manufacturer's tolerances.

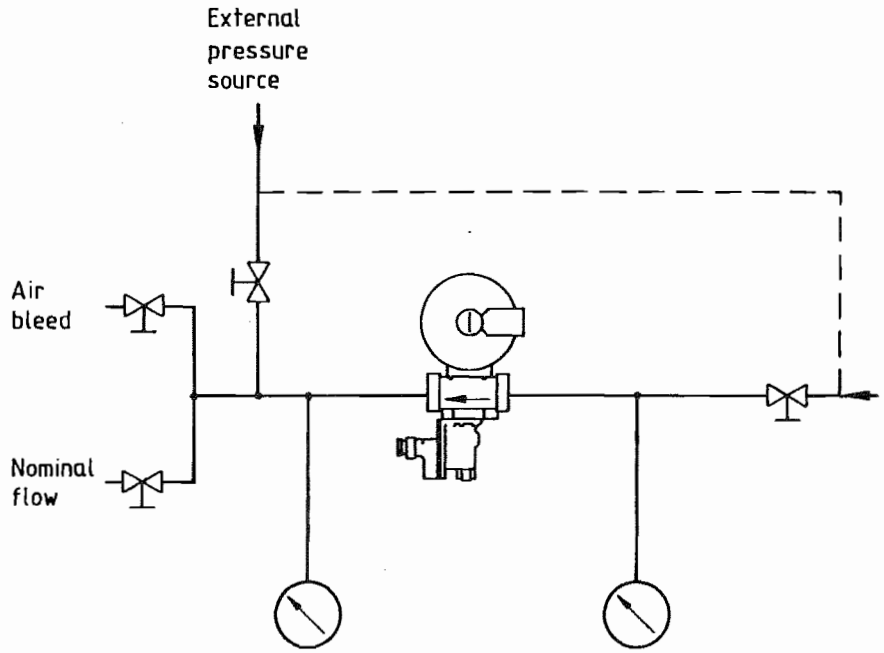


Figure 2 — General arrangement of equipment for overpressure, underpressure and relief valve tests

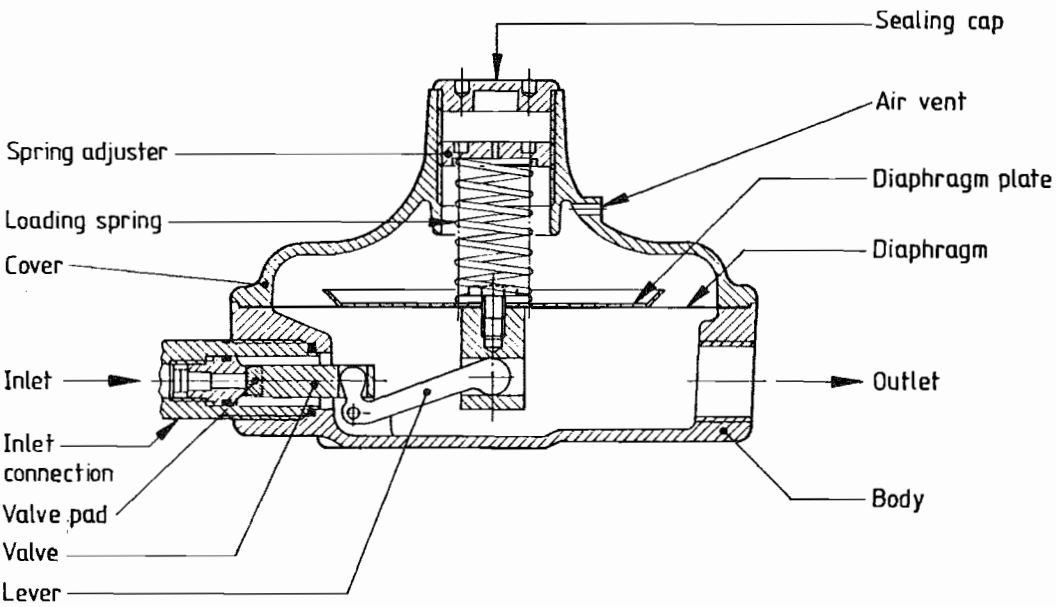


Figure 3 — Diagrammatic sectional illustration of a low pressure regulator

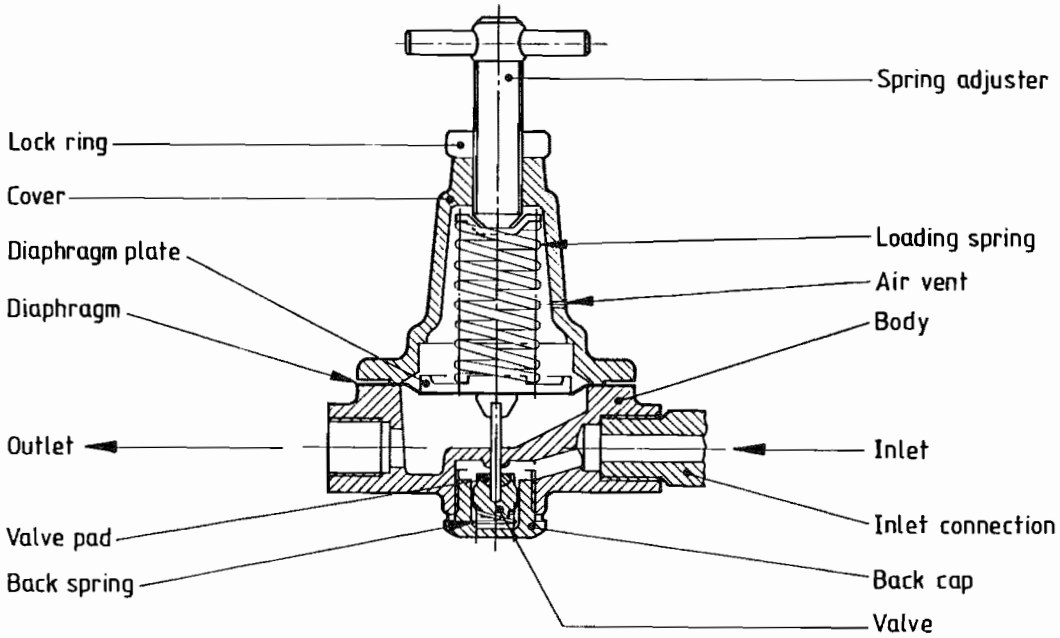


Figure 4 — Diagrammatic sectional illustration of a variable high pressure regulator

[A2] Figure 5 — *Deleted* [A2]

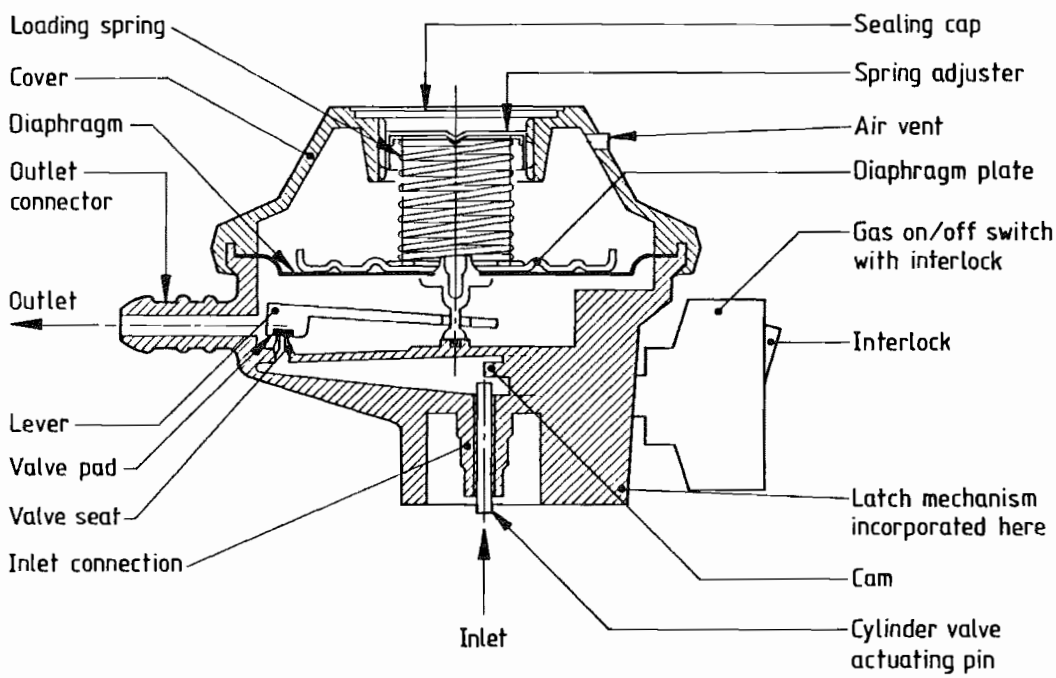


Figure 6 — Diagrammatic sectional illustration of a clip-on regulator

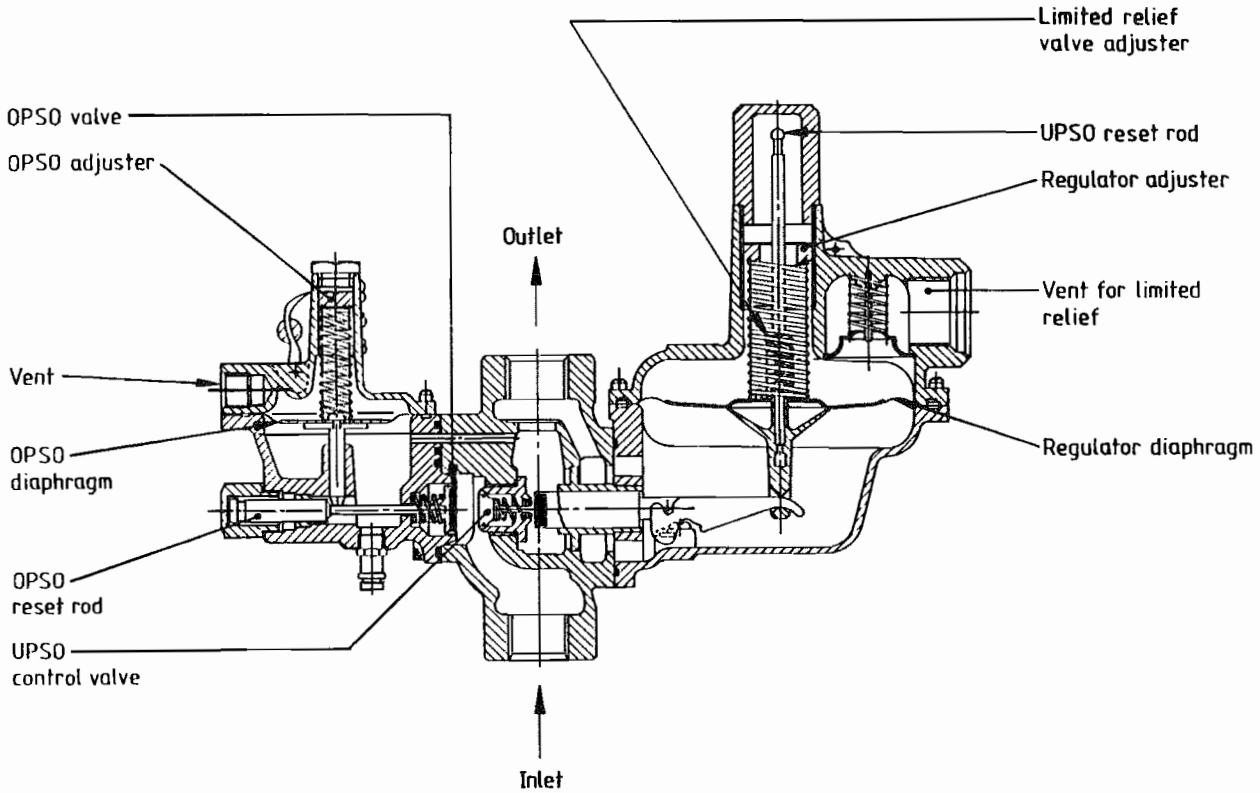


Figure 7 — Diagrammatic representation of regulator with integral limited pressure relief valve and OPSO and UPSO devices

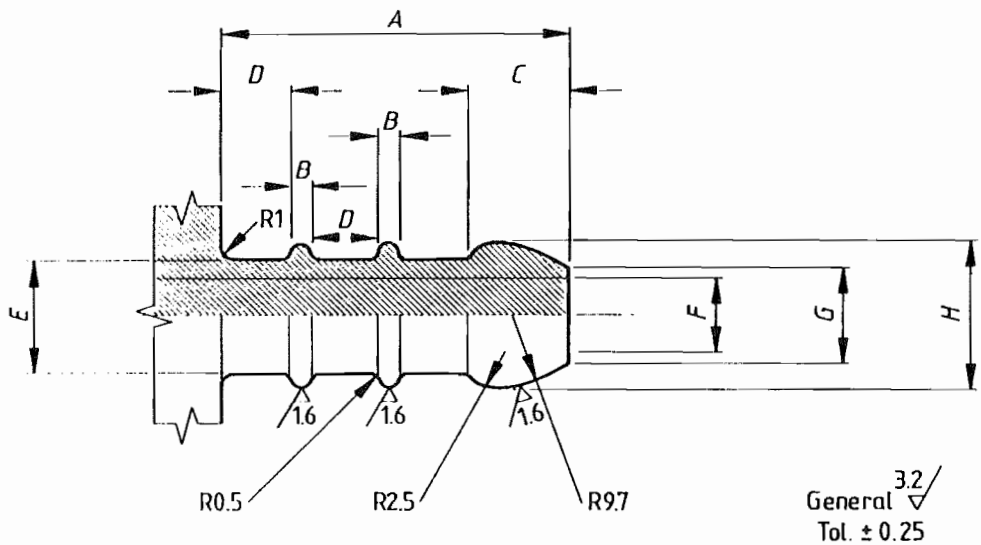


Figure 8 — Low pressure hose nozzle

Table 11 — Dimensions of low pressure hose nozzle

Nominal hose bore	$A \pm 0.25$	$B \pm 0.25$	$C \pm 0.25$	$D \pm 0.25$	$\varnothing E \pm 0.13$	$\varnothing F \pm 0.13$	$\varnothing G \pm 0.13$	$\varnothing H \pm 0.13$
mm	mm	mm	mm	mm	mm	mm	mm	mm
8	23.8	1.52	7	4.58	7.9	5	6.35	10.3

NOTE It is important that the hose nozzle profile has no sharp edges that could cut the hose whilst in use.

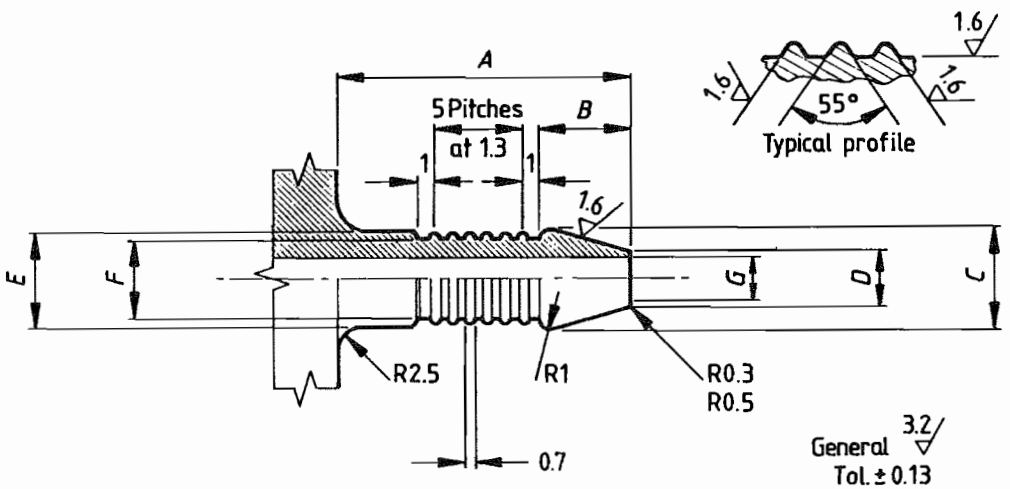
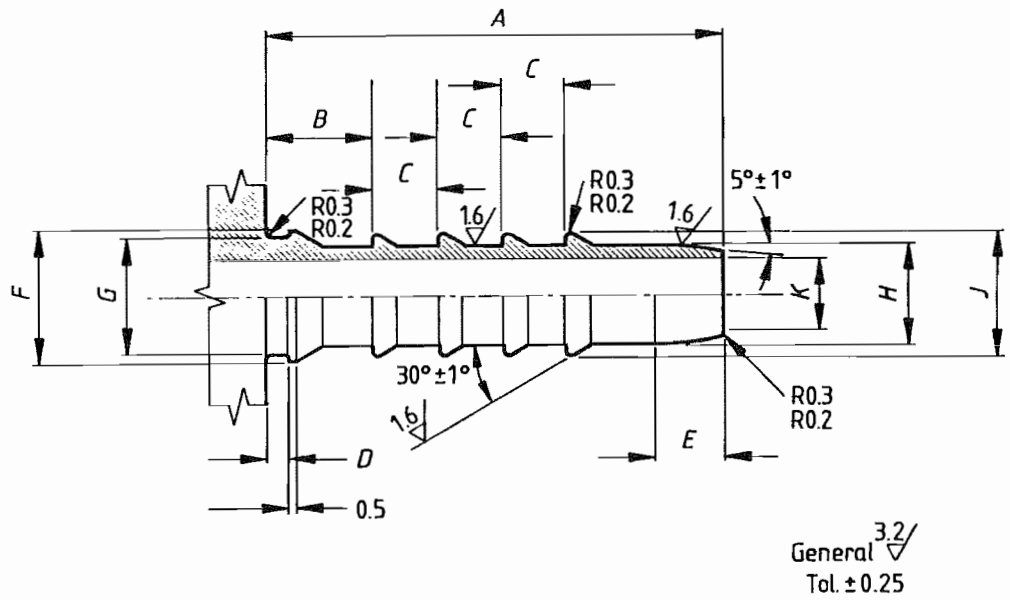


Figure 9 — High pressure hose nozzle

Table 12 — Dimensions of high pressure hose nozzles

Nominal hose bore	$A \pm 0.25$	$B \pm 0.25$	$\varnothing C^{+0.13}_{-0}$	$\varnothing D^{+0.13}_{-0}$	$\varnothing E^{+0.13}_{-0}$	$\varnothing F + 0.13$	$\varnothing G \pm 0.13$
mm	mm	mm	mm	mm	mm	mm	mm
4.8	20.3	6.35	6.73	4.06	6.35	5.58	3
6.3	20.3	6.35	8.23	5.56	7.85	7.08	4.5
8	25.4	8.7	9.93	7.26	9.55	8.78	6.2

NOTE It is important that the hose nozzle profiles have no sharp edges that could cut the hose whilst in use.



All dimensions are in millimetres

Figure 10 — Heavy duty hose nozzle

Table 13 — Dimensions of heavy duty hose nozzle

Nominal hose bore	$A \pm 0.25$	$B \pm 0.25$	$C \pm 0.25$	$D \pm 0.25$	$E \pm 0.25$	$\varnothing F \pm 0.25$	$\varnothing G^{+0.1}_{-0}$	$\varnothing H^{+0.1}_{-0}$	$\varnothing J^{+0.1}_{-0}$	$\varnothing K \pm 0.1$
mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
6.3	32	7.5	4.5	1.5	5	9.2	8	7	8.5	4.5
NOTE It is important that the hose nozzle profile has no sharp edges that could cut the hose whilst in use.										

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Publications referred to

BS 21, *Specification for pipe threads for tubes and fittings where pressure-tight joints are made on threads (metric dimensions).*

BS 341, *Specification for valve fittings for compressed gas cylinders — Part 1: Valves with taper stems (excluding valves used for breathing and medical purposes).*

BS 1004, *Specification for zinc alloys for die casting and zinc alloy die castings.*

BS 1179, *Glossary of terms used in the gas industry.*

BS 1400, *Specifications for copper alloy ingots and copper alloy and high conductivity copper castings.*

BS 1452, *Specification for grey iron castings.*

BS 1490, *Specification for aluminium and aluminium alloy ingots and castings for general engineering purposes.*

BS 1580, *Specification for Unified screw threads.*

BS 1780, *Specification for bourdon tube pressure and vacuum gauges.*

BS 2779, *Specification for pipe threads for tubes and fittings where pressure-tight joints are not made on the threads (metric dimensions).*

BS 2870, *Specification for rolled copper and copper alloys: sheet, strip and foil.*

BS 2871, *Specification for copper and copper alloys — Tubes — Part 2: Tubes for general purposes.*

BS 2872, *Specification for copper and copper alloys — Forging stock and forgings.*

BS 2874, *Specification for copper and copper alloy rods and sections (other than forging stock).*

ES 3212, *Specification — Flexible rubber tubing and hose (including connections where fitted and safety recommendations) for use in LPG vapour phase and LPG/air installations.*

BS 3643, *ISO metric screw threads.*

BS 3955, *Specification for electrical controls for household and similar general purposes.*

BS 4250, *Liquefied petroleum gas.*

BS 4947, *Specification for test gases for gas appliances.*

BS 5292, *Specification for jointing materials and compounds for installations using water, low pressure steam or 1st, 2nd and 3rd family gases.*

BS 5338, *Code of practice for zinc alloy pressure die casting for engineering.*

BS 5482, *Code of practice for domestic butane — and propane — gas-burning installations.*

BS 6505, *Specification for rubber-type materials used for controls components for use with 1st, 2nd and 3rd family gases.*

ANSI/ASME B1.20.1 *Pipe threads, general purpose (inch).*

Instructions for Consumer Products — Guidelines for Better Instructions and Safety Information for Consumer Products[5]. Published by DTI.

[5] Available from HMSO

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