

Automatic change-over valves 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

ICS 23.060.20

National foreword

This British Standard is the UK implementation of EN 13786:2004+A1:2008, incorporating corrigendum August 2004. It supersedes BS EN 13786:2004 which is withdrawn.

The start and finish of text introduced or altered by corrigendum is indicated in the text by tags. Text altered by CEN corrigendum August 2004 is indicated in the text by AC AC.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to CEN text carry the number of the CEN amendment. For example, text altered by CEN amendment A1 is indicated by A1 A1.

The UK participation in its preparation was entrusted to Technical Committee GSE/24, Dedicated LPG appliances.

A list of organizations represented on this committee can be obtained on request to its secretary.

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 cannot confer immunity from legal obligations.

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English Version

Automatic change-over valves 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

Inverseurs automatiques de débit inférieur ou égal à 100 kg/h, à pression de détente nominale maximale inférieure ou égale à 4 bar, et leurs dispositifs de sécurité associés, pour butane, propane ou leurs mélanges

Automatische Umschaltventile mit einem höchsten Ausgangsdruck bis einschließlich 4 bar und einem Durchfluss bis einschließlich 100 kg/h für Butan, Propan oder deren Gemische sowie die dazugehörigen Sicherheitseinrichtungen

This European Standard was approved by CEN on 2 February 2004 and includes Corrigendum 1 issued by CEN on 25 August 2004 and Amendment 1 approved by CEN on 27 September 2008.

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Foreword

This document (EN 13786:2004+A1:2008) has been prepared by Technical Committee CEN/TC 181 "Dedicated liquefied petroleum gas appliances", the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2009, and conflicting national standards shall be withdrawn at the latest by May 2009.

This document includes Amendment 1, approved by CEN on 2008-09-27 and Corrigendum 1 issued by CEN on 2004-08-25.

This document supersedes EN 13786:2004.

The start and finish of text introduced or altered by amendment is indicated in the text by tags **A1** **A1**.

The modifications of the related CEN Corrigendum have been implemented at the appropriate places in the text and are indicated by the tags **AC** **AC**.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

This European Standard covers only type testing.

Items relating to quality assurance systems, production testing and particularly certificates of conformity are not covered in this standard.

This text is the third part of a series of standards covering different applications of the equipment considered. Two complementary documents have been elaborated:

- EN 12864, *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;*
- **A1** EN 13785 **A1**, *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.*

The **A1** Annexes A, B, C, D, E, F, G, H, I and J **A1** are normative.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

1 Scope

This European Standard defines the constructional and operational characteristics, the safety requirements and test methods, and the marking of automatic change over devices with a capacity of less than or equal to 100 kg/h and having a maximum regulated pressure of less than or equal to 4 bar for butane, propane or their mixtures only in the vapour phase.

NOTE 1 bar = 10^5 Pa.

Liquefied gases containing methylacetylene and propadiene are not covered by this standard.

This European Standard also covers safety devices likely to be fitted onto automatic change over devices. The characteristics of these devices are given in annex A.

The requirements of this European Standard generally cover designs where regulation is in one stage, using a single diaphragm. These requirements do not exclude designs using more than one diaphragm, provided that these diaphragms are integrated in a single automatic change over devices complying with the requirements of this European Standard.

For specific uses in caravans and leisure vehicles, the automatic change over devices function may also be carried out by an assembly of regulators, forming a "automatic change over devices system" as defined in 3.1.2. This standard covers such an assembly as follows:

- special requirements for the manufacture, adjustment and operation of regulators forming a automatic change over devices system, as well as the corresponding test methods are given in annex B;
- except for these special requirements, and unless otherwise stated, constructional and performance characteristics given in the body of the standard are also applicable to the devices in annex B.

The requirements apply generally to automatic change over device used in locations where the temperature likely to be reached during use is between -20 °C and +50 °C. When the devices are used at temperatures outside this range they shall comply with special requirements defined in annex C.

This standard does not include the installation rules for automatic change over devices. In this matter, reference should be made to national regulations in force in the member countries.

This standard only covers type testing.

WARNING NOTICE: The figures in annexes G and H show the types of connections used according to the country of use of the regulators.

The top part of these figures (above the horizontal line) applies to the regulator and is normative. The bottom part of these figures (below the horizontal line) applies to the part to be connected to the regulator.

This is given as a guide for the tests and is not normative.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of their publications apply to this European Standard only when incorporated in it by amendment or revision. For undated reference the latest edition of the publication referred to applies (including amendments).

EN 437:2003, *Test gases – Test pressures – Appliance categories*

EN 549, *Rubber materials for seals and diaphragms for gas appliances and gas equipment*

EN 1949, *Specification for the installation of LPG-systems for habitation purposes in leisure accommodation vehicles and in other road vehicles*

prEN 1763, *Flexible rubber and plastics hose, tubing, nozzles and assemblies for use with propane and butane in the vapour phase – Specification*

EN 12164, *Copper and copper alloys – Rod for free machining purposes*

EN 12165, *Copper and copper alloys – Wrought and unwrought forging stock*

EN 12864:2001, *Low pressure, non adjustable regulators having a maximum outlet pressure 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*

EN 13785 ^{A1}, *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*

EN ISO 75-3, *Determination of temperature of deflection under load*

EN ISO 178, *Plastics – Determination of flexural properties (ISO 178:2001)*

EN ISO 180, *Plastics – Determination of Izod impact strength (ISO 180:2000)*

EN ISO 228-1, *Pipe threads where pressure-tight joints are not made on the threads - Part 1: Dimensions, tolerances and designation (ISO 228-1:2000)*

EN ISO 527-4, *Plastics – Determination of tensile properties*

EN ISO 3166-1, *Codes for the representation of names of countries and their subdivision – Part 1: Country codes (ISO 3166-1:1997)*

EN ISO 4892-3, *Plastics – Methods of exposure to laboratory light sources – Part 3: Fluorescent UV lamps (ISO 4892-3:1994)*

EN ISO 7253, *Paints and varnishes - Determination of resistance to neutral salt spray (fog)* ^{A1}

EN ISO 9773, *Plastics - Determination of burning behaviour of thin flexible vertical specimens in contact with a small-flame ignition source (ISO 9773:1998)*

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

ISO 301, *Zinc alloy ingots intended for casting*

ISO 565, *Test sieves – Metal wire cloth, perforated metal plate and electroformed sheet – Nominal sizes of openings*

ISO 7005-2, *Metallic flanges – Part 2: Cast iron flanges*

3 Terms and definitions

For the purposes of this European Standard, the following terms and definitions apply.

3.1 General terms and definitions

3.1.1

automatic change over devices

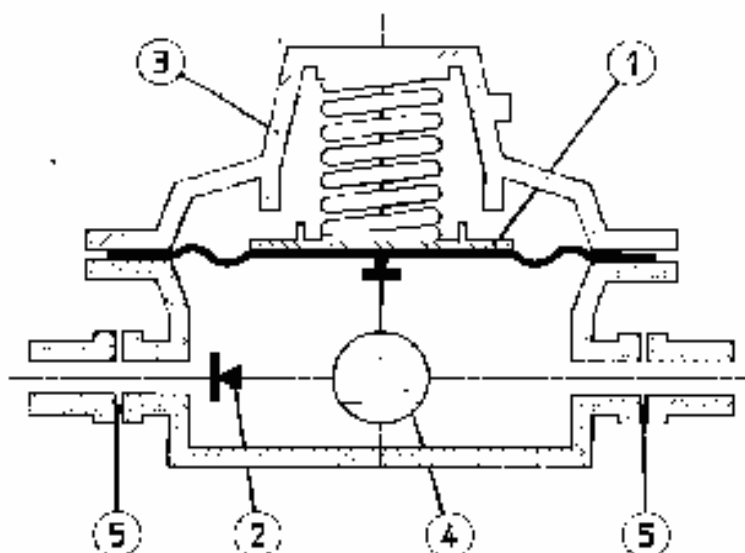
device which maintains the gas supply continuity by automatically using a gas from a "reserve" cylinder or series of cylinders when the supply pressure from a "service" cylinder or series of cylinders preselected by the user drops below a set value. This device allows regulation of the gas with upstream pressure within set limits, to a specified regulated pressure. It controls the operation of a supply-reserve indicator, allowing the identification of the cylinder or series of cylinders in use

The terminology used is shown in Figure 1. The diagram is shown as a guide, no other method is excluded.

3.1.2

automatic change over devices system

system of several regulators designed and adjusted in such a way as to operate like an automatic change over device as in 3.1.1 (see annex B)



Key

1 Pressure sensing subassembly

2 Regulation subassembly

3 Back pressure subassembly

4 Mechanical connection subassembly

5 Connection subassembly



Figure 1 — Diagram of an automatic change over devices

3.1.3

fixed automatic change over device

automatic change over device whose regulated pressure is adjusted by the manufacturer and fixed and whose adjustment cannot be modified by the user

3.1.4

variable automatic change over device

automatic change over device whose regulated pressure may be modified by the user simple manipulation between two fixed limits

3.1.5

adjustable automatic change over device

automatic change over device whose regulated pressure may only be modified by a specialist at the time of installation; it is then fixed fashion

3.1.6

tap

device for closing the gas flow which requires an intentional manual action (for example on a lever, a knob, etc...)

3.1.7

valve

component part of the regulation subassembly which ensures soundness between the part of the automatic change over devices at supply pressure and the part of the automatic change over devices at regulated pressure, when this is equal to the $\boxed{A_1}$ lock up pressure $\boxed{A_1}$

3.1.8

sealing

any arrangement of any device, for example an adjuster, such that any interference likely to change its setting causes the breaking of the device or sealing material making the interference apparent

3.1.9

nominal diameter (DN)

numerical designation common to all the components of a same pipe-work other than those named by their external diameter or by the size of the thread. It is a whole number used as a reference and related approximately to the manufacturing dimensions

[EN 88]

3.2 Terms and definitions concerning gas

3.2.1

butane

mixture of third family gases whose vapour pressure (p_v) at 50 °C is greater than or equal to 4,3 bar and at most equal to 7,5 bar, of mean volumetric mass in the gas phase equal to 2,4 kg/m³

3.2.2

propane

mixture of third family gases whose vapour pressure (p_v) at 50 °C is greater than or equal to 7,5 bar or at most equal to 16 bar, of mean volumetric mass in the gas phase equal to 1,85 kg/m³

3.2.3

LPG

mixture of third family gases whose vapour pressure (p_v) at 50 °C is greater than or equal to 4,3 bar or at most equal to 16 bar, of mean volumetric mass in the gas phase equal to 2,12 kg/m³

3.3 Terms and definitions concerning pressures

Values of pressures given in the text are to be considered as values of relative pressure and are expressed in bar (bar) or millibar (mbar).

3.3.1 supply pressure

p
value of the gas pressure measured at the automatic change over device's inlet

3.3.2 regulated pressure

value of the gas pressure measured at the automatic change over device outlet or of the automatic change over device system as described in annex B

3.3.3 nominal regulated pressure

p_d
value of the regulated pressure corresponding:

- either to the normal pressure for appliances as defined in 3.6 of EN 437:2003;
- or to the normal pressure for appliances operating outside the scope of EN 437;
- or to an intermediate pressure allowing the supply of a second stage regulator under the conditions of 6.2.

From this pressure the operational limits of the automatic change over devices are obtained. This pressure is marked on the automatic change over devices.

3.3.4 lock up pressure $\triangle A_1$

p_0
maximum regulated pressure obtained at no rate and for which all the values of the supply pressure between the limits given in 6.1

3.3.5 minimal admitted pressure

p_{Mg}
minimal value of the regulated pressure delivered by the automatic change over device for all values of the supply pressure and all values of the flow rate

3.3.6 maximal admitted pressure

p_{Mp}
maximal value of the regulated pressure delivered by the automatic change over device for all values of the supply pressure and all values of the flow rate in the operational area

3.3.7 change over nominal pressure

p_{di}
value of the nominal regulated pressure of the change over function, in case of two stages automatic change over devices, integrating a change over function and a regulator

3.4 Terms and definitions concerning rates

3.4.1 guaranteed rate

M_g
mass flow of gas that can be obtained, for any value of the supply pressure, at the "working" and "reserve" pressures between the specified limits

NOTE The guaranteed rate is expressed in grams per hour (g/h).

3.4.2

pilot rate

M_p

for automatic change over device up to 4 kg/h and for pressures complying with EN 437, the pilot rate is the gas flow (15 g/h) necessary for the supply of the ignition system of the appliance, generally called pilot

NOTE The pilot rate is expressed in grams per hour (g/h).

3.4.3

closing area

for automatic change over device over than 4 kg/h or for pressures not complying with EN 437 the closing area is the range between 0 % and 5 % of the guaranteed rate

3.4.4

operational area

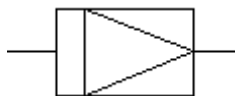
rate range between the pilot rate or the maximum of the closing area and 100 % of the guaranteed rate

4 Types of automatic change over devices

4.1 Introduction

There are typically two types of automatic change over device with pressure reduction:

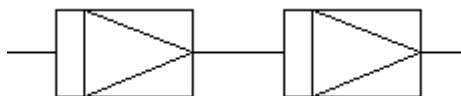
1 – Single stage:



Single stage automatic change over devices

- the supply pressure of the automatic change over device is equal to the pressure of the LPG supply containers;
- the automatic change over device supplies a gas appliance.

2 – Two or more stages:



*First stage automatic
change over device*

Regulator

- the supply pressure of the automatic change over devices is equal to the pressure of the LPG supply containers;
- the supply pressure of the regulator depends on the regulated pressure of the automatic change over device and on the pressure losses in the intermediate line;
- this regulator, covered by [EN 13785](#), supplies a gas appliance or another regulator.

4.2 Automatic change over devices for installations where the final regulator supplies a pressure specified in EN 437

Where an automatic change over device is a single stage it shall be fixed.

It is recommended that a first stage automatic change over device is fixed.

For interchangeability the recommended nominal values of regulated pressures (p_d) of the first stage automatic change over device are the following:

3 – 1,5 – 1 – 0,75 – 0,5 – 0,4 – 0,3 – 0,15

4.3 Other automatic change over devices installation

To supply appliances with pressures which are different from those specified by EN 437 fixed, variable or adjustable automatic change over devices are used.

5 Constructional characteristics

5.1 General

Automatic change over devices shall be designed, manufactured and assembled in such a way that their operation is satisfactory under the installation and service conditions specified by the manufacturer.

Safety devices likely to be fitted to automatic change over devices covered by this standard shall, if applicable, be designed and constructed in accordance with the requirements given in annex A.

All the parts of an automatic change over devices shall be free of sharp corners or edges capable of causing deterioration, injury or faulty operation.

Parts shall be clean internally and externally.

Holes for screws, pins, etc., intended for the assembly of the automatic change over devices components and for their fixing shall not open into the gas ways. The thickness of the wall between these holes and the gas ways shall be at least 1 mm.

Holes necessary for machining which join gas ways to the atmosphere, but which have no influence on the operation of the automatic change over devices, shall be permanently closed metallically. Appropriate additional sealing compounds may be used.

Gas tight threads shall be in accordance with ISO 7-1, where pressure-tight joints are made on the threads or with ENPT.

Devices capable of modifying the operation of the automatic change over device shall not go out of adjustment and shall be sealed. In particular, the automatic change over device body and cover shall be assembled in such a way that a separation is not possible without permanent damage of these parts or of this sealing.

5.2 Materials

The quality of materials, the dimensions used and the means of assembling the various components shall be such that the construction and performance characteristics are secure. Performance characteristics shall not alter significantly during the life expectancy mentioned in the literature when the automatic change over device is installed and used in accordance with the manufacturer's instructions. Under these conditions all components shall withstand the mechanical, chemical and thermal conditions to which they may be submitted during their use, under normal conditions.

The automatic change over devices shall withstand the action of organic substances, either of vegetable or animal origin.

The body shall be made of metallic material.

Internal parts and parts of the cover not related to pressure (except for the connections, see Figure 1), may be made of non metallic (thermoplastic or thermal setting) materials, provided that the following requirements are met:

- materials used shall meet the requirements of annex E;
- whole automatic change over devices shall withstand the various tests described in the body of the standard;
- automatic change over device with its non metallic parts removed shall resist a pressure test as in 7.2.1.3 remaining sound in the sense of 5.5 and without causing any danger.

Zinc alloys shall only be used if they are of the Zn Al4 or Zn Al4 Cu1 quality, in accordance with ISO 301 and if, as for non metallic components, zinc alloy parts are not likely to be exposed to a temperature greater than 80 °C. Brass alloys shall comply with EN 12164 or EN 12165.

The rotating threaded parts of connections, whether they are male or female, shall be made of brass in accordance with EN 12164 or EN 12165 or another standard, or of steel. The materials and manufacturing processes used shall not cause subsequent risk of stress corrosion.

Steel internal parts shall be protected against corrosion.

Threaded fixed parts of connections shall be made of metallic material, non threaded fixed parts of connections may be made of non metallic material, provided that they comply with the tests specified in annex E.

The assembly of parts of the gas ways intended to assure soundness shall not be made with solder whose lowest temperature in the melting range, after application, is below 450 °C.

Non metallic (thermoplastic or thermal setting) components used in the construction of an automatic change over device shall meet the special requirements of annex E.

Elastomeric components shall comply with the requirements defined in EN 549, within the temperature range specified in clause 1, including, for diaphragms, the requirements concerning resistance to ozone. In addition, reinforced materials shall comply with the additional requirements defined in annex F.

5.3 Special requirements

5.3.1 Pressure sensing subassembly

The dimensions, the shape and the method of assembly of the components of the pressure sensing subassembly shall avoid any risk of damaging the diaphragm.

The pressure sensing subassembly shall be manufactured in such a way that the operation of the automatic change over device complies with the requirements defined in clause 6 in all possible positions of the automatic change over device on the installation specified by the manufacturer in his instructions. The automatic change over device shall meet the $\overline{A_1}$ lock up pressure $\overline{A_1}$ requirements in all the specified mounting positions.

Whatever the position taken by the diaphragm, the spring shall not be fully compressed.

The diaphragm shall withstand, without rupture or slipping out of its fixing, the tests described in 7.2.1.2.

5.3.2 Regulation subassembly

At the lockout position, the regulation subassembly shall act as a seal between the supply pressure and the regulated pressure. It shall not move accidentally in use.

The soundness and function of the regulation subassembly shall not be affected by the tensile strength and bending tests on the connections.

After the test defined in 7.2.3, the valve, as defined in $\overline{A_1}$ 3.1.7 $\overline{A_1}$, shall not be displaced or come out of its housing.

5.3.3 Back pressure subassembly

The support surfaces of the cover and of the body shall be designed in such a way that they maintain the diaphragm firmly in its housing and make it capable of resisting the pressure tests defined in 7.2.1.

Vent holes shall be:

- mounted or placed in such a way that the risks of accidental blockage are reduced and to avoid against penetration of rain water, particularly if their cross section is greater than 3 mm²;
- constructed in such a way that it does not allow accidental damage to the internal parts of the device by any object introduced by the vent,

when the automatic change over device is installed in accordance with the instructions.

For adjustable automatic change over devices, after the adjustment to the adjustable value made at the time of installation, it shall be possible to block the setting and it shall be possible to seal the automatic change over device.

5.3.4 Connection subassembly

A1 Automatic change over devices shall be fitted with an inlet filter. The filter shall be made of a corrosion and gas resistant material, and situated upstream of the valve pad. The filter mesh shall not exceed the recommended dimensions for the 125 opening in accordance with ISO 565, or exceed 0,14 mm diameter in case of perforated sheet.

If the filter is not integral with the automatic change over device the instructions shall state the location of separate filter upstream. **A1**

The connections shall be of the following types:

- flanged: when flanges are used, they shall fit connections in accordance with ISO 7005-2 with dimensions corresponding to PN 16;
- threaded: threaded inlet connections where the seal is made on the thread may be used up to a nominal diameter DN 50. Parallel internal connections threads in zinc or aluminium are permitted up to and including DN 10 only;
- non threaded.

The equivalences of the dimensions of connections are given in Table 1.

Table 1 — Sizes of connections

Nominal DN diameter	Thread as in ISO 7-1 or in EN ISO 228-1	Nominal size of flanges as in ISO 7005-2
6	1/8	6
8	1/4	8
10	3/8	10
15	1/2	15
20	3/4	20
25	1	25
32	1 1/4	32
40	1 1/2	40
50	2	50

The connections shall comply with:

a) inlet connections:

- 1) one of the types in Figures G.1 to G.49¹⁾ if they are threaded;
- 2) one of the types in Figures G.50 to G.99²⁾ if they are not threaded;
- 3) future types will be acceptable providing they are not interchangeable with the connections specified in this European Standard, and providing their assembly gives an equivalent degree of safety;
- 4) for connections made with a rotating nut using a seal the backward movement of the nut shall be sufficient to expose the seal completely.

b) outlet connections:

- 1) one of the types in Figures H.1 to H.49³⁾ if they are threaded;
- 2) one of the types in Figures H.50 to H.99⁴⁾ if they are non threaded;
- 3) other connections may be mounted provided that the automatic change over device is sold with a fixed outlet tube;

1) A range of 49 figures has been reserved for each type of connections. However, the needs of this document do not use all this range.

2) A range of 49 figures has been reserved for each type of connections. However, the needs of this document do not use all this range.

3) A range of 49 figures has been reserved for each type of connections. However, the needs of this document do not use all this range.

4) A range of 49 figures has been reserved for each type of connections. However, the needs of this document do not use all this range.

- 4) future types will be acceptable providing they are not interchangeable with the connections specified in this European Standard, and providing their assembly gives an equivalent degree of safety.

Tables G.1, G.2 and H.1, H.2 show, for information, the inlet and outlet connections used in the various countries depending on their use.

The automatic change over devices shall only incorporate a single outlet connection.

The design of the connection shall ensure the soundness function of the connection under the assembly conditions specified in the instructions.

If the union incorporates a seal it shall:

- be of a distortable material;
- be mounted in such a way that it cannot fall off;
- be easily replaced by a new seal, if necessary, without using special tools;
- have a size in accordance with the indications given in annexes G and H;
- be fixed onto the automatic change over devices so as to be subject to all the tests in this standard.

No distortion or breakage shall be noticed and the automatic change over devices shall comply with the soundness test described in 5.5 after application of the forces defined in 5.4.1 and 5.4.2.

In addition, the manufacturer's instructions shall specify the use of a spanner when this is necessary for fitting or removing the automatic change over devices.

5.3.5 Supply-reserve indicator

A1 The supply-reserve indicator, if any, shows which cylinder is in use via a signal related to the pressure at the automatic change over device outlet. **A1**

The supply-reserve indicator may be integrated in the automatic change over device or be independent. If it is independent it shall be possible to connect it using appropriate connections in accordance with Figures G and H.

In any case it shall correspond to the automatic change over device used, in accordance with the manufacturer's users instructions.

5.3.6 Knob for selection of the operational cylinder

The automatic change over device shall be fitted with a knob, which is fixed by mechanical means to avoid unintentional dismantling. This knob shall not incorporate any sharp part or sharp edge. It is designed in such a way that the extreme positions are marked clearly.

The positions of the knob shall enable an observer to see which cylinder is in use when he stands 2 m away.

A1 *deleted text* **A1**

5.3.7 Fixing onto a wall

When the automatic change over device is designed to be fixed onto a wall, it shall be electrically insulated from this, in accordance with the specifications given in the instructions.

5.3.8 **A1** Non return valves

To prevent the leakage of gas from the inlet connection to the atmosphere when changing cylinders, the automatic changeover device shall be fitted with non return valves on each inlet.

This requirement is considered as met if the leak observed, at the end of the test carried out under the conditions described in 7.2.4.2 does not exceed 200 cm³/h. $\triangle A_1$

5.4 Mechanical strength

5.4.1 Resistance to pressure

5.4.1.1 The automatic change over devices shall be capable of resisting the pressure test described in 7.2.1.1 without rupture.

5.4.1.2 The automatic change over devices shall be capable of resisting the pressure test described in 7.2.1.2, without rupturing the diaphragm.

After these two tests, the device shall meet the soundness requirement specified in 5.5.

5.4.1.3 The automatic change over devices shall be capable of resisting the pressure test described in 7.2.1.3 without rupturing at the level of the body/cover assembly.

5.4.2 Strength of connections

5.4.2.1 Strength of the union/automatic change over devices connection

The fixing of the inlet connection onto the automatic change over devices body shall withstand the following tests, under the conditions defined in 7.2.2:

- a torque of at least 30 N·m in both directions;
- a bending moment created by a force of 400 N directed upwards and whose application point is at the base of the outlet connection (see Table 6);
- a tensile strength test of 2 000 N.

The fixing of the outlet connection onto the automatic change over devices body shall resist the following tests, under the conditions defined in 7.2.2:

- 1) a torque of at least 30 N·m in both direction;
- 2) a bending moment of 10 N·m;
- 3) a tensile strength test of 2 000 N.

In addition, for automatic change over devices of nominal DN diameter greater than or equal to 15 the two connections shall resist a torque of 100 N·m.

5.4.2.2 Strength of automatic change over devices when fitted onto its support

The automatic change over devices fitted to the installation as indicated in the instructions, shall resist the following tests, under the conditions defined in 7.2.2, Table 6:

- a) a torque in both directions:
 - 1) of at least 20 N·m for non threaded hose outlet connections;
 - 2) see Table 2 for threaded connections and flanged connections.

Table 2 — Torque applicable to threaded connections and to flanged connections

DN	Torque for cylindrical threaded connections with elastomer joint N·m	Torque for other threaded connections and flanges N·m
6	15	20
8	20	30
10	35	50
15	50	90
20	85	110
25	125	135
32	160	165
40	200	175
50	250	185

- b) a bending moment created by a force of 400 N directed downwards and whose application point is at the base of the inlet connection;
- c) a tensile strength test of 2 000 N (verification not required for inlet connections screwed onto the valve).

The mechanical strength required shall be ensured whatever the position of fixing of the automatic change over device onto the installation.

5.5 Soundness

The automatic change over device shall be sound for all positions and all pressures less than those defined in 7.2.4.1.

Soundness is considered to be satisfactory if the value of the leak measured is less than 15 cm³/h for automatic change over devices with a nominal diameter of less than or equal to DN 15 and to 30 cm³/h for automatic change over devices with a nominal diameter greater than DN 15.

For automatic change over device with rapid connections, if the automatic change over device can be mounted in different positions, soundness of the connection shall be ensured in all positions. If the automatic change over device can undergo rotation, soundness shall be ensured in all positions and even during rotation.

5.6 Mechanical endurance

Under the conditions defined in 7.2.5.1, the automatic change over devices shall withstand 10 000 complete valve opening/closing cycles without mechanical failure and remaining sound in the sense of 5.5.

After the endurance test, the operational requirements given in 6.2 and 6.3 shall be met.

5.7 Resistance to humidity changes

Any material likely to be altered by humidity shall be submitted to a test cycle for resistance to humidity changes as defined in 7.2.6.

The increase in mass between the second and the first weighing shall not exceed 20 % of the initial mass.

The change in mass between the first and the third weighing shall not exceed 5 % of the initial mass.

5.8 Resistance to corrosion

The complete device, not connected at the ends, is subjected to the tests defined in 7.2.7.

After this test, a visual examination shall reveal no corrosion of parts capable of impairing correct operation (salt deposit resulting from the test is not taken into account). Performance characteristics shall remain in accordance with the requirements given in clause 6.

6 Performance characteristics

6.1 General

6.1.1 Introduction

Under the test conditions specified in 7.3 the change over device operation curves obtained using the method specified in 7.3.2 shall lie within the perimeter defined by the pressure and guaranteed rate limits given in 6.2.

The change over device operation curves shall show no anomalies that indicate a fault.

Adjustable and variable change over devices shall comply with operating requirements of this standard in the regulated pressure range declared by the manufacturer.

The range of an adjustable change over devices shall remain within a tolerance of ± 15 % of the nominal regulated pressure.

6.1.2 Supply pressure

Butane: minimum: 0,3 or $p_d + 0,2$ if greater – Maximum: 7,5 bar

LPG: minimum: 0,3 or $p_d + 0,2$ if greater – Maximum: 16 bar

Propane: minimum: 1 or $p_d + 0,5$ if greater – Maximum: 16 bar

6.2 Operational limit characteristics (regulation function)

Whatever the values of the upstream “service” and “reserve” pressures between the limits specified in 6.1,

- a) the maximal regulated pressure shall not exceed 4 bar;
- b) for automatic change over devices which supply an appliance according to the pressures of EN 437 the regulated pressures shall comply with those of Table 3.

Table 3 — Pressure characteristics p_{Mg} , p_{Mp} , and p_0 based on nominal pressures specified in EN 437

Gas	Automatic change over devices regulated pressure mbar				Max pressure loss mbar	Appliance supply pressure mbar ^{a)}			Appliance categories ^{a)}
	p_d	p_{Mg}	p_{Mp}	p_0		p_n	p_{min}	p_{max}	
Butane	29	22	35	40	2	29 (28-30)	20	35	3B et 3+
Butane	50	47,5	57,5	62,5	5	50	42,5	57,5	3+
Butane	112	65	140	145	5	112	60	140	3+
GPL	29	27	35	40	2	29 (28-30)	25	35	3B/P
GPL	50	47,5	57,5	62,5	5	50	42,5	57,5	3B/P
Propane	37	27	45	50	2	37	25	45	3P et 3+
Propane	50	47,5	57,5	62,5	5	50	42,5	57,5	3P
Propane	67	55	80	85	5	67	50	80	3+
Propane	148	105	180	185	5	148	100	180	3+

^{a)} Data of EN 437, given for information.

- c) for automatic change over devices which supply an appliance with pressures out of EN 437 or a regulator, the regulated pressures are defined by:

$$p_0 = 1,3 \times p_d$$

$$p_{max} = 1,2 \times p_d$$

$$p_{min} = 0,50 \times p_d$$

These automatic change over devices may be adjustable.

- d) for automatic change over devices for installations for which the final regulator provides a pressure specified in EN 437 (see 4.2) the regulated pressures are those given in Table 4:

Table 4 – Regulated pressures for automatic change over devices which supply a regulator (bar)

Definition of the pressure		Numerical application given for information							
Nominal regulated pressure	p_d	3,00	1,50	1,00	0,75	0,50	0,40	0,30	0,15
Maximal pressure ^[A1] lock up pressure ^[A1]	$p_o = p_d \times 1,3$	3,90	1,95	1,30	0,98	0,65	0,52	0,39	0,20
Maximal pressure (service)	$p_{\max(o)} = p_d \times 1,2$	3,60	1,80	1,20	0,90	0,60	0,48	0,36	0,18
Minimal pressure (reserve)	$p_{\min(r)} = p_d \times 0,50$	1,50	0,75	0,5	0,375	0,25	0,20	0,15	0,075
with another device	$p_{\min(r)} = p_d \times 0,50 \times 0,8^a$	1,20	0,60	0,40	0,30	0,20	0,16	0,12	0,06
a) To take into account the pressure loss of the limiter downstream the automatic change over devices.									

6.3 Operational limit characteristics (Change over function)

^[A1] deleted text ^[A1]

6.3.1 Change over pressure

The difference between the minimum service regulated pressure and the maximum reserve regulated pressure shall be greater than 15 % of the nominal regulated pressure.

In case of a two stages automatic change over device, the regulated pressures to be considered are the first stage pressures (change over function). The nominal regulated pressure to be considered is the nominal change over pressure (p_{di}).

6.3.2 Selection of the operating cylinder

All the operational requirements described in 6.1, 6.2, 6.3.1 and 6.3.2 shall be met in either of the two positions of the knob.

7 Test methods

7.1 General conditions

7.1.1 Type of test gas

Whatever the gas (see 3.2) to be used with the automatic change over device, with the exception of the soundness test which shall be carried out using air, tests which involve the passage of gas inside a automatic change over devices may be carried out with air at $(20 \pm 5) ^\circ\text{C}$ or reference propane.

Reference propane is that defined as G 31 in EN 437:2003, the reference air is dry air as specified in EN 437. The equivalence ratio between air and propane being defined by the formula:

$$q_n(\text{air}) = 1,2454 q_n(\text{G 31})$$

where air and propane rates are expressed in litres per hour (l/h).

7.1.2 Test conditions

Unless stated otherwise tests shall be carried out at a room temperature of $(20 \pm 5) ^\circ\text{C}$, which remains constant during each test.

All measurements are corrected to reference conditions: $15 ^\circ\text{C}$, 1 013,25 mbar.

7.1.3 Equivalence formulae

From the results obtained with one of the reference gases, the mass rate corresponding to the gas indicated on the automatic change over devices can be calculated, under reference conditions, from the formula:

$$M_g = q_n \times \rho \times \sqrt{\rho_g / \rho}$$

where

M_g is the mass rate of the gas under reference conditions, expressed in kilograms per hour (kg/h);

q_n is the measured volume rate, expressed in cubic metres per hour (m^3/h), of the reference gas used, corrected to reference conditions of 7.1.2, according to the formula:

$$q_n = q_{(\text{measured})} \times \frac{288,15}{273,15+t} \times \frac{p_a}{1\,013,25}$$

where

q_{measured} is the actual volume rate measured, in cubic meters per hour (m^3/h);

t is the temperature in degree Celcius ($^\circ\text{C}$);

p_a is the atmospheric pressure in millibars (mbar);

ρ is the density of the reference gas used under reference conditions, expressed in kilograms per cubic metres (kg/m^3), in accordance with 7.1.1 and 7.1.2;

ρ_g is the density of the average liquefied petroleum gases for the appliance, expressed in kilograms per cubic metres (kg/m^3) see 3.2.

7.1.4 Test samples

Ⓐ For tests six identical devices shall be tested in the order specified in Table 5.

After those tests the devices shall be dismantled and requirements of 5.1 to 5.3 shall be checked visually and dimensionally. Ⓐ

Table 5 — Order of tests

Clause	Test	Automatic change over devices number					
		1	2	3	4	5	6
7.2.1	Resistance to pressure	X	X				X
7.2.2	Strength of connections	X	X				
7.2.4	Soundness before	X	X	X	X	X	X
7.2.3	Valve retention	X	X				
7.3	Performance (before)			X	X	X	
7.2.5	Endurance			X			
7.2.7	Corrosion					X	
7.2.4	Soundness after			X	X	X	X
7.3	Performance (after)			X	X	X	

7.2 Verification of constructional characteristics

7.2.1 Resistance to pressure

During the whole duration of the tests described in 7.2.1.1, 7.2.1.2 and 7.2.1.3, the temperature of the automatic change over devices and of the supply water shall be maintained at $(50 \pm 2) ^\circ\text{C}$.

NOTE Tests intended to be carried out with water may be carried out with air or with nitrogen provided that adequate safety measures are taken.

When the device has a safety valve, these tests shall be carried out in accordance with Annex A.

7.2.1.1 An automatic change over device is connected in turn by one of its inlet to a pipe supplied with water, the diverter valve being directed to the sense of supply. After reaching the required temperature, the outlet connection is blocked and the pressure of water is increased to 1,75 times the maximum supply pressure (p_a), the test shall not last less than 15 min after the application of the pressure.

7.2.1.2 The change over device is connected by its outlet to a pipe supplied with air or nitrogen. After reaching the required temperature, the pressure of air or nitrogen is increased to 1,5 times the regulated pressure with a minimum of 0,5 bar. The test shall not last less than 15 min after the application of the pressure period during which the leak at the regulator measured shall not exceed $50 \text{ cm}^3/\text{h}$.

At the end of this test, the requirements of 5.3.1 and 5.4.2 shall be met.

7.2.1.3 Another automatic change over device is connected by its outlet to a pipe supplied with water. The inlet connection, the vent and any other orifice opening to the atmosphere are blocked. For test purposes, the diaphragm may be pierced to allow for the free passage of water.

After reaching the required temperature, the water pressure is increased to the maximum supply pressure. The test shall not last less than 15 min after the application of the pressure. This test is intended to check the mechanical strength of the cover/body assembly, therefore leakage at joints shall be disregarded during the test.

At the end of this test, the requirements of 5.4.1.3 shall be met.

7.2.1.4 When a second regulation is integral to the automatic change over device, the manufacturer shall give to the laboratory the intermediate pressure values corresponding to its device, and tests shall be carried out as follows:

- in accordance to 7.2.1.1 by applying 1,75 times the supply pressure, through the inlet connection;
- in accordance with 7.2.1.2 by applying 1,5 times the maximum pressure given by the manufacturer at the first stage regulation outlet;
- in accordance with 7.2.1.1 by applying 1,75 times the maximum pressure given by the manufacturer through the second stage regulation inlet;
- in accordance with 7.2.1.2 by applying 1,5 times the maximum regulated pressure through the second stage regulation outlet,

by neutralizing each time the appropriate upstream or downstream regulation.

7.2.2 Mechanical strength of connections

Tests for mechanical strength shall be carried out using a dynametric device allowing the measurement of forces to an accuracy of within $\pm 5\%$.

For the torque test a system which neutralizes bending moments should be used (if a torque wrench is used it is desirable that this is two handed).

[A1] For threaded connections, the checks of 5.4.2 shall be carried out with the change over device installed in accordance with the manufacturer's instructions. **[A1]**

For flanged connections in accordance with ISO 7005-2 the tightening force to be applied to the flange nuts is given in Table 6.

[AC] Table 6 — Tightening of bolts as in ISO 7005-2 [AC]

Nominal diameter DN	6	8	10	15	20	25	32
Tightening force in N.m	20	20	30	30	30	30	50

The duration of application of the torques and forces shall be 1 min.

The corresponding requirements of 5.4.2 shall be met.

7.2.3 Regulation subassembly

The valve pad in position in its housing is placed in a pressurised container filled with liquid propene in such a way that the assembly is immersed completely, for example 50 ml of liquid in a 200 ml container.

After 72 h at $(20 \pm 5)^\circ\text{C}$, the container is emptied, the valve and its housing are taken out.

At the time when it is taken out of the container and during the ten minutes which follow, the assembly is checked and shall comply with the requirements of 5.3.2 concerning the valve.

7.2.4 Soundness

7.2.4.1 Soundness of the automatic change over devices

This test can be carried out according to the methods used in the laboratories provided that these methods give results that can be reproduced.

The measurement error shall not exceed 5 cm³/h.

In the event of disagreement the method described in annex D shall be used.

The automatic change over device is connected in turn through each of its inlet connection to a pipe supplied with air at a pressure of 150 mbar, then at a pressure of 8,25 bar for butane automatic change over devices and 17,5 bar for propane and LPG automatic change over devices. The outlet connection is blocked and the diverter valve is directed to the sense of supply.

The test shall last for not less than 2 min, after reaching the pressure.

A1 The automatic change over device is then connected through its outlet connection to a pipe supplied with air at a pressure of 1,5 times the regulated pressure with a minimum of 150 mbar, the two inlet connections being sealed. **A1**

The requirements of 5.5 shall be met.

7.2.4.2 **A1 Non return valve**

This test shall be carried out with a 0,4 mm injector connected to the outlet connection allowing air to flow constantly through the test.

Each inlet connection shall be supplied in turn with air at pressures of 300 mbar and 8,25 bar for butane, 1 bar and 17,5 bar for propane and 300 mbar and 17,5 bar for LPG mixtures. The opposite non return valve shall be checked for soundness with the manual change over device in both supply and reserve positions.

The requirements of 5.3.8 shall be met. **A1**

7.2.5 Endurance

7.2.5.1 Automatic change over devices endurance

A1 Both inlets of the automatic change over device, in its normal operating position, are connected to an air supply of 1,4 bar for butane and 7,5 bar for propane and LPG, at a temperature of (20 ± 5) °C.

The flow rate is adjusted to 20 % of the guaranteed rate.

10 000 cycles are carried out, consisting of:

- a) interruption of the outlet flow to induce lockup;
- b) restoration of the outlet flow;
- c) every 10 cycles the manual change-over valve is alternated.

Each cycle should allow the diaphragm to flex and for the valve to be held on its seat for 1 s. Minimum cycle time shall be 5 s.

The requirements of 5.6 shall be met. **A1**

7.2.6 Resistance to humidity changes

A sample is taken of any material capable of being altered in its structure and dimensional characteristics by humidity.

It is submitted to the following test cycle:

- drying in an oven at 50 °C for 12 h;
- weighing to an accuracy of 0,1 mg;
- immersion in distilled water at 20 °C for 24 h;
- removal from the water, superficial removal of the excessive water with filter paper;
- weighing to an accuracy of 0,1 mg;
- drying in an oven at 50 °C for 24 h;
- weighing to an accuracy of 0,1 mg.

At the end of this test, the requirements of 5.7 shall be met.

7.2.7 Resistance to corrosion

The whole automatic change over device, not connected at the ends, is tested according to ISO 9227. Other test methods leading to equivalent results, for example the method described in informative annex I, are allowed.

The test chamber being in a steady state, the device is placed in the position of use recommended by the manufacturer in the instructions and left for 96 h. At the end of this test the requirements of 5.8 shall be met.

7.3 Verification of performance characteristics

7.3.1 General

Tests shall be carried out whilst maintaining the device and gas at the temperatures shown in Table 7.

Table 7 — Regulation curves - Supply conditions

Type of gas	Temperatures °C	Supply pressure bar
Butane	+ 50 ± 2	7,5
	+ 20 ± 5	0,3 or $p_d + 0,2$ if greater - 7,5
	+ 0 ± 2	0,3 or $p_d + 0,2$ if greater
LPG	+ 50 ± 2	16
	+ 20 ± 5	0,3 or $p_d + 0,2$ if greater - 16
	- 20 ± 2	0,3 or $p_d + 0,2$ if greater
Propane	+ 50 ± 2	16
	+ 20 ± 5	1 or $p_d + 0,5$ if greater - 16
	- 20 ± 2	1 or $p_d + 0,5$ if greater

Performance tests shall be carried out in all possible positions for fixing the automatic change over device onto the installation. These tests, as well as the soundness test, shall be carried out before and after the endurance test.

Performance tests can be carried out using calibrated orifices or using rate meters which enable the obtaining of a full range of rates up to the guaranteed rate.

If rates are measured using the rate meter method (see Figure 2 a)), the reading is an integral number of turns of the volume meter C1 dividing the volume obtained by the time elapsed.

If rates are measured using the calibrated injector method (see Figure 2 b)), the regulated pressure of the automatic change over device examined is noted for each injector or group of injectors for a given upstream "operating" or "reserve" pressure.

This value noted on the rate-pressure curve of the injector or injectors used gives the value of the corresponding rate. These two values define an operational point of the automatic change over device under the downstream pressure considered. All the points obtained give the regulation curve for this upstream pressure.

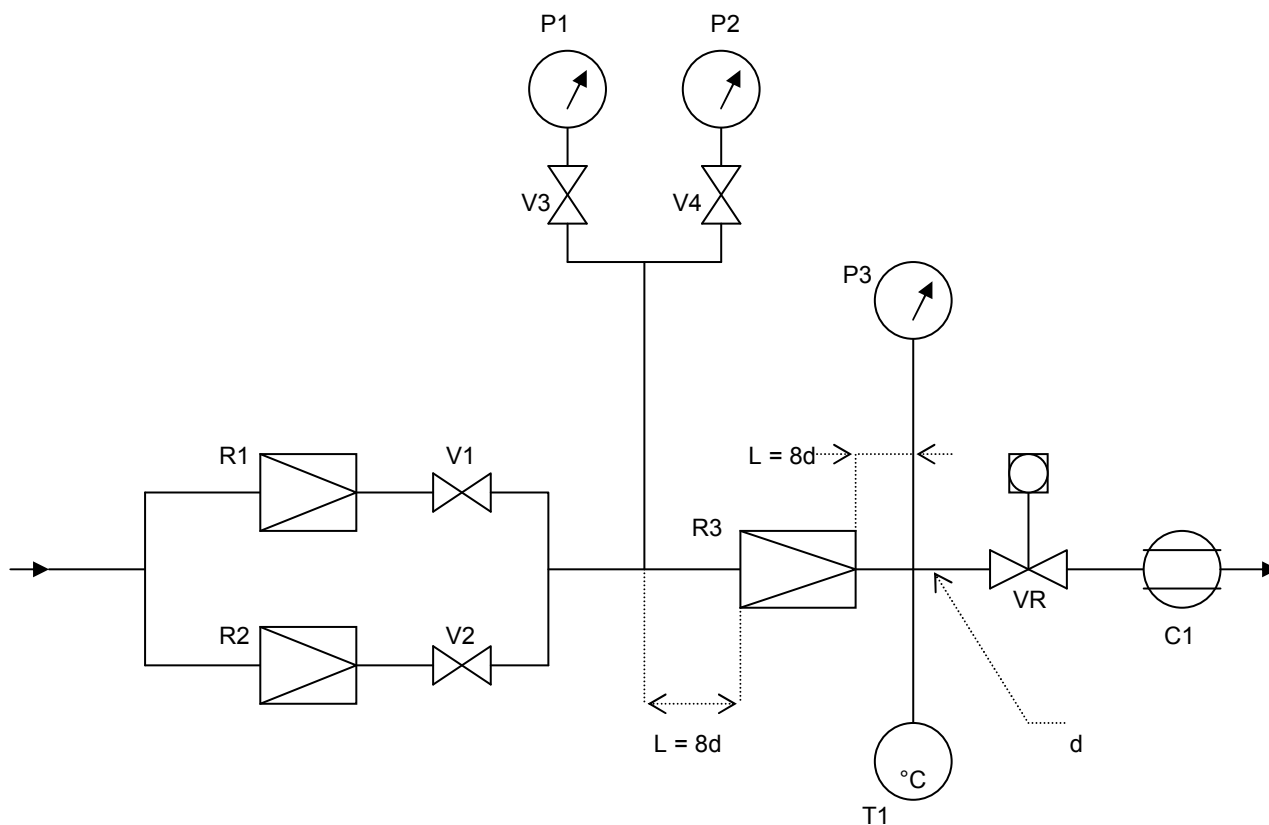
NOTE The lock up pressure A_1 is measured 5 s after effective closing.

The diameter of the pipework used downstream of the device under test and which supplies the injectors shall be sufficiently large to avoid creating pressure drops which could influence the results.

Whatever the method used tests are carried out with increasing rates from 0 to the guaranteed rate, then for decreasing rates.

The network of the rate-pressure curves, corresponding to each of the injectors used, is shown on a same graph.

The requirements of 6.2 shall be met.



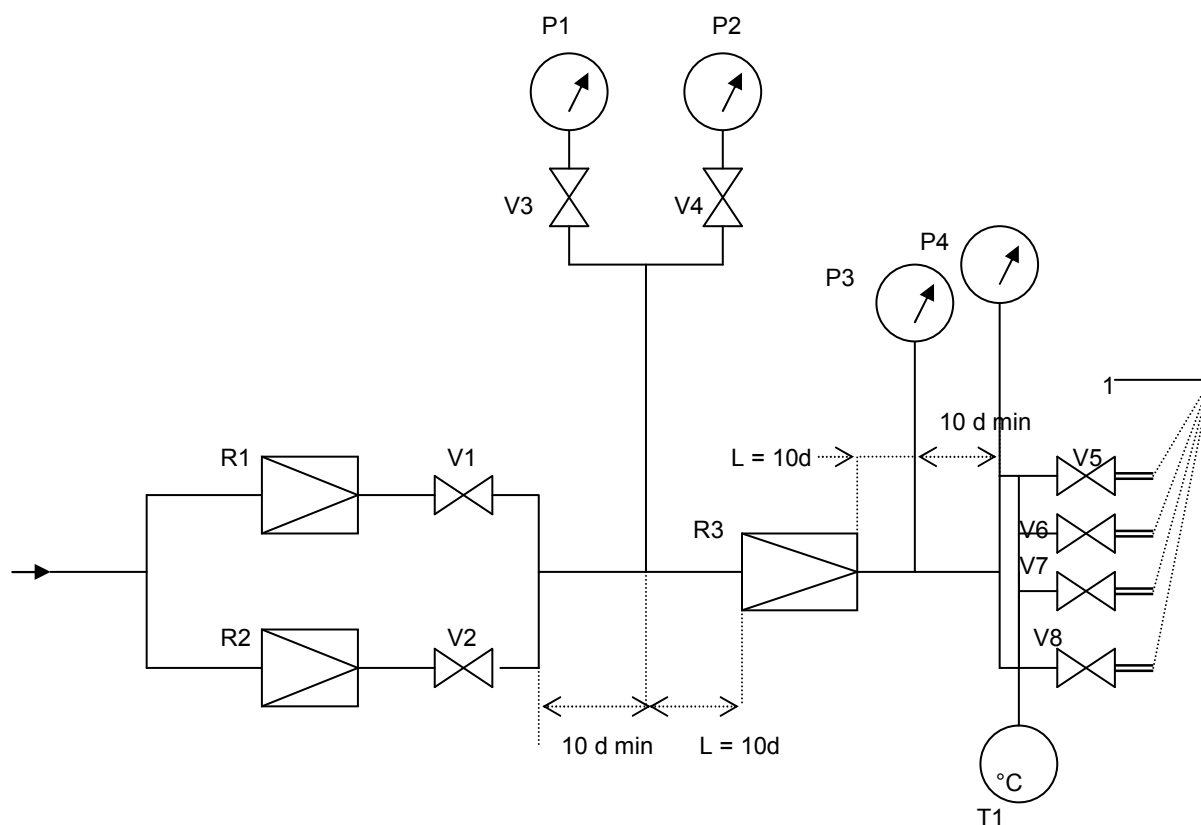
Key

R1, R2	Supply adjustment regulators
V1, V2	Ball valves (DN $\geq$ inlet DN of R3, minimum DN 10)
V3, V4	Ball valves
P1, P2	Measuring devices of upstream pressure (class 0,1)
R3	Automatic change over device under test
P3	Measuring device of downstream pressure (class 0,1)
T1	Thermometer (accuracy 1 °C)
VR	Flow rate adjuster
C1	Flow rate measuring device
d	$\geq$ outlet DN of R3, minimum DN 10

NOTE The supply device (R1/V1, R2/V2) is given as a guide.

a) volume rate method

Figure 2 – Performance tests



Key

- 1 Calibrated injectors
- R1, R2 Supply adjustment regulators
- V1 to V8 Ball valves (DN 10)
- P1, P2 Measuring devices of upstream pressure (class 0,1)
- R3 Automatic change over devices under test
- P3, P4 Measuring devices of downstream pressure (class 0,1)
- T1 Thermometer (accuracy 1 °C)

NOTE The supply device (R1/V1, R2/V2) is given as a guide.

b) calibrated injectors method (principle)

Figure 2 – Performance tests

7.3.2 Plotting of regulation curves

With the supplying in turn to each inlets and for each position of the manual knob change over, the regulation curves are plotted for the supplied values given in Table 7.

In each case the other inlet supply shall not be connected.

With those four curves, the requirements of 6.2 and 6.3.2 can be checked.

In case of two stages automatic change over devices, the requirements of 6.3.2 are checked on the curves of regulated pressure of the first stage (change over function).

8 Marking, packaging, instructions

8.1 General

Instructions and the information and warnings carried on the device and its packaging shall be written in the official language or languages of the country where the device is to be sold.

8.2 Marking of the device

The automatic change over device shall carry in a durable, legible and visible fashion the following information:

- manufacturer's name or logo and, possibly, trademark;
- marking in letters or figures allowing the identification of the automatic change over device;
- type of gas: butane, propane or LPG;
- maximum and minimum supplied pressures expressed in bars (bar);
- nominal regulated pressure, expressed in millibar (mbar) or bar (bar);
- change over nominal pressure, in case of two stage automatic change over devices expressed in millibar (mbar) or bar (bar);
- guaranteed rate in kilograms per hour (kg/h);
- date of manufacture indicated by the last two figures of the year;
- where necessary, an arrow to show the direction of the flow of gas.

Any additional information given by the manufacturer shall not lead to confusion with the information required by this standard.

8.3 Packaging

The automatic change over devices shall be protected against entry of foreign material by packaging which shall indicate in a clear and unambiguous fashion the type of gas, the nominal regulated "operating" pressure and possible limits of use, in particular the type of connection for which the automatic change over devices is designed.

8.4 Instructions for use and maintenance

Each automatic change over devices shall be accompanied by instructions intended for the user, which, in addition to the items in 8.2, shall specify:

- manufacturer's address and, if necessary, his agent;
- assembly conditions, in particular the preferred position recommended by the manufacturer and the instructions concerning the use of a spanner;
- installation, safety and soundness conditions, in particular with regard to the seals and their good condition;
- conditions of use, which will mention the following statement: "the life expectancy of the automatic change over devices being estimated as 10 years, it is recommended that it is changed within 10 years of the date of manufacture";
- installation conditions, which will include the statement such as "when the device is to be used outdoors, it shall be positioned or protected against direct penetration by any trickling water". They also give, when applicable, the relevant conditions to isolate the automatic change over devices mounted on to a wall, as well as necessary details to install a supply-reserve indicator ;
- a description of the operation of the safety devices (see annex A).

Attention shall be drawn on the respect of the regulations in force, when they imply the installation of specific safety devices, in particular in order to avoid leakage hazards when changing the cylinders.

If the instructions are printed on the automatic change over devices packaging, they shall be easily removable so that they may be kept by the user.

Annex A (normative)

Special requirements for automatic change over devices fitted with pressure or rate operated safety valves

A.1 Change over devices fitted with an over-pressure relief

A.1.1 Definition

An over-pressure relief is a device (possibly with a vent tube) for the discharge of gas which opens to the outside as soon as the gas pressure reaches a set pressure and closes when the monitored pressure has dropped. The valve is closed during normal operation.

A.1.2 Constructional characteristics

The relief shall be integral with the automatic change over device.

It may be part of the pressure sensing subassembly of the automatic change over device, a measuring device is not necessary. The adjustment of the set point shall be protected against any unauthorised modification.

For designs where gas is discharged via the pressure sensing subassembly, the respective cross sectional area of the valve and connection pipework to the atmosphere shall be chosen in such a way that no unacceptable rise in pressure can occur within the pressure subassembly.

The device shall incorporate a component enabling connection to a relief, for example via an Rp 1/8 internal thread. This component shall be used for discharging to the outside when the automatic change over device is used inside a dwelling. The discharge orifice shall be protected against rain water. The tube connecting to the atmosphere may also be used as a vent.

The instructions shall specify that connection to the outside shall be carried out when an automatic change over device fitted with a relief is to be used in a dwelling. They shall provide all necessary information on this connection and in particular the dimensions of the tube (maximum diameter and length).

A.1.3 Performance characteristics

A.1.3.1 Automatic change over devices having a maximum regulated pressure of up to and including 150 mbar

The opening pressure of the relief shall be between 2 times the nominal regulated pressure and 150 mbar, for ambient temperatures between -20 °C and + 50 °C.

Automatic change over devices designed to operate with pressures of 112/148 mbar shall not be fitted with a relief valve.

A.1.3.2 Automatic change over devices having a maximum regulated pressure exceeding 150 mbar

The valve shall operate in compliance with the regulations in force in the country of destination of the appliance.

A.1.4 Test methods

Only internal soundness tests, behaviour in operation and discharge are verified for the valve, all the strength and external soundness tests being carried out in compliance with the requirements for the automatic change over device.

A.1.4.1 Automatic change over devices having a maximum regulated pressure of up to and including 150 mbar

Tests shall be carried out under the following conditions:

— Internal soundness test before opening

The regulated pressure is increased to 1,4 times the nominal regulated pressure. The test shall be carried out at a room temperature of $(20 \pm 5) ^\circ\text{C}$. The relief shall be sound at that pressure, soundness is considered satisfactory if the value of leak measured is below $15 \text{ cm}^3/\text{h}$.

— Behaviour in operation and discharge

For ambient temperatures of $(-20 \pm 2) ^\circ\text{C}$, $(+20 \pm 5) ^\circ\text{C}$ and $(+50 \pm 2) ^\circ\text{C}$, the regulated pressure is increased up to a value of 150 mbar. The relief shall open between 2 times the nominal pressure and 150 mbar. At the upper limit pressure, the gas rate released shall be at least $0,1 \text{ m}^3/\text{h}$ (air, under the reference conditions).

— Internal soundness test after reclosing

After opening and reclosing of the valve, the pressure shall be dropped to 1,4 times the nominal regulated pressure and soundness shall be verified under the same conditions as before the opening.

A.1.4.2 Automatic change over devices having a maximum regulated pressure exceeding 150 mbar

The manufacturer's specifications shall be verified based on the information given to the test laboratory.

A.1.5 Automatic change over device marking

In addition to the information required in 8.2, the automatic change over device fitted with a relief valve shall carry the opening pressure.

A.2 Automatic change over device fitted with an over-pressure shut off safety valve

A.2.1 Definition

Shut off device, triggered by an excessive regulated pressure, which causes the complete shut off of the gas flow for all values of supply pressure.

The restoration of the gas flow shall only be possible by manual intervention when the conditions which cause the shut device to operate have disappeared.

The automatic change over device's manual device which enables the restoration of the gas flow is called resetting device.

A.2.2 Constructional characteristics

A.2.2.1 General

The shut off device may be either integral with the automatic change over device or be an auxiliary component. In any case, the constructional requirements for the shut off device are the same as those for the automatic change over devices.

The shut off device shall have its own restrictor, its own measuring device and its own measuring pipework which shall not be influenced by the operation of an over pressure relief.

The resetting device shall be protected against any intervention which could impair the operation of the over pressure shut off.

A.2.2.2 Closing force

The force which ensures the closing of the valve from the open position shall be at least equal to the resistance due to the maximum gas pressure and to the weight of relevant internal parts, plus five times the frictional force.

When the closing device is in the closed position, the closing force shall be at least equal to the force due to maximum supply pressure and to the weight of relevant internal parts plus twice the frictional force.

A.2.2.3 Diaphragm strength

The diaphragm shall be designed and/or incorporated in such a way that it withstands, after setting, a pressure equal to the maximum supply pressure.

A.2.3 Performance characteristics

A.2.3.1 Automatic change over devices with a maximum regulated pressure of up to and including 150 mbar

The device shall close the gas flow before the pressure measured downstream of the automatic change over device is between 2 times the nominal regulated pressure and 150 mbar under all use conditions.

Automatic change over devices designed to operate with pressures of 112/148 mbar shall not be fitted with an over pressure shut off device.

A.2.3.2 Automatic change over devices with a maximum regulated exceeding 150 mbar

The device shall operate in compliance with the regulations in force in the country of destination of the appliance and the device shall close the gas flow between 2 and 3 times the nominal regulated pressure.

A.2.4 Test methods

A.2.4.1 Test for the components transmitting the closing forces

The frictional force is measured with the closing spring removed and the valve in the open position.

Prior to testing, the mechanism is held at $(20 \pm 5) ^\circ\text{C}$ for 24 hours.

The valve is moved in the closing direction, the force needed to initiate the motion is recorded.

The test is first carried out at atmospheric pressure then at the maximum supply pressure.

The highest closing force is the retained value.

A.2.4.2 Test for diaphragm strength

First a performance test as defined in A.2.4.3 shall be carried out at $(20 \pm 5) ^\circ\text{C}$.

The diaphragm of the shut off device shall then be subjected to a test pressure equal to the maximum supply pressure.

This pressure shall be maintained for 10 min.

Another performance test shall then be carried out as defined in A.2.4.3. The values given for the operating pressures shall not vary from the values recorded during the previous test by more than 10 %.

A.2.4.3 Performance test

A.2.4.3.1 Automatic change over devices with a maximum regulated pressure of up to and including 150 mbar

Tests shall be carried out at $(20 \pm 5) ^\circ\text{C}$.

The device under test is supplied with compressed air through its outlet connection. The supply pressure is increased up to the pressure at which the device energizes.

At the time of the shut off, the pressure shall be below 150 mbar.

After shut off, check that the gas flow remains cut off at any pressure below the maximum supply pressure.

The test shall be repeated under extreme conditions of temperature and pressure given in Table 7 it is verified that the values obtained for the operating pressure are within the tolerance specified in A.2.3.1.

A.2.4.3.2 Automatic change over devices with a maximum regulated pressure exceeding 150 mbar

The manufacturer's specifications shall be verified based on the information given to the test laboratory.

A.3 Automatic change over device fitted with an under-pressure shut off safety device

A.3.1 Definition

An under-pressure shut off safety device is a device, which is integral in the automatic change over device, which causes the complete shut off of the gas flow for all the values of regulated pressure defined in A.3.2. This pressure drop may be caused either by an absence of gas upstream the automatic change over device, or by an excess of gas rate downstream the automatic change over device.

The components which provide control may also provide the safety function.

The restoration of the gas flow shall only be possible by manual intervention when the conditions which cause the safety device to operate have disappeared.

The automatic change over device's manual device which enables the restoration of the flow is called the resetting device.

A.3.2 Constructional and performance characteristics

The device shall cut out the gas flow only when the pressure measured downstream of the automatic change over device is at least equal to p_{Mg} .

When it is in the closed position, the resetting device shall not allow for any permanent opening of the gas flow in the event of impact. It shall be designed in such a way that, without manual intervention, it can only be in the fully open position or fully closed position. If the setting device also acts as a stop cock using a rotating handle, the sense of shutting off the gas shall be clockwise.

If the setting device has no other function and if it is accessible, it shall be protected against any intervention which could impair the automatic change over device's normal operation when it is reset.

A.3.3 Test methods

Tests shall be carried out at $(20 \pm 5) ^\circ\text{C}$.

The device under test being in the closed position, check that the gas rate remains shut off for any pressure below the maximum supply pressure.

The device under test is supplied with compressed air and adjusted to the guaranteed rate at the maximum supply pressure. Then the supply pressure is reduced to the pressure at which the device energises.

At the time of the cut out, the regulated pressure shall be at least equal to the minimum pressure required at the device's inlet, or at the inlet of the following regulator.

Check then that the cut out is maintained when the supply pressure is raised up to the upper limit.

After each shut off out check for soundness.

A.4 Automatic change over devices fitted with an excess flow valve

A.4.1 Definition

The excess flow valve is a device integral with the automatic change over device which causes the shut off of the gas flow for values of rate greater than the guaranteed rate.

The restoration of the gas flow shall only be possible by manual or automatic intervention, when the conditions which caused the safety device to operate have disappeared.

In the case of a manual device, the automatic change over device's device allowing for the restoration of the flow can be a re-setting device or a valve, generally appropriate for this type of automatic change over devices.

A.4.2 Performance characteristics

The excess flow valve shall shut off the gas rate in all the cases of disconnection of the flexible hose fitted downstream of the automatic change over devices. The device shall operate for an increase in the rate between 120 % and 200 % of the guaranteed rate, at an angle of $\pm 10^\circ$ relative to its axis in the fixing positions of the automatic change over devices onto the cylinder and over the whole ranges of temperatures defined in Table 7.

For automatic re-setting devices a maximum residual leak between 30 g/h and 60 g/h according to the national regulations, is permitted when the device is in the zero flow position so as to allow resetting.

For manual re-setting devices, a maximum residual leak between 15 cm³/h and 200 cm³/h according to the national regulations, is permitted.

The presence of the device shall not modify the automatic change over device's performance.

If a tap is integrated to the automatic change over device it is recommended that a two positions tap is used: one for full opening and one for complete closure in order to not influence the excess flow function.

In any case the excess flow rate shall ensure its function and the shut off valve shall carry a marking allowing the identification of the direction of closure.

A.4.3 Complementary tests for the automatic change over devices – Test methods

A.4.3.1 The performance tests for the excess flow valve shall be carried out at the following operating temperatures:

- $(+ 50 \pm 2)$ °C;
- (0 ± 2) °C for butane;
- $(- 20 \pm 2)$ °C for propane and LPG.

The closure caused by the excess flow valve shall occur in the range defined between 120 % and 200 % of the guaranteed flow rate.

A.4.3.2 After the tests for resistance to pressure and mechanical strength of the connection, carried out as described in 7.2.1 and in 7.2.2, the operation of the excess flow valve shall remain satisfactory at the temperatures given in A.4.3.1.

A.4.3.3 For the endurance test, the device shall be subjected to a series of 1 000 cycles of opening/closing, without change in the operating forces, of the sensitivity of the positioning devices and without apparent traces of pitting. This test shall be carried out at ambient temperature.

A.4.4 User and maintenance instructions

In addition to the information given in 8.4, the manufacturer shall clearly indicate in the instructions:

- a) type of cylinder which may be used with the automatic change over device;
- b) case of use on a cylinder, in addition to the requirements given in clause 8, the following limitations of use:
 - do not move the cylinder during use;
 - close the cylinder valve in the event of operation of the excess flow valve;
 - only open the valve after having rectified the cause of the device operating;
- c) if the valve has intermediate positions between fully open and fully closed, information shall be given that the valve shall always be in the fully open position so as to allow the operation of the pressure limiter;
- d) this automatic change over device is fitted with an excess flow valve which ensure the shut off between 120 % and 200 % of the guaranteed flow rate;
- e) way of operating the automatic change over device;
- f) instructions for installation.

A.5 Automatic change over devices fitted with a regulated pressure limiter

A.5.1 Definition

device which is part of the automatic change over device and limits, in the event of failure, the rise in pressure above a specified value without shut off the gas flow.

A.5.2 Constructional and performance characteristics

A.5.2.1 The pressure limiter may be either integral in the automatic change over device or an immovably attached component to it. In any cases, the pressure limiter is fitted downstream the regulation system and the construction requirements applicable to it are the same as those applicable to the automatic change over device.

A.5.2.2 As long as the pressure upstream of the pressure limiter is below the maximum regulated pressure the device does not operate as a pressure limiter.

If the upstream pressure exceeds the maximum regulated pressure, whatever the rate, the pressure limiter shall maintain the regulated pressure at a value at most equal to 120 % of the maximum regulated pressure.

Moreover, a mechanism can be provided to put in evidence the intervention of the pressure limiter (for instance, pressure nipple or independent indicator).

A.5.2.3 In addition, the pressure limiter shall not show a pressure drop exceeding 30 % of the nominal regulated pressure of the single automatic change over device.

A.5.3 Test methods

A.5.3.1 Test conditions

So as to verify the constructional and performance characteristics of the pressure limiter, the manufacturer shall provide the test house with all appropriate test means allowing to invalidate the pressure limiter function to check the regulation function and the opposite.

A.5.3.2 Measurement of the maximum regulated pressure

The automatic change over device being supplied under the conditions of A.5.2.2 check that the maximum regulated pressure remains below 120 % of the maximum regulated pressure for any rate up to 120 % of the guaranteed rate.

A.5.3.3 Measurement of the pressure drop

The automatic change over device is supplied under the conditions of A.5.2.3 and connected to a differential pressure measuring device upstream and downstream. The characteristics are checked for compliance with the requirements of A.5.2.3.

A.5.4 Users and maintenance instructions

In addition to the indications given in 8.4, the instructions shall give all information on the function and operation limits of the pressure limiter.

In particular, the instructions shall specify that this device shall not be fitted downstream a automatic change over devices incorporating an integral pressure limiter.

Annex B (normative)

A₁ Special requirements for automatic change over devices and automatic change over device systems for caravans, motor caravans or fresh water boats

An automatic change over device system shall be supplied as a complete assembly by the manufacturer or as an assembly of parts ("kit") which, once assembled, will be equivalent to an automatic change over device meeting the requirements of this European Standard.

Automatic change over devices and change over device systems for use in seawater boats are dealt with in Annex J.

This annex is applicable when the vehicle or boat is equipped with appliances operating in category I_{3B/P(30)}, supplied by means of LPG cylinders within the temperature and pressure ranges specified in Clauses 1 and 6.

In the following text "caravan" is used either for caravan or freshwater boats.

If the system is supplied as a kit it shall be easy to assemble correctly and difficult to assemble incorrectly. If special tools are specified for the assembly of the system they shall be supplied with the kit. It shall be possible to verify with tests the operation and soundness of the system once it is assembled and installed. Clear and sufficient instructions for the assembly and tests shall be supplied with the kit.

Flexible hoses used in the system shall meet the requirements of prEN 1763.

The length of flexible hoses used shall be in accordance with EN 1949.

All the connections used in the automatic change over device system shall be designed so as to prevent interchangeability with other devices which are not designed to be used in the system and to prevent parts of the system from being used independently.

The inlet and outlet connections shall comply with Annex D of EN 12864:2001. Intermediate connections shall be different from the system inlet and outlet connections if the assembly can be taken apart.

The second regulator included in the assembly is a fixed type as described in EN 13785. The tests on this regulator shall be carried out using the methods given in EN 13785, under the pressures declared by the manufacturer.

The regulated pressures shall be in accordance with Annex D of EN 12864:2001.

The nominal rate shall not be greater than 1,5 kg/h.

The automatic change over device or the automatic change over device system shall incorporate a safety device limiting pressure as in Annex D of EN 12864:2001.

Cylinder mounted regulators used in change over device systems shall meet the resistance to impact requirements of EN 12864, with the outlet connection protected.

Automatic change over devices and automatic change over devices systems complying with this annex shall carry in a durable, legible and visible fashion the marking "Caravan(e)".

In addition when the two stages of regulation are identified separately:

- first stage of regulation shall only indicate the values of the supply pressure as information on the pressure;
- second stage of regulation shall only indicate the regulated pressure 30 mbar as information on the pressure;

— nominal rate shall be indicated in the information of the second stage of regulation.

The instructions shall include a warning of the type "Only for use in caravans, motor caravans and freshwater boats".

The instructions of the caravan automatic change over devices or automatic change over device systems shall also include the following warning "This automatic change over device (system) is not suitable for mobile homes".

NOTE Requirements of 5.3.6 are not mandatory for such automatic change over devices and change over device systems. 

Annex C (normative)

Special requirements for low pressure automatic change over devices under extreme temperature conditions (temperatures below - 20 °C)

Any automatic change over devices which may be used under extreme temperature conditions (temperatures below - 20 °C) shall meet the following requirements:

The automatic change over devices is left at a temperature of - 40 °C for 24 h.

Its temperature is then raised to - 30 °C.

After this, the automatic change over devices shall meet at - 30 °C all the specifications requested in this standard at - 20 °C.

Any automatic change over devices meeting the requirements of this annex shall include, in addition to the information specified in 8.2, an indication of its suitability for use under extreme temperature conditions, as a marking such as "- 40 °C".

This information shall also be shown in the users and maintenance instructions.