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SOUTH AFRICAN NATIONAL STANDARD

Single-stage regulators for liquefied petroleum gas (LPG)

Amdt 1

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Table of changes

Change No.	Date	Scope
Amdt 1	2007	Amended to change the title, add new detail to the scope, modify the introductory paragraph to normative references, update referenced standards, change and add definitions, include requirements for materials, design and construction of regulators, inspection and methods of test, modify the performance requirements for the set outlet pressure, flow rates and endurance, modify a formula and the requirements for marking, include instructions for the use and maintenance of regulators, and revise the annex on the installation and use of regulators.
Amdt 2	2012	Amended to modify the requirement for the minimum flow rate.

Foreword

This South African standard was approved by National Committee SABS TC 1019, *Gas supply, handling and control (fuel, industrial and medical gases)*, in accordance with procedures of the SABS Standards Division, in compliance with annex 3 of the WTO/TBT agreement.

This document was published in March 2012.

This document supersedes SANS 1237:2007 (edition 3.1).

A vertical line in the margin shows where the text has been technically modified by amendment No. 2.

Annex A forms an integral part of this document. Annexes B, C and D are for information only.

Contents

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Single-stage regulators for liquefied petroleum gas (LPG) **Amdt 1**

1 Scope

1.1 This standard specifies performance, safety and constructional requirements for low-pressure regulators of the single-stage type intended for use with liquefied petroleum gas mixtures in the vapour phase and designed for a set outlet pressure of 2,8 kPa and a flow not exceeding 10 kg/h.

1.2 With the exception of the design and construction requirements and gas tightness, the requirements of this standard do not apply to pressure regulators used with liquefied petroleum gas mixtures in the vapour phase and designed for an outlet pressure greater than 2,8 kPa. **Amdt 1**

NOTE 1 Unless otherwise stated, all pressures given in the standard are gauge pressures. **Amdt 1**

NOTE 2 Pressure regulators intended for use in welding, cutting and allied processes are not covered in this specification. See SANS 2503 for more detail. **Amdt 1**

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this standard. All normative documents are subject to revision and, since any reference to a normative document is deemed to be a reference to the latest edition of that document, parties to agreements based on this standard are encouraged to take steps to ensure the use of the most recent editions of the normative documents indicated below. Information on currently valid national and international standards can be obtained from the Standards SABS Division. **Amdt 1**

SANS 1109-1/ISO 7-1, *Pipe threads where pressure-tight joints are made on the threads – Part 1: Dimensions, tolerances and designation*.

SANS 1156-2, *Hose for liquefied petroleum gas (LPG) – Part 2: Hose and tubing for use in LPG vapour phase and LPG-air installations*.

SANS 1306-1/ISO 228-1, *Pipe threads where pressure-tight joints are not made on the threads – Part 1: Dimensions, tolerances and designation*.

SANS 1774, *Liquefied petroleum gases*.

SANS 2503/ISO 2503, *Gas welding equipment – Pressure regulators for gas cylinders used in welding, cutting and allied processes up to 300 bar.* **Amdt 1**

SANS 7253/ISO 7253, *Paints and varnishes – Determination of resistance to neutral salt spray (fog).* **Amdt 1**

3 Definitions

For the purposes of this standard, the following definitions apply:

3.1
fixed pressure regulator
a regulator of which the pressure is set by the manufacturer at a pressure above 2,8 kPa and of which the setting is not intended to be adjusted by the user **Amdt 1**

3.2 **Amdt 1**
liquefied petroleum gas
LPG
a mixture of light hydrocarbons (predominantly propane, propene, butane and butene) that is gaseous under conditions of atmospheric temperature and pressure and that is maintained in the liquid state by an increase in pressure or a lowering of temperature, and that complies with the requirements of SANS 1774

3.3 **Amdt 1**
lock-up pressure
the pressure at the regulator outlet, under no-flow conditions

3.4 **Amdt 1**
minimum flow rate
the flow rate at an inlet pressure of 80 kPa and an outlet pressure of not less than 2,2 kPa with the same outlet **Amdt 1**

3.5 **Amdt 1**
nominal flow rate
the quantity of gas, in kilograms per hour, at the set outlet pressure and at an inlet pressure of 700 kPa **Amdt 1**

3.6 **Amdt 1**
set outlet pressure
the outlet pressure (at an inlet pressure of 700 kPa) to which a regulator has been set in the factory and that is regarded as the nominal operating pressure of the regulator. (See also 4.3.2.) **Amdt 1**

3.7 **Amdt 1**
variable pressure regulator
a high pressure regulator with a means of outlet pressure adjustment intended to be operated by the user **Amdt 1**

4 Requirements

4.1 Materials

4.1.1 The cantilever (which is part of the mechanism that controls the flow through the inlet orifice) should be of metal.

4.1.2 All non-metallic parts that come into contact with LPG shall be made of a material that is compatible with LPG and free from porosity and foreign particles. The parts shall have a smooth, non-tacky surface. All rubber connections and seals (excluding the rubber on the diaphragm) shall have a shore hardness value of between 60 and 90 IRHD before ageing, with a maximum deviation of ±10 and a minimum IRHD value of 60 after conditioning in accordance with 5.4.1. **Amdt 1**

4.1.3 When copper alloy parts are tested in accordance with 5.11, they shall show no evidence of seasonal cracking.

4.2 Design and construction

4.2.1 General

The design and construction of a regulator and of all its parts shall be such that the regulator operates safely when used with LPG vapour and complies with the requirements of this standard. **Amdt 1**

4.2.2 Control spring chamber

The control spring chamber shall have a breather hole of such design that

a) the risk of accidental entry of foreign matter is minimized,

b) the breather hole cannot easily become blocked, and

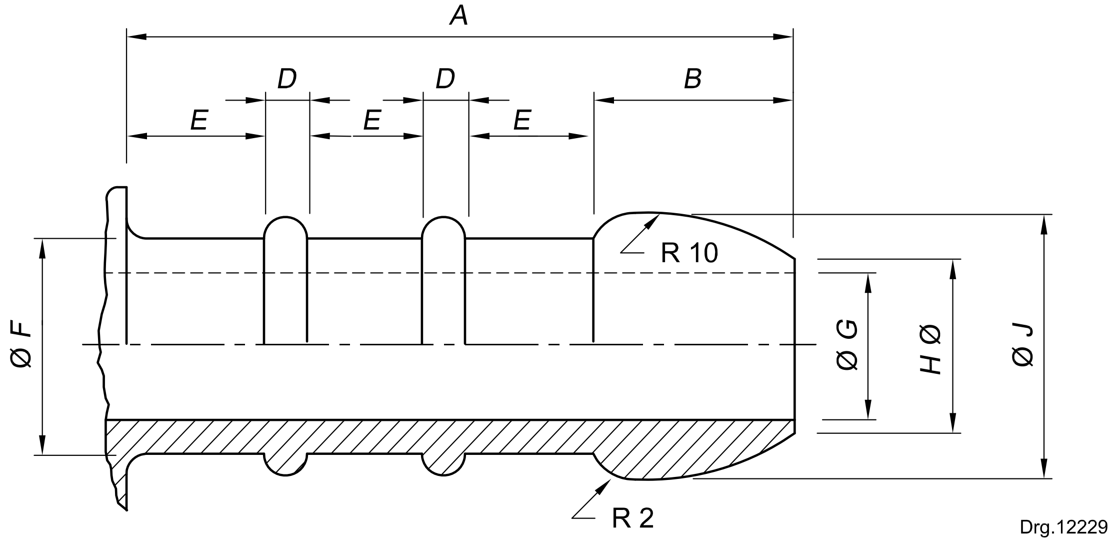
c) any instrument inserted into the breather hole cannot reach the diaphragm.

4.2.3 Connections

4.2.3.1 Outlet connection

The outlet connection of a regulator shall be furnished with an outlet connector (tailpiece) that conforms to the dimensions given in figure 1 or the connection shall be threaded for direct connection to supply pipelines (see 4.2.3.3). **Amdt 1**

Dimensions in millimetres



1	2	3	4	5	6	7	8	9
Nominal size[a]	***A***	***B***	***D***	***E***	**Dia. *F***	**Dia. *G***	**Dia. *H***	**Dia. *J***
8	22	7,0	1,5	4,3	7,9	5,4	6,50	10,3
	nominal	+ 1,0 − 0,5	+ 1,0 − 0,3	min.	± 0,3	max.	+ 1,0 − 0,3	+ 0,2 − 0,3

[a] The nominal size of the nozzle corresponds to the corresponding nominal size of the hose given in SANS 1156-2.

Amdt 1

Figure 1 — Outlet connection

4.2.3.2 Inlet connection

A regulator that is intended to be fitted to an LPG cylinder valve shall comprise of any of the appropriate types given in figures 1 to 5.

The inlet connection of a regulator that is intended to be screwed to an LPG cylinder valve shall incorporate a handwheel for tightening purposes, except that, in the case of a fixed mount arrangement, the handwheel may be excluded as shown in figure 2. It shall have, on the high-pressure side, a rubber-sealing washer that is self-locating, resistant to LPG and of such quality and design that, when the regulator is tested in accordance with 5.8, there is no leakage past the sealing washer. **Amdt 1**

Dimensions in millimetres

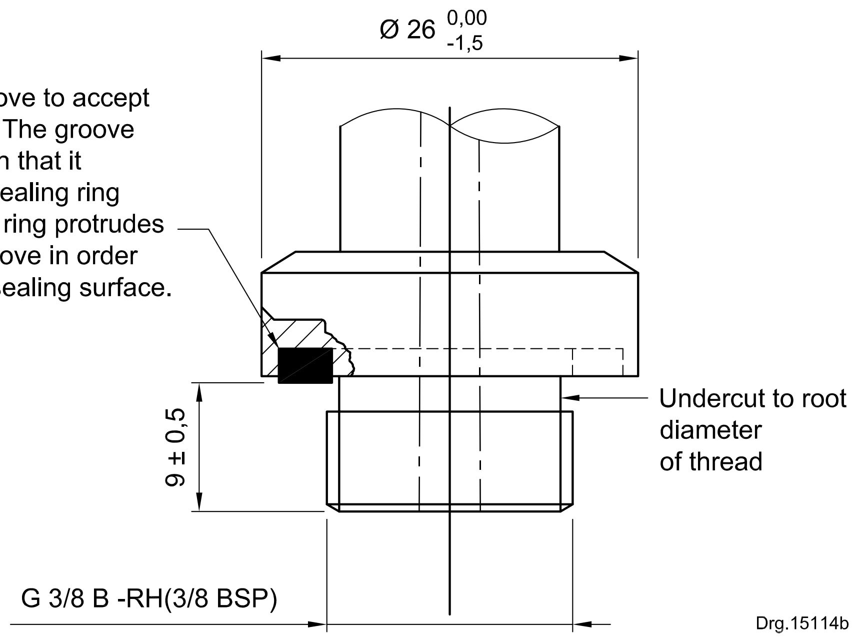
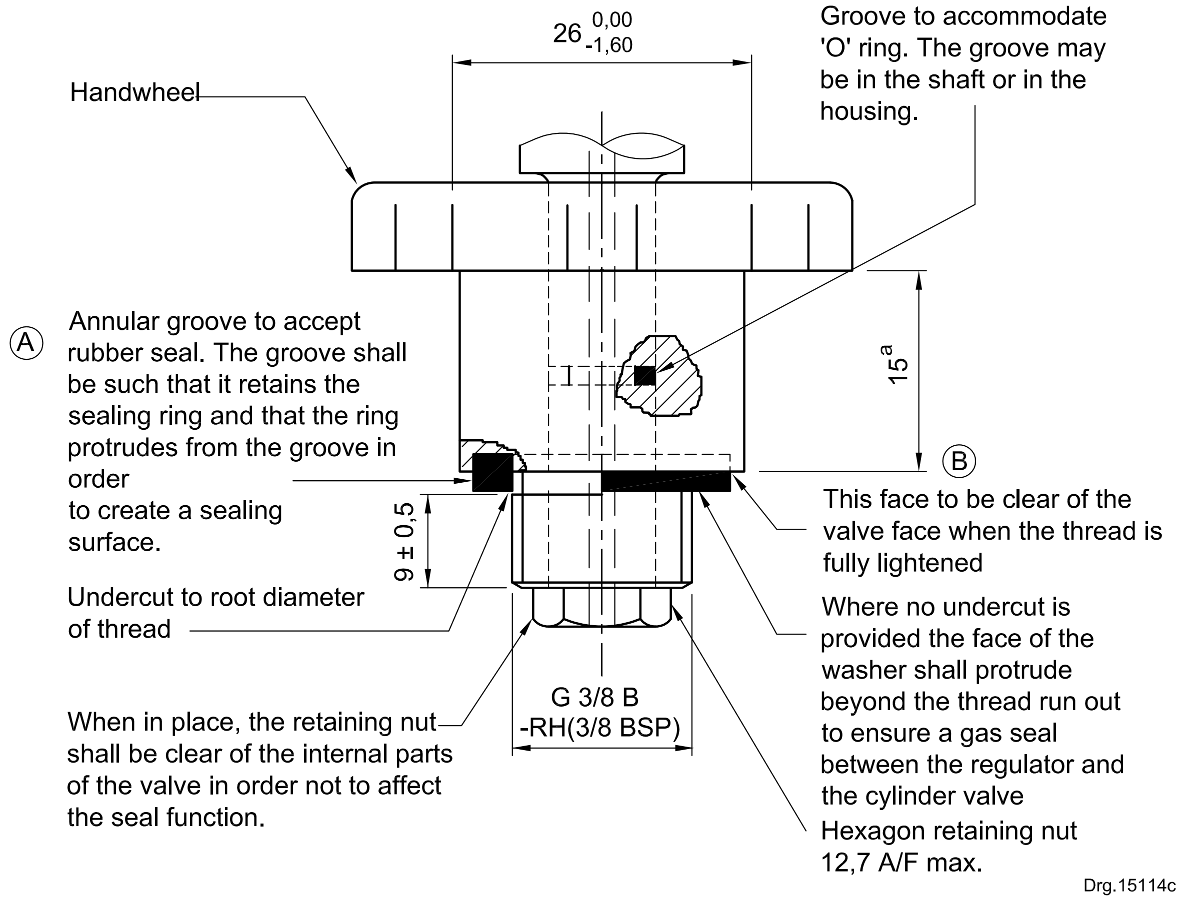


Figure 2 — G ⅜ fixed type cylinder connection for regulator **Amdt 1**

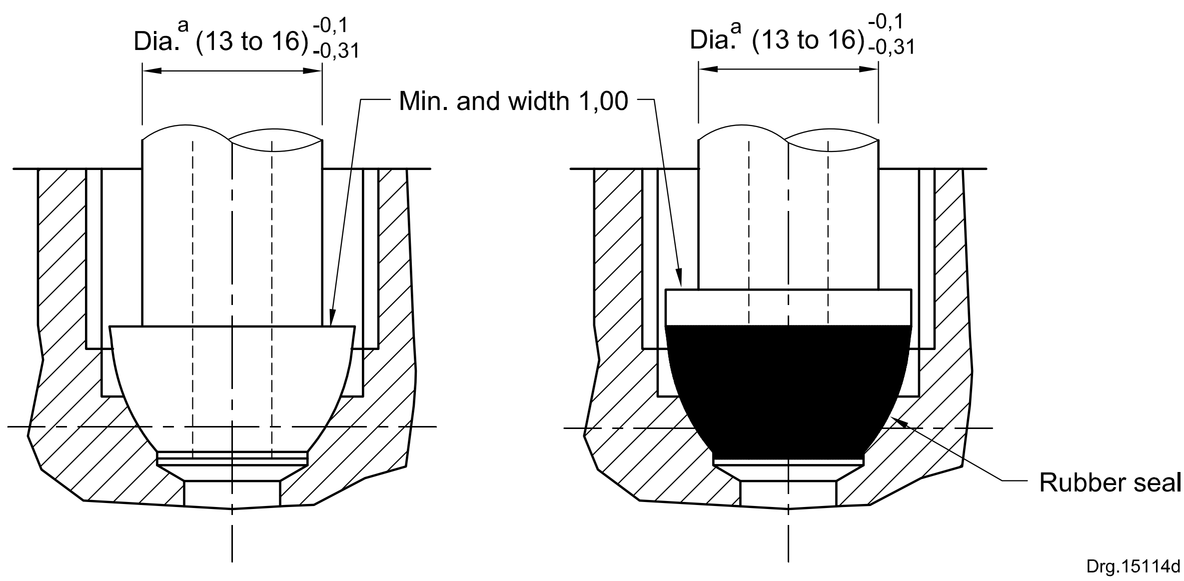


NOTE 1 Option A is supplied with an undercut.

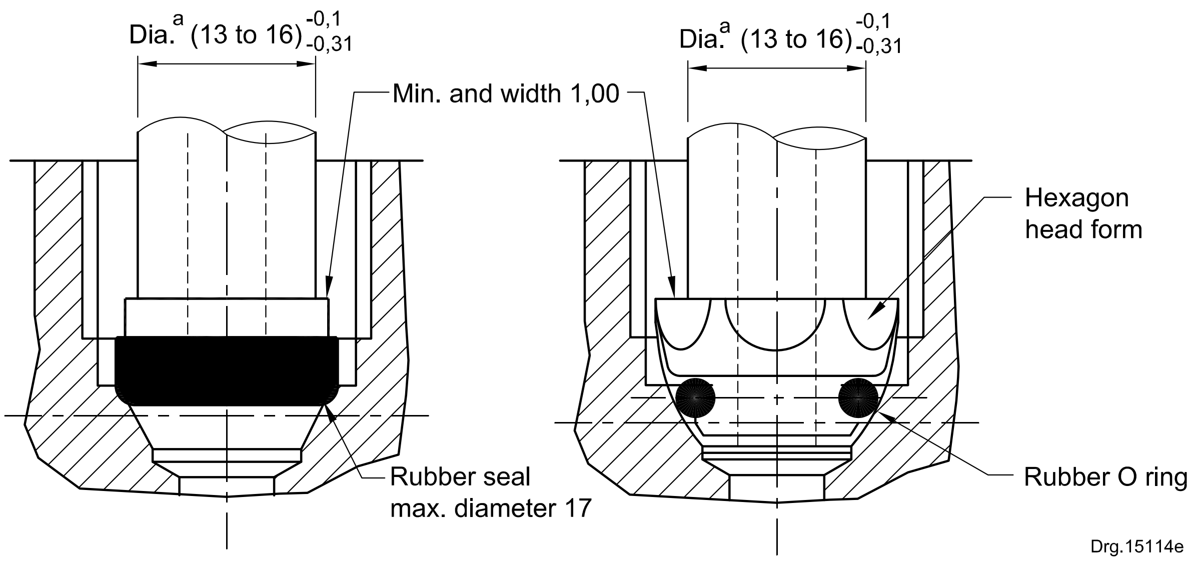
NOTE 2 Option B is supplied without an undercut but with the thread run out behind the face of the sealing washer.

[a] This dimension refers only to regulators supplied for connection to internal cylinder valves operated by a removable key or lever.

Figure 3 — G ⅜ swivel type cylinder connection for regulator **Amdt 1**



a) Type A bullnose inlet stem **b) Type B bullnose inlet stem**



c) Type C bullnose inlet stem **d) Type D bullnose inlet stem**

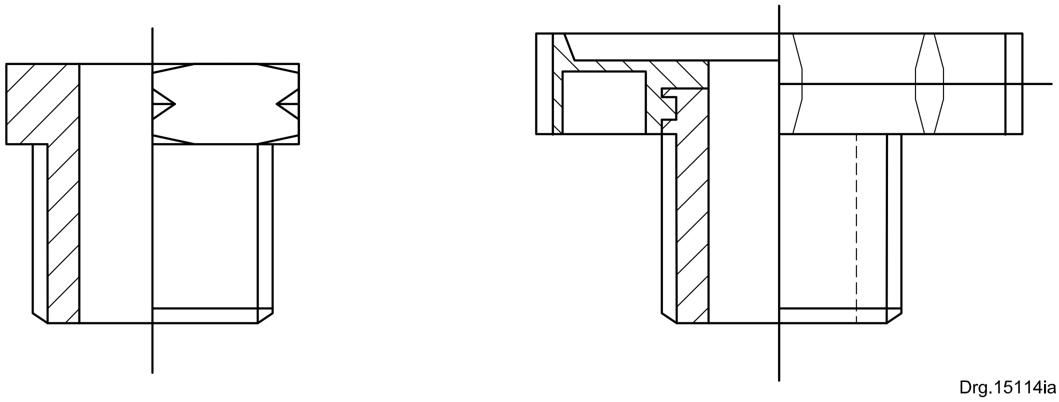
NOTE 1 Type A inlet stem may only be used with a hexagon-headed coupling nut.

NOTE 2 Type B, C and D inlet stem may only be used with a coupling nut designed to be hand tightened.

[a] The nominal diameter of the inlet stem and the coupling nut bore shall match, i.e. a 13 mm inlet stem may only be used with a coupling nut with a 13 mm bore diameter.

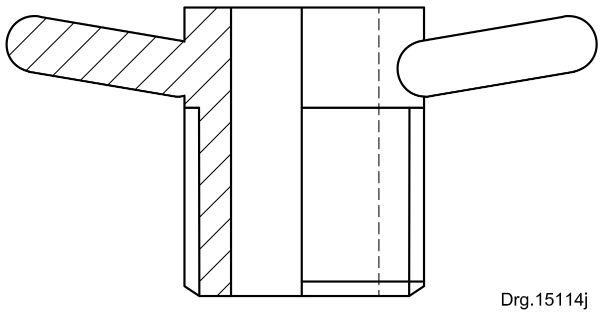
Figure 4 — Various types of bullnose inlet stem connections **Amdt 1**

Dimensions in millimetres

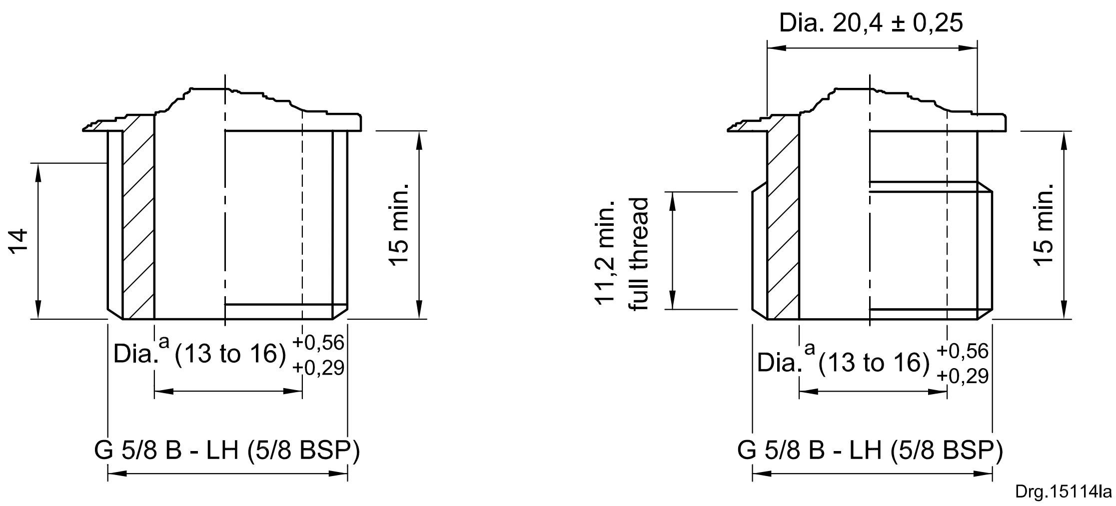


a) Hexagon type coupling nut
(only for use with type A inlet stem)

b) Handwheel type coupling nut
(only for use with type B, C or D inlet stem)



c) Wingnut type coupling nut (only for use with type B, C or D inlet stem)



d) Bullnose coupling nut (without undercut)

e) Bullnose coupling nut (with undercut)

[a] Nominal size of coupling nut bore and inlet stem diameter shall match, i.e. a 13 mm inlet stem may only be used with a coupling nut with 13 mm bore diameter.

Figure 5 — Typical coupling nuts for bullnose connectors **Amdt 1**

4.2.3.3 Threaded connections

The threads shall comply,

a) in the case of the connections shown in figures 2 and 3, with the appropriate requirements given in SANS 1306-1, or

b) in the case of connections intended for direct connection to supply pipelines, with the appropriate requirements given in SANS 1109-1 or for NPT threads ANSI B 2.1. **Amdt 1**

4.2.4 Resistance to deformation and breakage

When a regulator is tested in accordance with 5.10, it shall show no sign of breakage or permanent deformation of any of its parts.

4.2.5 Position of mounting and operation

Unless otherwise specified by the manufacturer, the regulator shall be suitable for mounting and operation in a horizontal and top-side-up position. All evaluation shall be carried out with the regulator mounted in the intended position.

NOTE A change in the mounting position will alter the performance characteristics of a regulator. The extent of the alteration will depend on a variety of factors (for example, quality, design, size and type). It is therefore recommended that, if the installation is other than normal, the user acquaint himself with the extent to which the performance of a specific regulator will be affected.

4.3 Performance

4.3.1 Gas-tightness

When a regulator is tested in accordance with 5.6 and 5.9, it shall show no sign of leakage.

4.3.2 Set outlet pressure

Regulators shall be factory set to an outlet pressure of 2,8 kPa $^{+0,2}_{0}$ kPa. **Amdt 1**

4.3.3 Nominal flow rate

The nominal flow rate of a regulator shall be specified by the manufacturer (see 6.2.1(d)) but it shall be not less than 1 kg/h and, when a regulator is tested in accordance with 5.3, the flow rate shall be not less than that specified. **Amdt 1**

4.3.4 Minimum flow rate

When determined in accordance with 5.3.2.3(e) and 5.3.2.3(f), the flow rate shall be not less than 85 % of the nominal flow rate and the outlet pressure shall be not less than 2,2 kPa. **Amdt 1; amdt 2**

4.3.5 Operation

When a regulator is tested in accordance with

a) 5.7.3.1, the outlet pressure shall not exceed 3,5 kPa; **Amdt 1**

b) 5.7.3.2, the lock-up pressure shall not exceed 3,8 kPa; **Amdt 1**

c) 5.7.3.3, the outlet pressure shall be not less than 2,3 kPa; and **Amdt 1**

d) 5.7.3.4, the outlet pressure shall not be less than 2,2 kPa and the maximum shall be not more than 3,5 kPa. **Amdt 1**

4.3.6 Control spring arrangement

The control spring and control spring adjusting mechanism (when not locked and sealed) shall be so designed, mounted and located that, when a regulator is tested in accordance with 5.7.3.6, the spring does not become compressed in a manner that will interfere with the normal lock-up operation of the regulator, and the maximum lock-up pressure does not exceed 8 kPa.

4.3.7 Endurance

When a regulator is tested in accordance with 5.4,

a) it shall show no sign of sticking, jamming, warping, wear or any other malfunction;

b) the diaphragm shall not pull out of its fixture, or burst;

c) the flow control cantilever shall show no sign of any permanent damage or distortion, or any wear that can affect the normal operation of the valve;

d) the regulator shall, during the test, not chatter or hum; and

e) the shore hardness of the seals shall comply with the requirements of 4.1.2. **Amdt 1**

4.4 Relief valves

4.4.1 Quality and design of relief valve

A regulator shall, when so required (see annex A), incorporate a relief valve of such quality and design that, when the regulator is tested in accordance with 5.5,

a) the relief valve opens at a pressure in the range 5,0 kPa to 8,5 kPa; and

b) at the end of the test, the relief valve does not leak.

4.4.2 Relief valve outlet connection

The regulator body shall, when a relief valve is incorporated, have an outlet port that will allow the escape of gas from the body. The outlet port shall be threaded or non-threaded.

4.4.3 Manner of installation

Regulators that have non-threaded relief valve ports are not suitable for indoor installation. Regulators that have threaded relief valve ports are not recommended for indoor use; however, if such a regulator is used indoors, the relief valve shall be vented to the outside.

4.5 Finish

All metal parts of a regulator shall be of an intrinsically corrosion-resistant material or otherwise all outside surfaces of metal parts shall have an application of a corrosion-resistant coating of such quality that, when a regulator is tested in accordance with 5.9, there is no penetration of the underlying metal.

5 Inspection and methods of test

5.1 Inspection

At least five samples shall be provided to the test laboratory for test and inspection. All the samples shall be tested for compliance to the requirements of 4.2 to 4.4, inclusive. Subject one of the samples to testing for full compliance to the test requirements of the standard. For a typical pressure and flow test bench see annex E. **Amdt 1**

5.2 Sequence of tests

Carry out the following tests, on each regulator in the sample, in the sequence in which they are given.

5.3 Determination of nominal and minimum flow rate

5.3.1 Apparatus

5.3.1.1 Air supply, capable of being adjusted to a constant pressure of 700 kPa ± 5 kPa and 80 kPa ± 5 kPa, as relevant.

5.3.1.2 Test bench, consisting of:

a) **water manometer** (or other pressure indicating device),

b) **pressure gauge** of 1 000 kPa,

c) **outlet control valve**,

d) **calibrated air-flow meter**, and

e) **connecting pipes**, of individual lengths of 600 mm to 650 mm, of bore diameter at least equal to that of the bore of the relevant regulator outlet or the outside diameter of the outlet nozzle, as relevant. **Amdt 1**

5.3.2 Procedure

5.3.2.1 Connect (in series and in the sequence given) the air supply, the regulator, the outlet control valve and the air-flow meter.

5.3.2.2 Connect the pressure gauge to the supply pipe at the inlet of the regulator, and the manometer to the outlet pipe at the outlet of the regulator.

5.3.2.3 Verify the nominal flow rate and the minimum flow rate corresponding to the outlet size of the regulator, as follows:

a) Determine the ambient pressure and ambient temperature. Open the air supply, adjust the inlet pressure to 700 kPa ± 5 kPa, and maintain the pressure at that value;

b) So adjust the outlet control valve (while maintaining the inlet pressure at 700 kPa ± 5 kPa) that the outlet pressure corresponds to 2,8 kPa;

c) Allow the pressures to stabilize for 2 min, making appropriate adjustments if necessary;

d) Note the flow rate and check for compliance with 4.3.3, i.e. not less than the nominated capacity as determined by the manufacturer; **Amdt 1**

e) Without any adjustment of the outlet control valve, reduce the inlet pressure to 80 kPa ± 5 kPa. Allow the inlet and outlet pressures to stabilize for 2 min, making appropriate adjustments to the inlet pressure if necessary;

f) Note the outlet pressure and the flow rate and check for compliance with the appropriate requirements of 4.3.4. Calculate the gas-flow rate m_g, in kilograms per hour, from the following formula:

$$m_g = \frac{4,61 \times Q_A \times P}{T}$$ (see D.4 and D.5 for derivations)

where

m_g is the gas-flow rate, in kilograms per hour;

Q_A is the air flow at ambient pressure and ambient temperature, in cubic metres per hour;

P is the ambient pressure (atmospheric), in kilopascals;

T is the ambient temperature, in Kelvins.

NOTE For further information regarding the use of the above formula, see annex D.

g) Repeat the procedure for each additional outlet size given (see 6.2.2(a)).

5.4 Endurance test

5.4.1 Conditioning

Before the test, subject the regulator to the following conditioning procedure(s), as relevant:

a) **Temperature conditioning for regulators with plastics component parts.** Subject the regulator to a temperature of 80 °C ± 2 °C for 72 h and then let it cool and rest at room temperature for 24 h.

b) **N-pentane conditioning for all regulators.** Immerse the regulator (when relevant, after the temperature conditioning procedure given in (a) above) completely in N-pentane for 72 h. Remove the regulator from the test liquid. Remove all free N-pentane from the regulator and allow it to dry in the open air for 24 h.

5.4.2 Procedure

5.4.2.1 Before connecting the regulator to the air supply the seal shall be subjected to a hardness test for compliance with 4.1.2. **Amdt 1**

5.4.2.2 Connect the inlet of the regulator to an air supply at a pressure of 800 kPa ± 25 kPa and connect the outlet to a solenoid valve operated by means of a timing device.

5.4.2.3 Throttle the valve to ensure a backpressure of about 2,8 kPa on the regulator.

5.4.2.4 Adjust the timing device to open and close the solenoid valve at a rate of 15 cycles per minute, each cycle consisting of one opening and one closing action of approximately equal duration.

5.4.2.5 Subject the regulator to 50 000 cycles.

5.4.2.6 Examine the regulator and check for compliance with 4.3.7.

5.5 Performance test of relief valve

5.5.1 Connect the outlet of the regulator to an air supply and increase the pressure until the relief valve opens.

5.5.2 Reduce the pressure to zero and again increase the pressure until the relief valve opens.

5.5.3 Repeat this procedure 19 times (i.e. to a total of 20 times), each time noting the pressure at which the relief valve opens, and check for compliance with 4.4.1(a).

5.5.4 Reduce the pressure to zero and then increase the pressure to a value of 4,7 kPa, and check the valve for leaks.

5.5.5 Check for compliance with 4.4.1(b).

5.6 Test for gas-tightness

5.6.1 First, subject the outlet of the regulator, with the inlet closed, to an air pressure of 25 kPa. When testing high-pressure regulators use a pressure of 1,5 times the maximum outlet pressure obtainable from the regulator. **Amdt 1**

NOTE When a relief valve is fitted, ensure that all vents in the top half of the body (above the diaphragm) are sealed.

5.6.2 Then subject those portions of the regulator subjected to inlet pressure to an air pressure of 1 600 kPa.

5.6.3 In each case, using a soap solution and brush, examine the regulator for leakage while the pressure is being applied, and check for compliance with 4.3.1.

5.7 Tests for outlet pressure and lock-up pressure

5.7.1 Apparatus

5.7.1.1 Air supply, the pressure of which can be adjusted to any constant value in the range 70 kPa to 800 kPa.

5.7.1.2 Water manometer (or other pressure indicating device).

5.7.1.3 Pressure gauge of 1 000 kPa.

5.7.1.4 Outlet control valve.

5.7.1.5 Calibrated air-flow meter.

5.7.1.6 Connecting pipes, of individual lengths of 600 mm to 650 mm, of bore diameter at least equal to that of the bore of the relevant regulator outlet or the outside diameter of the outlet nozzle, as relevant.

5.7.2 Flow calculation

Air-flow rates required at each stage shall be calculated from the given gas-flow rate (see 6.2.1(d)), using the formula given in the note to 5.3.2.3.

5.7.3 Procedure

5.7.3.1 Set and maintain the inlet pressure at 700 kPa ± 5 kPa and adjust the outlet control valve, to obtain an air-flow rate equivalent to 10 % of the nominal gas-flow rate (see 6.2.1(d)). Note the outlet pressure and check for compliance with 4.3.5(a). **Amdt 1**

5.7.3.2 Close the outlet control valve completely, readjust the inlet pressure to 700 kPa ± 5 kPa, note the lock-up pressure and check for compliance with 4.3.5(b). **Amdt 1**

5.7.3.3 Open the outlet control valve and adjust the air-flow rate to the equivalent of 200 % of the nominal flow rate. Note the outlet pressure and check for compliance with 4.3.5(c). **Amdt 1**

5.7.3.4 Repeat the procedure given in 5.7.3.1 to 5.7.3.2 above with the inlet pressure adjusted to 80 kPa ± 5 kPa. **Amdt 1**

5.7.3.5 In the case of a control spring adjusting mechanism that is not locked, adjust the control spring to the maximum compression possible, close the outlet control valve, observe the lock-up operation, note the lock-up pressure and check for compliance with 4.3.6. **Amdt 1**

5.8 Determination of sealing ability of sealing washer

5.8.1 Apparatus

LPG cylinder, that is filled to its normal working capacity and that has an undamaged outlet connection designed to accept the regulator under test.

5.8.2 Procedure

5.8.2.1 Fit the regulator to the cylinder and screw it in hand-tight, as in practice.

5.8.2.2 Seal the outlet of the regulator and open the cylinder valve.

5.8.2.3 Using a soap solution and brush, check for leakage of gas around the sealing washer.

5.8.2.4 With the cylinder valve still in the open position, loosen the regulator until excessive leakage occurs at the sealing washer or through two full turns, whichever occurs first.

5.8.2.5 Tighten the regulator again and check for leakage.

5.8.2.6 Repeat this procedure four times (i.e. to a total of five times), each time checking for leakage of gas past the sealing washer.

5.8.2.7 Check for compliance with 4.2.3.3.

5.9 Test for corrosion resistance

Using SANS 7253, subject the regulator to the salt fog for 168 h and then inspect the valve for compliance with 4.5. Repeat the test given in 5.6 and inspect the valve for compliance with 4.3.1.
Amdt 1

5.10 Tests for resistance to deformation and breakage

5.10.1 Bending test

5.10.1.1 Regulators with threaded connections

5.10.1.1.1 So rigidly fix the regulator body that the axes of both the inlet and the outlet of the regulator are in a horizontal plane.

5.10.1.1.2 Insert a pipe nipple of appropriate thread size and of length at least 50 mm into the threaded connection. Fit a pipe of length approximately 350 mm snugly over the nipple.

5.10.1.1.3 Using the pipe as a cantilever, subject the regulator outlet to the bending moment given in column 2 of table 1, appropriate to the size of the connection given in column 1, first about the horizontal and then about the vertical axis perpendicular to the outlet axis.

5.10.1.1.4 Apply the force for 10 s in each direction.

5.10.1.1.5 Check for compliance with 4.2.4.

5.10.1.1.6 Repeat the above test with the nipple fitted to the regulator inlet.

Table 1 — Bending moment for threaded connections

1	2
Size of connection mm	**Bending moment** Nm
10	25
15	70
20 and greater	100

5.10.1.2 Regulators with outlet hose connections

5.10.1.2.1 So rigidly fix the regulator body that the outlet of the regulator is in a horizontal plane.

5.10.1.2.2 Fit an appropriately sized pipe of length approximately 350 mm snugly over the regulator outlet.

5.10.1.2.3 By using the pipe as a cantilever, apply to the regulator connection a bending moment of 10 Nm, first about the horizontal and then about the vertical axis perpendicular to the outlet axis.

5.10.1.2.4 Apply the force for 10 s in each direction.

5.10.1.2.5 Check for compliance with 4.2.4.

5.10.2 Test on threads

5.10.2.1 Fit to the threaded connection a fitting with a matching thread and apply to the fitting a tightening torque of 15 Nm, 20 Nm, 35 Nm or 50 Nm for a thread size of 6 mm, 8 mm, 10 mm or 15 mm, respectively.

5.10.2.2 For a threaded outlet, repeat the above test.

5.10.2.3 Check for compliance with 4.2.4.

5.11 Determination of susceptibility of copper alloy parts to seasonal cracking

5.11.1 Reagents

5.11.1.1 Nitric acid, concentrated (d = 1,42 g/cm^3).

5.11.1.2 Nitric acid, dilute, 50 % (by volume) of concentrated nitric acid in distilled water.

5.11.1.3 Mercurous nitrate solution, a distilled water solution that contains 1 % (by mass) of mercurous nitrate ($Hg(NO_3)_2H_2O$) and 1 % (by volume) of the concentrated nitric acid. **Amdt 1**

5.11.2 Test specimen

Use the copper alloy part (or a piece cut from it, if it is too large to be immersed in the test solution).

5.11.3 Procedure

5.11.3.1 Degrease the test specimen and then dip it, for 30 s, in the diluted nitric acid solution.

5.11.3.2 Rinse the test specimen in cold water and immediately immerse it completely in the mercurous nitrate solution.

5.11.3.3 For all alloys remove the test specimen after 30 min, rinse it well in cold water, wipe it carefully, and examine it immediately. **Amdt 1**

5.11.3.4 Check for compliance with 4.1.3.

6 Packing and marking

6.1 Packing

Each regulator shall be so packed as to prevent the ingress of any foreign matter into the regulator.

6.2 Marking

6.2.1 The following information shall be legibly and indelibly stamped, embossed, or otherwise permanently applied, on the body of each valve:

a) the manufacturer's name or trade name or trademark;

b) the direction of flow indicated by, for example, an arrow;

c) the set outlet pressure (i.e. 2,8 kPa);

d) the nominal gas-flow rate of the regulator (expressed in kilograms per hour or grams per hour);

e) the month and year of manufacture;

f) in the case of regulators manufactured with non-threaded relief valve ports (see 4.4.3), acceptable wording to the fact that the regulator is for outdoor use only;

g) in the case of regulators manufactured with threaded relief valve ports (see 4.4.3), acceptable wording to the fact that the relief valve shall be vented to the outside of the building; and **Amdt 1**

h) the model number of the regulator. **Amdt 1**

6.2.2 The following information shall be supplied with the regulator:

a) when relevant, any additional outlet sizes of the regulator and the corresponding flow capacities;

b) wording to the effect

   1) that the regulator is for use with LPG only, and

   2) when relevant, that the spring setting is preadjusted and should not be tampered with;

c) any additional information regarding the safe and effective installation and operation of the regulator; and

d) in the case of a regulator that has

   1) non-threaded relief valve port(s), a warning that the use of such a regulator indoors is not permitted (see 4.4.3), or

   2) threaded relief valve port(s), a warning that the use of such a regulator indoors is not recommended (see 4.4.3), accompanied by explicit instructions regarding the venting of threaded relief valve ports to the outside should it be used indoors.

6.2.3 Instructions for use and maintenance

Each regulator shall be accompanied by instructions intended for the user that shall specify:

a) the agent or manufacturer's address;

b) the assembly conditions, in particular the preferred position recommended by the manufacturer and the instructions concerning the method of connection (for example connection of the hose to the regulator, connection of the regulator to the cylinder valve, etc.);

c) any specific sealing requirements with particular attention to the sealing surfaces; and

d) the conditions of use. **Amdt 1**

Annex A
(normative)

Note to purchasers

The following requirement shall be specified in tender invitations and in each order or contract:

Whether a relief valve is required (see 4.4.1).

Annex B
(informative)

Quality verification of single-stage low-pressure regulators for liquefied petroleum gas

When a purchaser requires ongoing verification of the quality of regulators, it is suggested that, instead of concentrating solely on evaluation of the final product, he also direct his attention to the manufacturer's quality system. In this connection it should be noted that SANS 9001 covers the provisions of an integrated quality system. **Amdt 1**

Annex C
(informative)

The installation and use of regulators

C.1 General

A well-designed and well-manufactured regulator is inexpensive and efficient and serves the function of reducing a known high inlet pressure of a gas to a predetermined and known operating pressure. The operating pressure is, however, regulated by controlling the rate of flow of gas through the regulator orifice. Although the outlet pressure is kept almost constant over a very wide range of flow rates, extreme conditions cannot be catered for and problems can arise (see C.2).

The regulator control spring is designed and adjusted for particular operating conditions (outlet pressure and flow). These conditions can be slightly altered by readjustment of the spring setting. Such alteration, however, influences the performance of other parts of the regulator and is therefore never recommended, except when executed by the manufacturer with the aid of the appropriate instruments.

The regulator cannot effectively deliver more gas than the amount for which it has been set. It is therefore essential that the user determine his requirements in full and then obtain a regulator of the appropriate (or larger) capacity. The use of a number of small-capacity gas appliances connected to a single regulator can, however, lead to certain low flow difficulties. It is recommended that such conditions be discussed with and solved by the supplier during installation. (For further particulars, see C.2.)

The rating of the regulator should not exceed the evaporative capacity of the LPG cylinder to which it is attached. If the evaporative capacity of the LPG cylinder is exceeded, the liquid in the cylinder will cool down and cause a reduction in the quantity of gas supplied. The evaporative capacities of LPG cylinders of various sizes are given in table C.1 (see also SANS 10087-1). Because a regulator is adjusted to operate at a specific outlet pressure, it cannot efficiently or safely supply a combination of individual appliances that have different operating pressures.

Usually the regulator will supply too little for the higher pressure appliances (units) or too much for the lower pressure appliances, both conditions being hazardous. In such cases, it is recommended that a combination of two (or more) regulators be installed, each being adjusted for its particular duty. This approach does not necessarily involve a doubling of cost, because the flow is split and, since the rating is thereby reduced, smaller regulators can be used.

The regulator is adjusted for operating pressures measured near its outlet. Friction losses in the supply pipe from the regulator to the appliance will cause a proportionate reduction in the gas flow. The resulting gas supply at the end of the supply pipe can be much less than the intended rating of the regulator and can lead to hazards, annoyance, and unresolved arguments with the supplier.

Table C.1 — Evaporative capacities of gas cylinders

1		2	
Nominal size of cylinder		**Approximate evaporative capacity**	
Water capacity L	**Nominal mass of gas** kg	L/h	g/h
14	6	66	90
22	9	100	230
34	13/14	140	320
45	19	200	460
113	48	400	920
454	196	1 000	2 300

Amdt 1

C.2 Problems and their rectification

The following problems can be encountered in a gas supply system to an appliance:

a) In certain appliances (such as refrigerators and gas heaters) a constantly burning pilot burner is used to keep the appliance in operation while the main gas supply is shut off or reduced to a very low operating rate. The quantity of gas consumed by a pilot burner is minute (practically nil) and demands a flow rate much lower than the flow rate (10 % of nominal flow rate) at which the regulator is tested (see 5.7.3.2). Consequently, should the main burner(s) of the appliance be shut off, the gas flow will be radically reduced, the supply pressure will rise suddenly, and the pilot burner, if not properly designed, might be extinguished.

b) All gas appliances are designed for a specific flow rate and a specific operating pressure. These conditions are as determined at the inlet to the appliance. Alteration of either of these conditions can lead to a variety of ineffective operations including incomplete combustion causing carbon monoxide production, which could result in the poisoning and even the death of a user. It is therefore necessary that in the case of long supply pipes (exceeding 2 m), the bore of the pipes be calculated to ensure that no significant pressure drop will occur during periods of maximum flow. It is strongly recommended that the total pressure drop in such a system does not exceed 0,25 kPa.

The general (but incorrect) solution to this problem is to increase the regulator pressure by the same amount as the drop in pressure. It should be kept in mind that the lock-up pressure and low-flow pressure automatically rise when the set outlet pressure is increased. This naturally distorts the balance of the whole system and can be hazardous. Users are strongly cautioned against trying to reduce the cost of the system by reducing the size of the supply pipes. Changing to a different type or make of regulator will not prevent the above-mentioned pressure drop.

C.3 Design considerations

From the foregoing, it is obvious that the operation of an effective, trouble-free, efficient and safe gas supply system can be quite complex and that each system should be individually and specifically designed. In this regard, the following factors should be kept in mind:

a) The total consumption of all the appliances connected to the system or the rating of the regulator should not exceed the evaporative capacity of the gas cylinder (see table C.1), and in certain cases a duplicate system might prove the most effective.

b) The system (i.e. the length and bore of supply pipes, their distribution, and the types of fitting and control) should be designed to prevent any detrimental pressure loss or flow loss.

c) The operating pressures of all appliances in one system or all appliances supplied by one regulator shall be the same and, in this regard, manufacturers of appliances shall adapt their units to comply with the requirements of SANS 1539. **Amdt 1**

d) Regulators shall not be adjusted without the use of the appropriate test apparatus and without the advice or agreement of the manufacturer. For systems incorporating high pressure regulators the pressure may be adjusted by the registered installer. **Amdt 1**

e) Regulators fitted with relief valves are not recommended for use in indoor applications unless they are fitted with a means to vent the gas, in case of a leak, to the outside of the building. (See SANS 10087-1.) **Amdt 1**

f) Appliances that have constantly burning pilot burners, and a combination of appliances, some of which have intermittent high consumptions and others that have consistent low consumptions, can be subject to serious operational inadequacies when under the direct control of a badly designed pressure regulator. For this reason, the use of a technically sound regulator is imperative if the provision of additional regulators or supply pipes (or both) is to be obviated.

Annex D
(informative)

Relationship between gas-flow and air-flow ratings

D.1 The relationship between gas flow and air flow (effusion) through an orifice can be calculated from the following formula:

$$Q_A = Q_g \sqrt{\frac{\rho_g}{\rho_A}} = Q_g \sqrt{\frac{M_g}{M_A}}$$

where

Q_A is the air flow, in litres per hour;

Q_g is the gas flow, in litres per hour;

ρ_g is the density of gas, in grams per cubic centimetre;

ρ_A is the density of air, in grams per cubic centimetre;

M_g is the molecular mass of gas, in grams per mole;

M_A is the molecular mass of air, in grams per mole.

D.2 The molecular masses of various gases and air are as follows:

Table D.1 — Molecular masses

1	2
Gas	**Molecular mass** kg/mol
Air Propane Butane	29 44 58
50:50 propane/butane 30:70 propane/butane Town gas	51 54 13

D.3 Since, for this standard, the flow rates are determined (for a 50:50 mixture of propane and butane gases) at the same outlet pressure (an atmospheric pressure of 101,3 kPa) and at the same temperature (20 °C), the above formula for flow (see D.1) may be reduced to the following formula:

$$Q_A = Q_g \sqrt{\frac{M_g}{M_A}} = Q_g \sqrt{\frac{51}{29}} = 1{,}33\ Q_g \quad \text{..........} \quad (1)$$

where

Q_A is the air flow, in litres per hour;

Q_g is the gas flow, in litres per hour;

ρ_g is the density of gas, in grams per cubic centimetre;

ρ_A is the density of air, in grams per cubic centimetre;

M_g is the molecular mass of gas, in grams per mole;

M_A is the molecular mass of air, in grams per mole.

From the ideal gas law, at 101,3 kPa and 20 °C, 1 mole of 50:50 propane/butane occupies a volume given by the following formula:

$$\frac{RT}{P} - \frac{8\,314 \times (273 + t)\mathrm{L}}{101{,}3 \times 10^3}$$

where

R is the molar gas constant, taken to be 8 314 J/mol.K;

T is the temperature, in Kelvins;

P is the atmospheric pressure, in kilopascals;

t is the temperature, in degrees Celsius.

1 mole of the gas mixture has a mass of 51,0 g, therefore

$$\rho_g = \frac{51 \times 101{,}3 \times 10^3}{8\,314 \times 293}$$

$$= 2{,}12 \text{ g/L at } 101{,}3 \text{ kPa and } 20\ ^\circ\text{C}$$

$$\text{and } Q_A = \frac{1{,}33}{2{,}12} m_g = 0{,}63\, m_g \quad \text{.......... (2)}$$

where

ρ_g is the density of gas, in grams per cubic centimetre;

Q_A is the air flow at 101,3 kPa and 20 °C, in litres per hour;

m_g is the gas flow at 101,3 kPa and 20 °C, in grams per hour.

D.4 If, during the test, the air temperature and barometric pressure differ significantly from those given in D.3, then the following formula based on actual temperature and atmospheric pressure may be used:

$$Q_A - 0{,}217 \frac{(273) + t)}{P} m_g$$

where

Q_A is the air flow at P and t, in litres per hour;

t is the operating temperature, in degrees Celsius;

P is the atmospheric pressure, in kilopascals;

m_g is the gas flow at 101,3 kPa and 20 °C, in grams per hour.

D.5 To determine the mass gas flow at 101,3 kPa and 20 °C, the reverse of the formula in D.4 may be used as follows:

$$m_g - \frac{4,61 \times Q_A \times P}{T}$$

where

m_g is the mass gas flow at 101,3 kPa and 20 °C, in grams per hour;

Q_A is the air flow at P and T, in litres per hour;

P is the atmospheric pressure, in kilopascals;

T is the operating temperature (= 273 + t) in degrees Celsius.

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SANS 1539, *Appliances operating on liquefied petroleum gas – Safety aspects*.

SANS 9001/ISO 9001, *Quality management systems – Requirements.* **Amdt 1**

SANS 10087-1, *The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic, commercial, and industrial installations – Part 1: Liquefied petroleum gas installations involving gas storage containers of individual water capacity not exceeding 500 L and a combined water capacity not exceeding 3 000 L per installation*.

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