BS EN 14129:2014

BSI Standards Publication

LPG Equipment and accessories — Pressure relief valves for LPG pressure vessels

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National foreword

This British Standard is the UK implementation of EN 14129:2014. It supersedes BS EN 14129:2004 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PVE/19, LPG containers and their associated fittings.

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.

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Foreword

This document (EN 14129:2014) has been prepared by Technical Committee CEN/TC 286 “Liquefied petroleum gas equipment and accessories”, the secretariat of which is held by NSAI.

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of an identical text or by endorsement, at the latest by August 2014, and conflicting national standards shall be withdrawn at the latest by August 2014.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 14129:2004.

This European Standard has been submitted for reference into:

— the RID [9]; and

— the technical annexes of the ADR [10].

NOTE These regulations take precedence over any clause of this European Standard. It is emphasised that RID/ADR/ADN are being revised regularly at intervals of two years which may lead to temporary non-compliances with the clauses of this European Standard.

The major changes to this revision include the addition of:

— pilot operated pressure relief valve;

— an ageing test, see 7.9 and Annex C;

— an endurance test, see 7.10; and

— a stress cracking test, see 7.11.

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.

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, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This European Standard calls for the use of substances and procedures that may be injurious to health and/or the environment if adequate precautions are not taken. It refers only to technical suitability: it does not absolve the user from their legal obligations at any stage.

Protection of the environment is a key political issue in Europe and elsewhere around the world. Protection of the environment in this document is understood in a very broad sense. The phrase is used, for example, in relation to the total life-cycle aspects of a product on the environment, including expenditure of energy, and during all phases of its existence, from mining of raw materials, to fabrication, packaging, distribution, use, scrapping, recycling of materials, etc.

NOTE 1 Annex D comprises an environmental checklist which highlights the clauses of this European Standard that address environmental aspects.

Provisions have to be restricted to a general guidance. Limit values are specified in national laws.

It is recommended that manufacturers develop an environmental management policy. For guidance see the EN ISO 14000 series [6], [7] and [8].

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

All pressures are gauge pressures unless otherwise stated.

Valves designed in accordance with this standard are specifically for use in LPG applications. Valves manufactured in accordance EN ISO 4126-1 may also be used in certain LPG applications.

NOTE 2 This European Standard requires measurement of material properties, dimensions and pressures. All such measurements are subject to a degree of uncertainty due to tolerances in measuring equipment, etc. It may be beneficial to refer to the leaflet “measurement uncertainty leaflet” SP INFO 2000 27 [13].

1 Scope

This European Standard specifies the requirements for the design and testing of spring loaded pressure relief valves and thermal expansion valves for use in:

— static LPG pressure vessels,

NOTE The pressure vessels can be situated above ground, underground or mounded.

— LPG pressure vessels on road tankers, rail tankers, tank-containers or demountable tanks.

This document does not address production testing.

Normative Annex B prescribes testing with conditioning at - 40 °C for valves for use under extreme low temperature conditions.

The requirements for pressure relief valve accessories such as isolating devices, changeover manifolds and vent pipes are specified in EN 14071.

EN 14570 identifies the requirements for the pressure relief valve capacities for static pressure vessels.

EN 12252 identifies the requirements for the pressure relief valve capacities for road tankers.

Valves designed in accordance with this standard are specifically for use in LPG applications. Valves manufactured in accordance with EN ISO 4126-1 may also be used in certain LPG applications.

Terms used with LPG pressure relief valves are described graphically in Annex A.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 549:1994, *Rubber materials for seals and diaphragms for gas appliances and gas equipment*

EN 751-1, *Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water - Part 1: Anaerobic jointing compounds*

EN 751-2, *Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water - Part 2: Non-hardening jointing compounds*

EN 751-3, *Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water - Part 3: Unsintered PTFE tapes*

EN 837-1, *Pressure gauges - Part 1: Bourdon tube pressure gauges - Dimensions, metrology, requirements and testing*

EN 1092-1:2007+A1:2013, *Flanges and their joints - Circular flanges for pipes, valves, fittings and accessories, PN designated - Part 1: Steel flanges*

EN 1503-1:2000, *Valves - Materials for bodies, bonnets and covers - Part 1: Steels specified in European Standards*

EN 1503-2:2000, *Valves - Materials for bodies, bonnets and covers - Part 2: Steels other than those specified in European Standards*

EN 1503-3:2000, *Valves - Materials for bodies, bonnets and covers - Part 3: Cast irons specified in European Standards*

EN 1503-4:2002, *Valves - Materials for bodies, bonnets and covers - Part 4: Copper alloys specified in European Standards*

EN 1563:2011, *Founding - Spheroidal graphite cast irons*

EN 10204, *Metallic products - Types of inspection documents*

EN 10270-3:2011, *Steel wire for mechanical springs - Part 3: Stainless spring steel wire*

EN 12165:2011, *Copper and copper alloys - Wrought and unwrought forging stock*

EN 12420:1999, *Copper and copper alloys - Forgings*

EN 13906-1:2013, *Cylindrical helical springs made from round wire and bar - Calculation and design - Part 1 : Compression springs*

EN 14071:2004, *Pressure relief valves for LPG tanks - Ancillary equipment*

ISO 7-1:1994, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation*

ISO 6957:1988, *Copper alloys — Ammonia test for stress corrosion resistance*

ANSI/ASME B1.20.1–1983, *Pipe Threads, General Purpose (Inch)*

3 Terms and definitions

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

3.1
liquefied petroleum gas
LPG
low pressure liquefied gas composed of one or more light hydrocarbons which are assigned to UN 1011, UN 1075, UN 1965, UN 1969 or UN 1978 only and which consists mainly of propane, propene, butane, butane isomers, butene with traces of other hydrocarbon gases

3.2
pressure vessel
assembly of the pressure-retaining envelope (including the openings and their closures) and non-pressure-retaining parts attached directly to it

3.3
pressure relief valve
self-closing valve which automatically, without the assistance of any energy other than that of the vapour concerned, discharges vapour at a predetermined pressure, and operates with a pop action

3.4
thermal expansion valve
self-closing valve which automatically, without the assistance of any energy other than that of the fluid concerned, discharges fluid at a predetermined pressure

3.5
spring loaded pressure relief valve
valve in which the loading due to the vapour pressure underneath the sealing element is opposed only by the force of a spring

3.6
external pressure relief valve
pressure relief valve which when fitted to the LPG pressure vessel has the spring external to the pressure envelope

Note 1 to entry: See Figure 1.

3.7
pilot operated pressure relief valve
external pressure relief valve where the pressure setting is separate from the discharge function

Note 1 to entry: See Figure 2.

3.8
internal pressure relief valve
pressure relief valve which when fitted to the LPG pressure vessel has the spring internal to the pressure envelope

3.9
semi-Internal pressure relief valve
pressure relief valve which when fitted has the spring inside the pressure envelope and which has some of the working parts and the wrenching section outside the pressure envelope

Note 1 to entry: See Figure 3.

3.10
fully internal pressure relief valve
pressure relief valve which, when fitted, has the spring, all working parts and the wrenching section inside the pressure envelope

Note 1 to entry: See Figure 4.

3.11
nominal set pressure
predetermined pressure of the pressure relief valve at which the valve is set to start to discharge

Note 1 to entry: RID [9] and ADR [10] require a capability of automatic opening under a pressure between 0,9 times and 1,0 times the test pressure of the pressure vessel to which they are fitted.

3.12
start to discharge pressure
inlet pressure at which the first of a stream of bubbles appears at the outlet of a pressure relief valve through a water seal of not more than 50 mm water column, or other equivalent method

3.13
overpressure
pressure increase between the nominal set pressure and the flow rating pressure, usually expressed as a percentage of nominal set pressure

3.14
reseal pressure
inlet pressure at which leakage ceases through a water seal of not more than 50 mm water column on the outlet of the valve, after the valve has been subjected to a pressure equal to or above the start to discharge pressure but below the "pop" pressure

3.15
reseat pressure
inlet pressure at which the sealing element effects a seal with the valve seat after the valve has been subjected to pop action

3.16
flow rating pressure
inlet pressure at which the discharge capacity is measured

3.17
maximum allowable pressure
PS
maximum pressure for which the valve is designed, as specified by the manufacturer

3.18
pop action
rapid opening of the valve sealing element to achieve full lift, resulting from an increase of inlet pressure creating a sudden increase in force and compression of the spring

3.19
pop pressure
pressure at which pop action occurs

3.20
blowdown
difference between start to discharge and reseat pressures, usually expressed as a percentage of the nominal set pressure

3.21
discharge capacity
capacity at the flow rating pressure of a pressure relief valve expressed in cubic metres per minute of free air at STP

3.22
sealing element
non-metallic resilient component which effects a seal by contact with the pressure relief valve seat

3.23
valve seat
normally raised area of the pressure relief valve body on to which the sealing element effects the seal

3.24
pressure relief valve isolating device
device fitted between the storage pressure vessel and an external pressure relief valve (including pilot operated), which permits replacement of the pressure relief valve without depressurising the pressure vessel

3.25
changeover manifold
device fitted to a storage vessel permitting two or more pressure relief valves to be fitted, only one of which can be isolated at a time, which permits replacement of the isolated pressure relief valve without depressurising the vessel

3.26
leak tightness
resistance to leakage to atmosphere across the valve seat or any other pressure containing component when the valve is closed

3.27
Standard Temperature and Pressure
STP
15,6 °C (288,7 K), 1,013 bar absolute (0,1013 MPa absolute)

4 Operating conditions

4.1 The pressure relief valve shall be suitable for a minimum operating temperature of - 20 °C, the temperature to which the valve is expected to be exposed during normal use. Temperatures below this may be encountered during short periods, for example, during discharge.

4.2 In some parts of Europe, and for certain applications, lower minimum operating temperatures are encountered. When equipment is designed for a temperature lower than −20 °C, the pressure relief valve shall meet the requirements of Annex B.

4.3 The pressure relief valve shall be suitable for the maximum operating temperature of 65 °C.

4.4 The pressure relief valve shall be suitable for the minimum pressure a valve or fitting is normally exposed to, which is 1 bar absolute. Vacuum conditions on the valve, arising from butane at low temperature or evacuation of the pressure vessel can expose the valve or fitting to a vacuum of 50 mbar absolute.

4.5 Pressure relief valves manufactured in accordance with this European Standard are expected to have a useful safe service life expectancy of a minimum of 15 years from the date of manufacture/reconditioning, under normal operating conditions. This requirement does not apply to the protective cap or plug.

5 Materials

5.1 General

5.1.1 The manufacturer shall endeavour to acquire materials and components from suppliers who have a declared environmental policy; see EN ISO 14021, EN ISO 14024 and EN ISO 14025.

5.1.2 All materials in contact with LPG shall be physically and chemically compatible with LPG under all normal operating conditions for which the valve is intended to be used.

5.1.3 Material for components shall be selected for adequate strength in service. The material shall resist brass dezincification, stress corrosion, impact or material failure. If stress corrosion could be present in a material, stress relieving heat treatment shall be carried out as necessary.

5.1.4 The components exposed to atmosphere shall be manufactured from corrosion resistant materials or suitably protected against corrosion.

5.2 Metallic materials

5.2.1 Valves shall be made from steel, stainless steel, copper alloys or other suitable materials.

5.2.2 For pressure containing components, steel and stainless steels shall comply with EN 1503-1:2000 or EN 1503-2:2000, cast iron shall comply with EN 1503-3:2000 and copper alloys shall comply with EN 1503-4:2002.

5.2.3 Components made from stainless steel shall contain not less than 16 % chromium, and not less than 7 % nickel.

5.2.4 Springs shall be manufactured from stainless steel in accordance with EN 10270-3:2011 or material with an equivalent resistance to corrosion.

5.2.5 When carbon steel is used for a spring for an external relief valve, due to material strength requirements, it shall be adequately protected against corrosion.

5.2.6 Hot stamped brass shall be non-porous and suitable for machining or other processes. Leaded brass shall be CW614N or CW617N in accordance with EN 12420:1999 or EN 12165:2011. Sand-cast brass shall not be used. Cold drawn brass rods shall only be used for machining after adequate testing for internal cracking, porosity or other inclusions and shall be heat treated if required. Components produced from stamping brass shall not exhibit cold shuts or surface defects. Components manufactured from hot stamped brass or made of drawn brass or machined from brass rod shall be capable of withstanding, without cracking, the stress-cracking test.

5.2.7 Spheroidal graphite cast iron shall comply with EN 1563:2011, with an elongation at fracture of more than 18 %. Other ductile irons or cast irons shall not be used. Castings shall be free from inclusions and surface defects, which could adversely affect the strength, leak tightness or performance of the valve.

5.2.8 For guidance on the choice of metallic materials, see EN ISO 11114-1:2012.

5.3 Non-metallic components

5.3.1 All non-metallic materials in contact with LPG shall not distort, harden or adhere to the body or seat face to such an extent as to impair the function of the valve.

5.3.2 All rubber materials shall also comply with the requirements of EN 549:1994. The ozone test in EN 549:1994 shall only be carried out where gaskets/seals are exposed to the atmosphere. For guidance on the selection of non-metallic materials, see EN ISO 11114-2:2013

5.4 Lubricants, sealants, and adhesives

Where used on threads and seals; lubricants, sealants, and adhesives shall be compatible with LPG and shall not interfere with the operation of the valve or fitting.

Sealants shall comply with EN 751-1, EN 751-2 or EN 751-3.

5.5 Certification

5.5.1 The main metallic pressure-bearing parts shall be provided with material manufacturers' certificates conforming to EN 10204; certificate 3.1.

5.5.2 Springs and other metallic parts shall have certificates conforming to EN 10204, certificate type 2.2 or certificate 3.1.

5.5.3 Non-metallic parts shall be provided with certificates confirming their conformance with the specification stated on the purchase order.

5.5.4 Certificates of material conformity with the requirements of the specification and the order shall be obtained by the manufacturer for all materials. For metallic materials certificates in accordance with EN 10204 for the complete consignment shall be obtained.

6 Design

6.1 General

6.1.1 All requirements described in this European Standard for “pressure relief valves” are also applicable to “thermal expansion valves” unless otherwise specified.

6.1.2 A pressure relief valve shall be:

— an external pressure relief valve, see Figure 1;

— pilot operated pressure relief valve, see Figure 2;

— a semi-internal pressure relief valve, Figure 3; or

— a fully internal pressure relief valve, see Figure 4.

6.1.3 The design of the pressure relief valve should consider the following:

— minimising the use and waste of materials; and

— minimising the environmental impact of in service maintenance and end of life disposal.

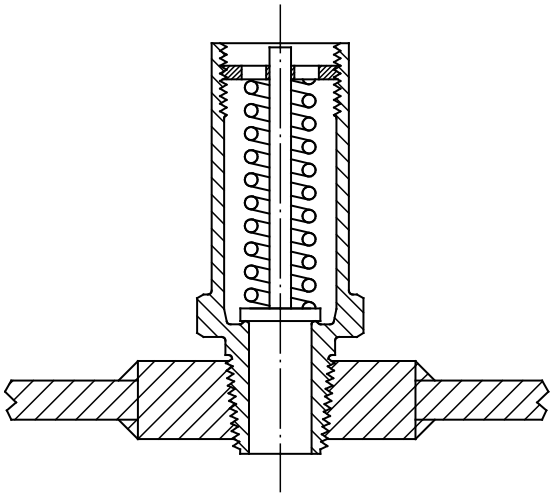


Figure 1 — External pressure relief valve

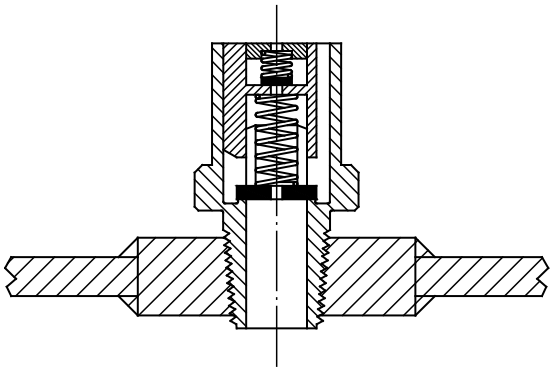


Figure 2 — Pilot operated pressure relief valve

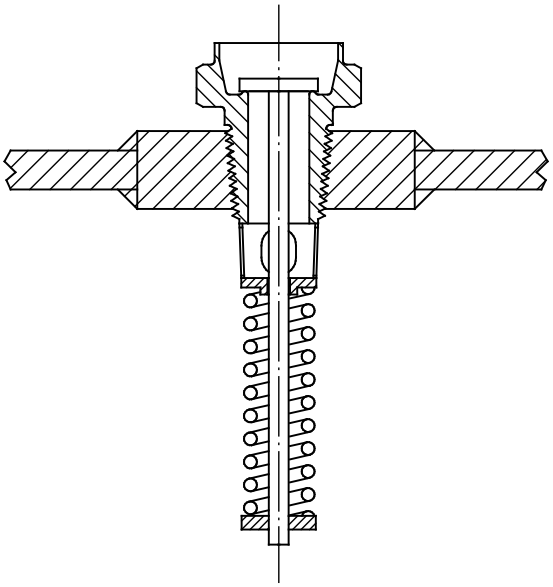


Figure 3 — Semi-internal pressure relief valve

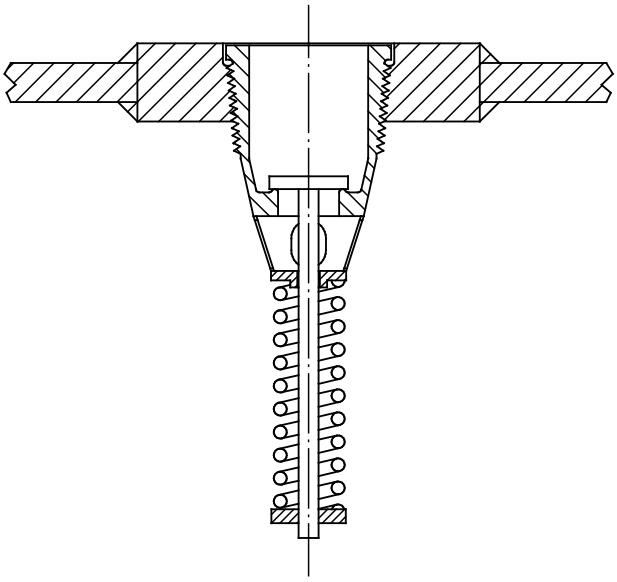


Figure 4 — Fully internal pressure relief valve

6.2 Design parameters

6.2.1 The valve components shall be designed with adequate strength and clearances to ensure correct operation in service.

6.2.2 The valve shall be designed to operate with the characteristics identified in 7.2.5 and 7.2.6.

6.2.3 Pressure relief valves shall be designed to operate with a “pop” action. “Pop” action shall take place between the start to discharge pressure and the flow rating pressure. Thermal expansion valves are not required to operate with a “pop” action.

6.2.4 The blowdown shall not be more than 35 % of the nominal set pressure for a pressure relief valve. This requirement does not apply to thermal expansion valves.

6.2.5 Valves shall reseal at a pressure above 85 % of the nominal set pressure.

6.3 Threads

6.3.1 Pressure relief valves intended to be directly connected into the pressure vessel shall be connected by means of a taper thread in accordance with ANSI/ASME B1.20.1–1983 or by a flange connection in accordance with EN 1092-1:2007+A1:2013. To avoid mismatching with ANSI/ASME B1.20.1-1983 threads, ISO 7-1:1994 shall not be used.

6.3.2 Pressure relief valves intended to be connected to isolating devices shall be connected by means of a parallel thread used in conjunction with a bonded seal in accordance with EN 14071:2004.

Pressure relief valve connections that are not shown in EN 14071:2004 shall be designed to prevent connection with the isolating devices shown in EN 14071:2004.

6.3.3 Pressure relief valves intended to be fitted to changeover manifolds shall be connected by means of flanges or parallel threads used in conjunction with a gasket or a taper thread.

6.3.4 Only right hand threads shall be used.

6.4 Springs

6.4.1 Helical compression springs shall be designed in accordance with EN 13906-1:2013

6.4.2 Springs shall be designed to prevent design stresses being exceeded at the flow rating pressure. Stops may be provided to avoid excessive stress. There shall be sufficient spring compression to allow the full lift of the sealing element at the flow rating pressure.

6.5 Additional requirements

6.5.1 The design shall incorporate guiding arrangements of the sealing element housing necessary to ensure reliable operation and leak tightness.

6.5.2 The sealing element shall be secured within its housing to avoid it becoming loose in operation.

The sealing element housing shall be manufactured from a metallic material with a minimum melting point of 450 °C. Non-metallic materials may be used if they are able to meet the same requirements without deformation or degradation which might impair the operation of the valve.

6.5.3 The setting of the pressure relief valve shall be secured in a way that discourages and reveals any interference.

6.5.4 External and semi-internal pressure relief valves shall be provided with a means of drainage to prevent accumulation of water on the discharge side of the valve. Where LPG is expelled from the drain holes of the pressure relief valve during operation it shall be done in a safe manner.

6.5.5 Pressure relief valves shall be fitted with a removable protection cap or means of protection to prevent the ingress of water or foreign matter. Such protection shall be designed so as not to be inadvertently displaced except by the discharge of the valve and shall not affect the performance of the valve.

For mobile applications, the pressure relief valve shall withstand a deceleration of 100 times gravity in the X, Y and Z axis and shall remain leak tight and operate correctly afterwards.

6.5.6 A valve shall achieve the required leak tightness where the leakage rate does not exceed 15 cm^3 per hour of air measured at STP rounded down to one decimal place.

6.6 Pressure relief valve with parallel thread

6.6.1 Pressure relief valves intended for use with isolating devices shall have positive means to determine that closure of the isolating device has occurred. This shall be achieved by:

— the use of two tell-tale holes in the pressure relief valve which shall be visible above the bonded seal, when 3 full turns of engagement remain; or the use of visible marking (e.g. machined groove) on a thermal expansion valve which shall be visible when 3 full turns of engagement remain; and

— a noticeable audible change in the release of gas which shall have taken place when removing the pressure relief valve indicating closure of the isolating device while a minimum of 3 threads remain engaged.

6.6.2 Where the pressure relief valve is used with an isolating device, the relief valve and the isolating device shall be in accordance with EN 14071:2004.

6.6.3 The pilot valve of a pilot operated pressure relief valve shall comply with 6.8.

6.7 Pressure relief valve for use with a changeover manifold

6.7.1 Pressure relief valves intended for use with changeover manifolds shall have positive means to determine that closure of the isolating device has occurred. This shall be achieved by:

— the use of two tell-tale holes in the pressure relief valve which shall be visible above the bonded seal, when 3 full turns of engagement remain;

— a noticeable audible change in the release of gas which shall have taken place when removing the pressure relief valve indicating closure of the isolating device while a minimum of 3 threads remain engaged; and

— as an alternative changeover manifolds may incorporate bleed valves to indicate the correct operation of isolation device.

6.7.2 Where the pressure relief valve is used with a changeover manifold, it shall be in accordance with EN 14071:2004.

6.8 Pilot operated pressure relief valve

6.8.1 The pressure setting shall be separate from the discharge function. It shall be activated by a pilot valve.

6.8.2 The valve shall be composed of two separate components in the assembly:

— the main body provides the discharge capacity; and

— the pilot valve provides the set to discharge pressure, pop action, blowdown and reseal pressure.

6.8.3 When the pilot valve is removed from the assembly:

— the orifice for the pilot valve shall be sealed either metal to metal or with a soft seal; and

— the main sealing element in the main body shall be locked in the closed position and shall remain leak tight.

7 Testing of the design

7.1 General

7.1.1 The strength, operating and flow characteristics of pressure relief valves shall be determined by type tests.

7.1.2 Pressure relief valves shall be provided with the valve completely assembled.

7.1.3 All sample pressure relief valves shall be tested in accordance with 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 7.9, 7.10, 7.11, 7.12 and 7.13.

7.1.4 The test sequence and valve sample numbers are identified in Table 1.

7.1.5 The test medium for all tests, except the hydraulic test, shall be air or nitrogen and shall be dry to avoid any condensation in the full test loop including the pressure relief valve itself.

7.1.6 The accuracy class for pressure measuring equipment used during the tests shall not be more than 0,6, with the test pressure within the middle third of the instrument range and shall be in accordance with recognised standards, for example EN 837-1.

7.1.7 The test equipment for use in measuring the flow discharge capacity shall be accurate to within 2 % of the nominal flow rate.

7.1.8 When changes are made in the design of a pressure relief valve, which affect its flow path or discharge capacity, or if the set pressure is to be modified by more than 10 %, new tests shall be carried out.

7.1.9 Water used during testing should be reused or recycled to minimise waste.

7.1.10 Where LPG is used for testing, it should not be allowed to escape to atmosphere and should be contained for reuse.

NOTE Pressure relief valves in accordance with this European Standard are subject to a conformity assessment system consisting of the testing and approval of the design type, the recognition of quality assurance systems for the production and the initial inspection and testing of valves manufactured in accordance to the design type.

Table 1 — Valve type test requirements

Test No.	Test detail	Clause	Condition of test valve/test sequence	Temperature at which the test is performed	Valve sample number	Number of cycles per valve
1	Dimensional checks	7.3	As received	Room temperature	1	1
2	Hydraulic proof test	7.4	As received	Room temperature	2	1
3	Overtorquing test	7.5	From Test No. 2	Room temperature	2	1
4	Start to discharge pressure test	7.6	As received and from Test No. 10	Room temperature	3, 4, 5, 13, 14 and 15	3
5	Discharge capacity test	7.7	From Test No. 4	Room temperature	3, 4 and 5	1
6	Leak tightness tests	7.8	From Test No. 5, Test No. 7 and Test No. 10	Room temperature, $65\ ^{+2,5}_{-2,5}$ °C, and $-20\ ^{+0}_{-5}$ °C	3, 4, 5, 6, 7, 8, 13, 14, and 15	1
7	Ageing test	7.9	As received	Per Annex C	6, 7 and 8	1
8	Endurance test	7.10	As received	Room temperature	9,10 and 11	100
9	Stress cracking test	7.11	As received	Room temperature	12	1
10	Vacuum test	7.12	As received	Room temperature	13, 14, and 15	1
11	Visual inspection	7.13	From Test No. 3, 6, 7, 8, 9 and 10	Room temperature	2 to 15	1

7.2 Test requirements

7.2.1 There shall be no chatter, flutter, sticking or vibration during the tests that interferes with the satisfactory operation of the pressure relief valve.

7.2.2 The pressure relief valve shall be dimensionally correct when checked in accordance with the design drawings; see 7.3.

7.2.3 The pressure relief valve shall withstand a hydraulic proof test without visible permanent deformation, rupture or leak in accordance with 7.4.

7.2.4 The pressure relief valve shall withstand an overtorquing test to ensure the freedom of movement of all operating parts and leak tightness in that condition in accordance with 7.5

7.2.5 The pressure relief valve shall be subject to a start to discharge pressure test in accordance with 7.6.

The start to discharge pressure shall be within ± 5 % of the nominal set pressure. The results of the start-to-discharge pressure test shall be within 5 % of the average of the pressure relief valves tested.

The reseal pressure for each valve shall be in accordance with 6.2 and the valve shall be leak tight in accordance with 6.5.6.

7.2.6 The pressure relief valve shall be subject to a discharge capacity test in accordance with 7.7.

The range of results of the discharge capacity test for each pressure relief valve shall be within ± 5 % of the mean value.

The lowest of the three test results shall be deemed to be the discharge capacity and shall be quoted in cubic metres per minute of air measured at STP rounded down to one decimal place.

The blowdown for each valve shall be in accordance with 6.2 or the design shall be rejected.

Thermal expansion valves are not subject to a discharge capacity test but shall have a minimum discharge capacity identified for each valve.

7.2.7 The pressure relief valve shall withstand leak tightness tests in accordance with 7.8; the leakage rate shall not exceed 15 cm^3/h at STP.

7.2.8 An ageing test including humidity, temperature variation and ultraviolet light, shall be carried out in accordance with 7.9.

The relief valve shall then be subject to a start to discharge pressure in accordance with 7.6, where appropriate shall be subjected to “pop” action and shall be leak tightness tested in accordance with 7.8.

After ageing test the start to discharge pressure shall be under 110 % of the nominal set pressure and reseal pressure above 80 % of the nominal set pressure.

7.2.9 The pressure relief valve shall be submitted to an endurance test in accordance with 7.10.

After the test the valve shall meet the following requirements:

— the leak rate shall be less than 570 cm^3/s with an inlet pressure of 1 bar;

— the valve components (excluding the sealing element) shall be inspected to ensure that there is no damage, deformation or wear that could affect the opening and closing movements of the valve; and

— the blowdown of the valve shall be checked to ensure that it does not exceed 35 % of the nominal set pressure.

7.2.10 A stress cracking test shall be carried out on brass components in accordance with 7.11.

Each test sample shall be subjected to the physical stresses normally imposed on or within a part as the result of assembly with other components. Such stresses shall be applied to the sample prior to, and be effective during, the test.

After being tested, a brass part shall show no evidence of cracking or lamination when examined using 25 × magnification.

7.2.11 A vacuum test shall be carried out in accordance with 7.12. The valve shall then meet the requirements of 7.2.5

7.2.12 The pressure relief valve shall be visually inspected for damage, deformation, wear and cracks in accordance with 7.13. Any failure, deformation, excessive wear or cracks that may affect the operation of the pressure relief valve shall be a cause of rejection.

7.3 Dimensional checks

7.3.1 The sample valve shall initially be subjected to dimensional checks for conformity with the design type specification.

7.3.2 The pressure relief valve shall meet the requirements of 7.2.2, or the design shall be rejected.

7.4 Hydraulic proof test

7.4.1 The test shall be carried out in the following manner.

7.4.2 The body seat of the relief valve shall be blanked off so that the pressure is only applied to those parts on the inlet side of the seat.

7.4.3 Pressure shall be applied through a fitting reproducing the pressure vessel boss or isolating device.

7.4.4 The test medium shall be water or other suitable fluid.

7.4.5 The pressure shall be raised continuously and gradually.

7.4.6 The test pressure shall be 1,43 times the maximum allowable pressure.

7.4.7 The test duration shall be for a minimum of two minutes from when the test pressure is reached.

7.4.8 The pressure relief valve shall meet the requirements of 7.2.3, or the design shall be rejected.

Alternatively pneumatic testing may be carried out, if a similar level of sensitivity and safety is provided.

7.5 Overtorquing test

7.5.1 The valve body shall be fitted on a test fixture representative of its expected use.

7.5.2 A parallel threaded pressure relief valve shall be tightened to 1,5 times the manufacturer's maximum recommended fitting torque.

7.5.3 A taper threaded pressure relief valve shall be tightened to 5 Nm. It shall then be tightened a further 3 revolutions.

7.5.4 After the torque has been applied, the pressure relief valve shall be checked for:

— freedom of movement of all operating parts:

— leak tightness (see 6.5.6).

7.5.5 The valve shall meet the requirements of 7.2.4 or the design shall be rejected.

7.6 Start to discharge pressure test

7.6.1 Samples of the pressure relief valve set at the same nominal set pressure shall be used. Any dust or protection cap shall be removed. Any relief valve isolation device, see EN 14071, which can affect the flow characteristics, shall be included in the samples being tested.

7.6.2 The start to discharge pressure shall be determined in the following manner, which shall be carried out three times for each of the pressure relief valves:

— the pressure shall be increased to approximately 90 % of the nominal set pressure. The valve shall remain leak tight.

— the pressure shall be further increased slowly at a rate not exceeding 0,15 bar per second until the first bubbles are observed from the outlet of the pressure relief valve;

— the pressure at which the first bubbles appear is the start to discharge pressure of the pressure relief valve and shall be recorded.

— the pressure shall be gradually reduced until the valve has resealed and the reseal pressure shall be recorded.

7.6.3 The pressure relief valve shall meet the requirement of 7.2.5, or the design shall be rejected.

7.7 Discharge capacity test

7.7.1 The discharge capacity shall be determined in the following manner.

7.7.2 The pressure shall gradually be increased until the flow rating pressure (120 % of the nominal set pressure) is reached. The rate of pressure increase shall not exceed 0,15 bar per second between 90 % of the nominal set pressure and the pop pressure.

7.7.3 This pressure shall be maintained until the discharge capacity has been recorded.

7.7.4 The pressure shall gradually be decreased until the pressure relief valve reseats and the reseat pressure shall be recorded.

7.7.5 The lowest value of the discharge capacity of the tested pressure relief valves shall be deemed to be the nominal discharge capacity of the pressure relief valve.

7.7.6 The pressure relief valve shall meet the requirements of 7.2.6, or the design shall be rejected.

7.8 Leak tightness tests

7.8.1 The pressure relief valve shall be tested to ensure leak tightness at any pressure below the start to discharge pressure and above 0,1 bar. The inlet of the pressure relief valve shall be pressurised to 80 % of the nominal set pressure.

7.8.2 The leak tightness test shall be carried out at the temperatures and in the sequence as given in Table 1.

7.8.3 For valves which are used under extreme low temperature conditions (temperatures below −20 °C) the low temperature test shall be carried out in accordance with Annex B.

7.8.4 The pressure relief valve shall meet the requirements of 7.2.7, or the design shall be rejected.

7.9 Ageing test

7.9.1 Valves shall be tested in a fixture representative of its intended use without a cap or plug on the outlet.

7.9.2 Ageing shall take place in a climatic chamber and shall follow the sequence as shown in Annex C. Table C.1 shows the sequence for a twenty four hour period. This cycle will then be repeated until ageing has taken place for 1 000 h.

7.9.3 The pressure relief valve shall meet the requirements of 7.2.8 or the design shall be rejected.

Water used during this test should be recycled for further use.

7.10 Endurance test

7.10.1 The endurance test shall be carried out in the following manner.

7.10.2 The pressure shall be increased to the flow rating pressure, ensuring that the discharge capacity is reached and where applicable that pop action has taken place.

7.10.3 Discharge duration of the valve shall not exceed 15 s and the pressure shall then be isolated ensuring the immediate closure of the valve.

7.10.4 The cycle shall be repeated 20 times for each sample.

7.10.5 The valve shall then be leak tested.

NOTE As an alternative, the pneumatic test can be replaced by a mechanical test that ensures that the operation of the poppet simulates that of opening of the valve and closure after pop action.

7.10.6 The pressure relief valve shall meet the requirements of 7.2.9 or the design shall be rejected.

7.11 Stress cracking test

7.11.1 General

The stress cracking test shall be either a mercurous nitrate immersion test or a moist ammonia test.

7.11.2 Mercurous nitrate immersion test

The sample shall be degreased and shall withstand total immersion for 30 min without cracking, in an aqueous mercurous nitrate solution containing 10 g of mercurous nitrate and 10 ml of nitric acid (specific gravity 1,42) per litre of solution.

7.11.3 Moist ammonia air stress cracking test

The sample shall be degreased and then tested in accordance with ISO 6957:1988 for a duration of 168 h.

7.12 Vacuum test

7.12.1 A vacuum of 50 mbar absolute is applied to the valve in a direction which would allow the sealing mechanism to be pressed against the valve seat.

7.12.2 The test duration shall be for a minimum of two minutes.

7.12.3 After the test, the valve shall be subject to a start to discharge pressure test.

7.12.4 The pressure relief valve shall meet the requirement of 7.2.5 or the design shall be rejected

7.13 Visual inspection

7.13.1 The valve shall be dismantled and visually inspected for damage, deformation, wear and cracks.

7.13.2 The pressure relief valve shall meet the requirements of 7.2.12.

7.14 Test records

The following data shall be recorded for each sample:

a) manufacturer's name;

b) valve type number with reference to the design type specification;

c) valve sample number; and

d) results of tests for 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 7.9, 7.10, 7.11, 7.12 and 7.13.

8 Marking

8.1 Pressure relief valves

The following minimum information shall be marked on the body of the pressure relief valve:

a) manufacturer's name or trademark;

b) type number;

c) date (code) indicating month and year of manufacture;

d) nominal set pressure in bar (and code if relevant for pilot operated relief valves);

e) maximum allowable pressure preceded by PS;

f) discharge capacity of air, quoted in cubic metres per minute, specified at 120 % of the nominal set pressure;

g) −40 °C for pressure relief valves fulfilling the requirements of Annex B; and

h) where the relief valve is intended to be used in combination with an isolating device, the system capacity shall be marked on the relief valve.

NOTE 1 The European Directive on Pressure Equipment 97/23/EC [11] also has marking requirements.

NOTE 2 The marking of pressure receptacles/pressure vessels is regulated by RID/ADR which take precedence over any clause in this European Standard. The European Directive on Transportable Pressure Equipment 2010/35/EU [12] includes additional marking requirements (π-marking).

8.2 Thermal expansion valves

The following minimum information shall be marked on the body:

a) manufacturer's name or trademark;

b) type number;

c) date (code) indicating month and year of manufacture;

d) nominal set pressure in bar; and

e) maximum allowable pressure preceded by PS.

NOTE 1 The European Directive on Pressure Equipment 97/23/EC [11] also has marking requirements.

NOTE 2 The marking of cylinders/pressure vessels is regulated by RID/ADR which take precedence over any clause in this European Standard. The European Directive on Transportable Pressure Equipment 2010/35/EU [12] includes additional marking requirements (π-marking).

8.3 Pilot operated pressure relief valve

In additional to the information required in 8.1 on the main valve body, the following information shall also be marked on the pilot valve component:

a) manufacturer's name or trademark;

b) date (code) indicating month and year of manufacture; and

c) nominal set pressure in bar or code.

9 Operating instructions

9.1 Operating instructions shall be provided with each consignment of pressure relief valves, and shall contain at least the following information:

a) manufacturer's name and address;

b) type number and data on performance;

c) details for fitting, removal and replacement of the pressure relief valve;

d) method and torque requirements for sealing connecting threads;

e) information on maintenance;

f) number of this European Standard (EN 14129:2014);

g) details of the isolating device to be used where the pressure relief valve is used with an isolating device;

h) if applicable, details on the importance of keeping “tell tale” holes and means of drainage free;

i) a warning using the following words:

WARNING — Pressure relief valves, which have operated up to their “pop” pressure, shall be removed from service for reconditioning or destruction. No spring shall be reused once removed from a pressure relief valve that has been subject to pop action.

9.2 Operating instructions and warnings shall be written in the official language or languages of the country where the valve is to be sold.

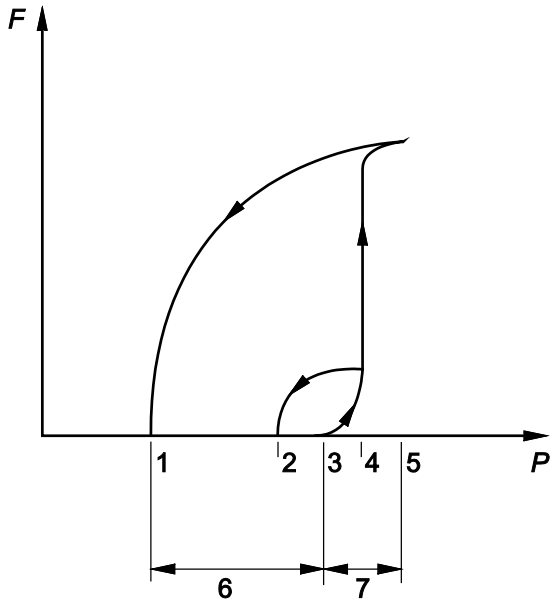
10 Packaging

Any packaging and protection used during storage/transport of the finished products should be selected to have the minimum environmental impact, i.e. use of recyclable or bio-degradable materials, minimum use of energy.

Recycling instructions and/or recycling symbols for each packaging material should be printed on the packaging.

Annex A
(informative)

Terms used with LPG pressure relief valves



Key

1 Reseat pressure
2 Reseal pressure
3 Nominal set pressure
4 “Pop” pressure
5 Flow rating pressure
6 Blowdown
7 Overpressure
F Flow
P Pressure

Figure A.1 — Terms used with LPG pressure relief valves

Annex B
(normative)

Special low temperature requirements for valves

B.1 Valves which are used under extreme low temperature conditions (temperatures below - 20 °C) shall meet the requirements of this European Standard as well as the requirements of B.2.

B.2 In place of the leak tightness test 7.8 and in Table 1 carried out at −20 $^{+0}_{-5}$ °C, the following test shall be carried out:

a) the valve shall be subjected to a temperature of (−40 $^{+0}_{-5}$) °C for 24 h;

b) a leak tightness test shall be carried out at 0,9 times the nominal set pressure and the leakage rate through the valve shall not exceed 15 cm^3 per hour of air measured at STP rounded down to one decimal place; and

c) the temperature shall not exceed 30 °C during the test.

Annex C
(normative)

Ageing test

C.1 General

Relief valves shall be subjected to an ageing test. Each of the three sample valves shall be placed in a climatic chamber and shall be subject to artificial ageing.

Ageing shall be carried out on a cyclic basis as described in Table C.1 which shows the different phases throughout a 24 hour period. This cycle is also shown graphically in Figure C.1.

These phases include different combinations of heat, cold, humidity, rain and UV conditions. UV light shall be provided in accordance with C.2 for the phase numbers shown in Table C.1. Rain shall be provided in accordance with C.3 for the phases as shown in Table C.1.

C.2 Ultraviolet light

Ultraviolet (UV) light shall be applied in the following condition:

— energy to be received by samples is (65 ± 10) W/m^2; and

— the wavelength range shall be (360 ± 40) nm [nanometres].

C.3 Rain

Rain shall be applied in the following condition:

a) demineralised water with a high resistivity more than 250 Ωm;

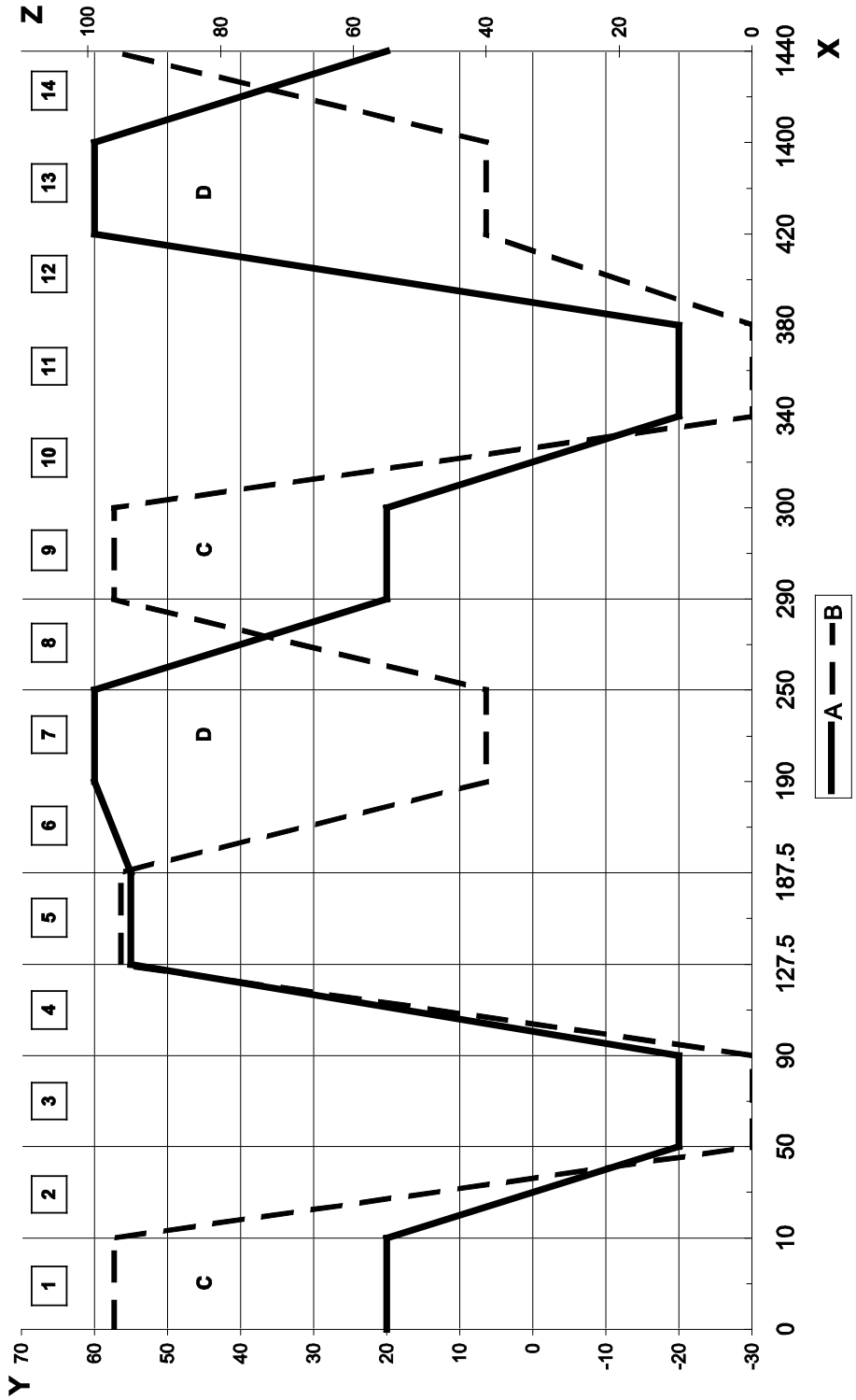
b) the acidity/alkalinity of the water shall be neutral with a ph value of 7 ± 0,2;

c) pouring rain shall be provided by using an appropriate device; this device shall provide small drops of water falling down onto the sample with an incidence angle of 30° to 45°;

d) the flow of drops of water shall be sufficient in order to keep the samples wet.

Table C.1 — Ageing test parameters

Phase number	Initial time min	Final time min	Initial temperature °C	Final temperature °C	Temperature gradient °C/min	Humidity	UV W/m^2
1)	0	10	20	20	0	96 %	-
2)	10	50	20	−20	−1	From 96 % to 0 %	-
3)	50	90	−20	−20	0	0 %	-
4)	90	127,5	−20	55	+2	From 0 % to 95 %	-
5)	127,5	187,5	55	55	0	95 %	-
6)	187,5	190	55	60	+2	From 95 % to 40 %	-
7)	190	250	60	60	0	40 %	65
8)	250	290	60	20	−1	From 40 % to 96 %	-
9)	290	300	20	20	0	96 %	-
10)	300	340	20	−20	−1	From 96 % to 0 %	-
11)	340	380	−20	−20	0	0 %	-
12)	380	420	−20	60	+2	From 0 % to 40 %	-
13)	420	1 400	60	60	0	40 %	65
14)	1 400	1 440	60	20	−1	From 40 % to 96 %	-
At the end of 1 000 h, the relief valve shall be stabilised for 48 h at (20 ± 5) °C and at (50 ± 5) % humidity.							



Key

X	Time (mins)
Y	Temperature (°C)
Z	Humidity (%)
A	Temperature
B	Humidity
C	Rain
D	Ultraviolet

Figure C.1 — Ageing graph

Annex D
(informative)

Environment checklist

Environmental Aspect	Stages of the life cycle										All stages
	Acquisition		Production		Use			End-of-Life			
	Raw materials and energy	Pre-manufactured materials and	Production	Packaging	Use	Maintenance and repair	Use of additional	Reuse / Material and Energy	Incineration without energy recovery	Deposition	Transportation
Inputs											
Materials	5.1.1 6.1.3	5.1.1 6.1.3		10		5.1.1 6.1.3	5.1.1	5.1.1 10		6.1. 3	
Water			7.1.9 7.9								
Energy	5.1.1	5.1.1									
Land											
Outputs											
Emissions to air			7.1.1 0								
Discharges to water			7.1.9								
Discharges to soil											
Waste				10							
Noise, vibration, radiation, heat losses											
Other relevant aspects											
Risk to the environment from accidents or unintended use		Intro			9						
Customer information					9						
Comments: The function of a PRV is to release LPG at a predetermined pressure to atmosphere to maintain the pressure vessel in a safe condition.											

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 97/23/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive 97/23/EC of the European Parliament and of the Council of 29 May 1997 on the approximation of the laws of the Member States concerning pressure equipment.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the clauses of this standard given in Table ZA.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

Table ZA.1 — Correspondence between this European Standard and EU Directive 97/23/EC

Clause(s)/sub-clause(s) of this European Standard	Essential requirements (ERs) of EU Directive 97/23/EC Annex I	Qualifying remarks/Notes
4.5	2.1 (1st paragraph)	Safe throughout intended life
5.1.3 5.1.4 5.2 6.2.1 6.4	2.2.1	Design for adequate strength
7.4 7.5 7.10	2.2.4	Experimental design method
6	2.3	Safe handling and operation
6.5.4 6.5.5	2.5	Means of draining and venting
5.1.2 5.1.4 5.2.4 5.2.5 5.3	2.6	Corrosion and other chemical attack
7.2.10 7.9 7.10	2.7	Wear
8.1 8.2	3.3	Marking and labelling
9	3.4	Operating instructions

WARNING: Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

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[4] EN ISO 11114-1:2012, *Gas cylinders - Compatibility of cylinder and valve materials with gas contents - Part 1: Metallic materials (ISO 11114-1:2012)*

[5] EN ISO 11114-2:2013, *Gas cylinders - Compatibility of cylinder and valve materials with gas contents - Part 2: Non-metallic materials (ISO 11114-2:2013)*

[6] EN ISO 14021, *Environmental labels and declarations - Self-declared environmental claims (Type II environmental labelling) (ISO 14021)*

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[9] Regulations concerning the International Carriage of Dangerous Goods by Rail (RID), appearing as Appendix C to the Convention concerning International Carriage by Rail (COTIF), Vilnius, 3 June 1999, as amended

[10] European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR), Geneva, 30 September 1957, as amended

[11] Directive 97/23/EC of the European Parliament and of the Council of 29 May 1997 on the approximation of the laws of the Member States concerning pressure equipment

[12] Directive 2010/35/EU of the European Parliament and of the Council on transportable pressure equipment, Brussels, 16 June 2010, as amended

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