

Specification for

Pressure regulators for liquefied petroleum gases

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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

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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has been prepared under the direction of the Gas Standards Policy Committee and supersedes BS 3016:1983 which is withdrawn.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 will 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 bar¹⁾ 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 = 10⁵ N/m² = 10⁵ 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

 Text deleted 

1.2.9

 Text deleted 

1.2.10

 Text deleted 

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**

 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 

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**

 a flow rate, declared by the manufacturer, at which the regulator is set 

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 reseal 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 reseal 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 $20 \pm 5^\circ\text{C}$.

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**.