BS EN 1487:2014

BSI Standards Publication

Building valves — Hydraulic safety groups — Tests and requirements

bsi.

...making excellence a habit.™

National foreword

This British Standard is the UK implementation of EN 1487:2014. It supersedes BS EN 1487:2000 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee B/504, Water supply.

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.

© The British Standards Institution 2014.
Published by BSI Standards Limited 2014

ISBN 978 0 580 80008 5
ICS 91.140.60

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 July 2014.

Amendments/corrigenda issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 1487

July 2014

ICS 91.140.60

Supersedes EN 1487:2000

English Version

Building valves - Hydraulic safety groups - Tests and requirements

Robinetterie de bâtiment - Groupes de sécurité hydraulique - Essais et exigences

Gebäudearmaturen - Hydraulische Sicherheitsgruppen - Prüfungen und Anforderungen

This European Standard was approved by CEN on 22 May 2014.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of 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 United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

© 2014 CEN All rights of exploitation in any form and by any means reserved worldwide for CEN national Members.

Contents

Page

Foreword

This document (EN 1487:2014) has been prepared by Technical Committee CEN/TC 164 “Water Supply”, 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 January 2015, and conflicting national standards shall be withdrawn at the latest by January 2015.

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 1487:2000.

The main changes compared to EN 1487:2000 are as follows:

a) the Scope has been modified to nominal sizes DN 15 to DN 25;

b) Normative references were updated;

c) Terms and definitions were changed;

d) subclause 4.1 (general wording for materials) was modified;

e) subclauses 4.3 (Detection of residual stress), 4.4 (Outside visible surfaces), 4.5 (Corrosion resistance), 4.6 (Coating adherence) and 4.7 (Compatibility with the products used for disinfection of the networks) were added;

f) subclauses 5.2 (Dimensional characteristics), 5.3 (Test port) and 5.4 (Pressure tapping) were modified;

g) subclause 5.7 (Other threads) was deleted;

h) subclauses 5.8 (Replacing of the safety valve) and 5.9 (Check valve) were added;

i) Clause 6 (Apparatus) was added, thus renumbering of the following clauses was necessary;

j) Clause 7 (Hydraulic tests and requirements) was modified;

k) Clause 8 (Acoustic tests and requirements) was moved to Clause 11 and modified editorially;

l) Clause 9 (Tests and requirements of the components of the hydraulic safety group) was modified;

m) Clause 10 (Resistance to thermal shocks) was added;

n) Clause 12 (Classification) was modified;

o) Clause 13 (Designation) was modified editorially;

p) Clause 15 (Technical documents, presentation at delivery) was added;

q) informative Annex A was replaced by informative Annex A (Test sequences).

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

In respect of potential adverse effect on the quality of water intended for human consumption, caused by the product covered by this standard:

a) This standard provides no information as to whether the product may be used without restriction in any of the Member States of the EU or EFTA.

b) It should be noted that, whilst awaiting the adoption of verifiable European criteria, existing national regulations concerning the use and or the characteristics of this product remain in force.

1 Scope

This European Standard specifies dimensions, materials and performance requirements (including methods of test) for hydraulic safety groups, of nominal sizes from DN 15 to DN 25, having working pressures[1)] from 0,1 MPa (1 bar) to 0,7 MPa (7 bar). Hydraulic safety groups are intended for fitting to the potable water supply of storage water heaters, having a maximum storage temperature of 95°C.

Hydraulic safety groups limit the pressure in hot water heaters, prevent the backflow of water into the main circuit and prevent the discharged water to get into contact with the water in the water heater.

Hydraulic safety groups do not control the temperature. They ensure the hydraulic safety of water heaters if the mechanical resistance of the water heater remains at least equal to the rating pressure.

NOTE The use of the device specified in this European Standard does not override the need to use controls (e.g. thermostats and cut-outs) which act directly on the power sources of water heaters.

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 248:2002, *Sanitary tapware - General specification for electrodeposited coatings of Ni-Cr*

EN 806-1, *Specifications for installations inside buildings conveying water for human consumption - Part 1: General*

EN 806-2, *Specification for installations inside buildings conveying water for human consumption - Part 2: Design*

EN 806-3, *Specifications for installations inside buildings conveying water for human consumption - Part 3: Pipe sizing - Simplified method*

EN 806-4, *Specifications for installations inside buildings conveying water for human consumption - Part 4: Installation*

EN 806-5, *Specifications for installations inside buildings conveying water for human consumption - Part 5: Operation and maintenance*

EN 1488, *Building valves - Expansion groups - Tests and requirements*

EN 1567, *Building valves - Water pressure reducing valves and combination water pressure reducing valves - Requirements and tests*

EN 1717:2000, *Protection against pollution of potable water in water installations and general requirements of devices to prevent pollution by backflow*

EN 10226-1, *Pipe threads where pressure tight joints are made on the threads - Part 1: Taper external threads and parallel internal threads - Dimensions, tolerances and designation*

EN 13959, *Anti-pollution check valves - DN 6 to DN 250 inclusive family E, type A, B, C and D*

---

1) All pressures are gauge unless otherwise stated.

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)*

EN ISO 3822-1, *Acoustics - Laboratory tests on noise emission from appliances and equipment used in water supply installations - Part 1: Method of measurement (ISO 3822-1)*

EN ISO 3822-3, *Acoustics - Laboratory tests on noise emission from appliances and equipment used in water supply installations - Part 3: Mounting and operating conditions for in-line valves and appliances (ISO 3822-3)*

EN ISO 4628-3, *Paints and varnishes - Evaluation of degradation of coatings - Designation of quantity and size of defects, and of intensity of uniform changes in appearance - Part 3: Assessment of degree of rusting (ISO 4628-3)*

EN ISO 6509, *Corrosion of metals and alloys - Determination of dezincification resistance of brass (ISO 6509)*

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

3 Terms and definitions

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

3.1
hydraulic safety group
safety device that limits the pressure in hot water heaters, prevents the backflow of water into the main circuit, prevents the discharged water from coming into contact with the water in the water heater, allows the function of the backflow prevention to be controlled and isolates and drains the water heater for maintenance services

Note 1 to entry: A hydraulic safety group is comprised of at least the following items in a single unit, in an upstream to downstream order, as shown in Table 1.

Table 1 — Components of hydraulic safety groups

	DN 15	DN 20	DN 25
isolating valve	1	1	1
test port for monitoring the check valve	1	1	1
check valve	1	1	1
isolating valve	1[a]	1[a]	1[a]
additional outlet connection	1[a]	1[a]	1[a]
pressure safety valve	1	1	1
drain device or drain function	1	1	1
air break to drain	1	1	1
pressure tapping	1[a]	1[a]	1[a]
[a] Optional.			

3.2
isolating valve
valve that allows the water heater to be isolated from the potable water supply

Note 1 to entry: If a second valve is fitted, it is placed between the check valve and safety valve.

3.3
check valve
valve that allows water to flow into a water heater, and automatically prevents water returning to the water supply

3.4
additional outlet connection
outlet connection that allows cold potable water to be supplied to an additional device

Note 1 to entry: For example, inline hot water supply tempering valves etc.

3.5
pressure safety valve
valve that limits the pressure of the water in the water heater to a predetermined value by discharging water to the drain and in case of temperature control failure, discharging the energy stored as water or steam

3.6
drain device or drain function
device that allows the water heater to be drained without removing the hydraulic safety group and the outlet connection which is also used to discharge water or steam from the pressure safety valve

3.7
air break to drain
air break that prevents discharged water from returning to the hydraulic safety group and thus to the water heater

3.8
pressure tapping
tapping that allows pressure measuring equipment to be connected

3.9
nominal set pressure (P_{nr})
pressure of the pressure safety valve which is set on production

Note 1 to entry: The "nominal set pressure" (P_{nr}) is often called "set pressure".

3.10
water tightness pressure (P_e)
pressure up to which the pressure safety valve is closed

Note 1 to entry: See Figure 1.

3.11
initial opening pressure (P_{dc})
3.11.1
$P_{dc,\ water}$
pressure at which the pressure safety valve opens for the first time, as indicated by the first droplet of water at the outlet of the safety group, after a period of storage

Note 1 to entry: See Figure 1.

3.11.2
$P_{dc,\ steam}$
pressure at which the pressure safety valve opens for the first time, as indicated by the first appearance of steam at the outlet of the safety group, after a period of storage

Note 1 to entry: See Figure 1.

3.12
opening pressure (P_o)

3.12.1
$P_{o,\ water}$
pressure at which the pressure safety valve opens as indicated by the appearance of water at the discharge connection of the hydraulic safety group

Note 1 to entry: See Figure 1.

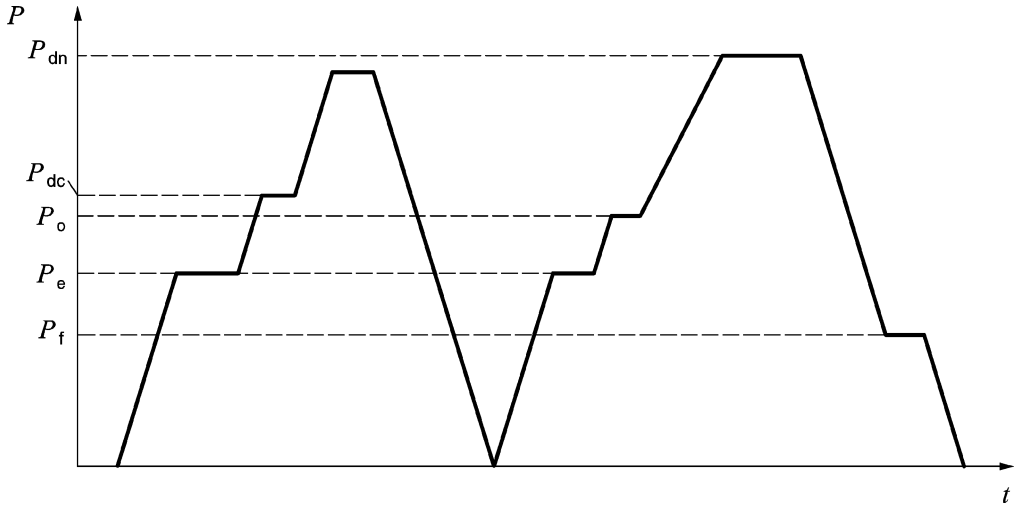
3.12.2
$P_{o,\ steam}$
pressure at which the pressure safety valve opens as indicated by the appearance of steam at the discharge connection of the hydraulic safety group

3.13
rating pressure (P_{dn})
pressure at which the discharged flow is above the limit given in Table 9 and Table 10

Note 1 to entry: See Figure 1.

3.14
closing pressure (P_f)
pressure at which the pressure safety valve closes after having reached the rating pressure

Note 1 to entry: See Figure 1.



Key
P pressure
t time

Figure 1 — Pressures

4 Materials and surface finishes

4.1 General

The selection of materials is the responsibility of the manufacturer, provided they satisfy the following requirements:

a) Materials and coatings shall not contaminate the potable water.

b) In a technical document, the manufacturer shall state the nature of the materials and coatings used.

c) Materials with inadequate corrosion resistance shall have additional protection.

d) The materials used shall be suitable for the temperatures specified in the tests in this standard.

e) The materials, and in particular copper alloys, for which recommendations or international standards exist, shall comply with the relevant recommendations or international standards.

4.2 Materials

All materials in accordance with national regulations of the European Community can be used.

Copper-zinc alloys containing more than 10 % zinc are subject to dezincification when submitted to water capable of dezincification. In the countries where the use of products made of dezincification resistant materials is required, the products shall guarantee a dezincification depth less than 200 µm in any direction, they shall be tested in accordance with EN ISO 6509 and shall be marked in compliance with the indications according to Clause 14.

4.3 Detection of residual stress

4.3.1 Test

This test is based on ISO 6957. Its purpose is to verify the resistance to cracking of copper alloy pieces under stress corrosion in ammonia medium.

The test entails exposing test specimens consisting of the assembled safety group in an atmosphere loaded with ammonia vapour.

4.3.2 Test method (Procedure)

The paragraph below details ISO 6957.

Test solution:

a) Use solutions of analysis quality and of distilled water.

b) Solution of ammonia at 20 % (in weight).

c) The pH of the test solution is to be adjusted to $9{,}5\ ^{+0}_{-0{,}2}$.

d) The test temperature is to be (23 ± 2) °C with a measurement uncertainty of ± 1 °C.

Test specimen:

e) The test specimen consists of three samples of a single assembled product. The test specimen is inserted into the test enclosure under no stress.

Instructions:

f) Rinse the test specimens with a clean non-chlorinated solvent (for example, ethanol).

g) Let them dry in the air.

h) Insert the test specimens into the test enclosure along with the ammonia solution. The test enclosure volume is to be (10 ± 1) l.

i) The volume of the solution inserted is to be 200 ml for 3 l of total volume of the container.

j) Place the test specimens in the container in such a way that they will not touch each other and that they will not be in contact with the solution.

k) After an exposure of 24h $^{+2}_{-0}$, remove the test specimens and rinse them.

4.3.3 Requirements

The test is positive if at least two samples are in accordance with the test in 7.2.

4.4 Outside visible surfaces

4.4.1 Surfaces without coatings

Surfaces without coatings shall be free from:

a) scab;

b) crazing;

c) sand inclusion;

d) heat marks from machining;

e) bumping or nipping damage from tools;

f) scratches;

g) pits or porosity: surface defects in the base metal;

h) shrinkage cavities: absence of "feed" in foundry or in plastic injection;

i) cutting and grazing: grazing due to handling or to bumps during transportation;

j) burns: surface rough and with greyish appearance;

k) orange skin effect: defect of smoothing (similar to an orange skin).

The requirements of a), c), d), e), f) h), i), j), k) are fulfilled if not visible with naked eye from 300 mm distance under daylight conditions.

4.4.2 Surfaces with coatings

The surfaces of coated parts shall be free of the following defects:

a) pitting;

b) scratches;

c) nipping damage from tools;

d) coating missing;

e) scaling: absence of "preparation" and brittleness of the deposit.

4.5 Corrosion resistance

4.5.1 Test method

The test is carried out on one complete safety group, first under the conditions of EN 248:2002, 5.1 and after that according to 9.3.2 of this standard.

4.5.2 Requirements

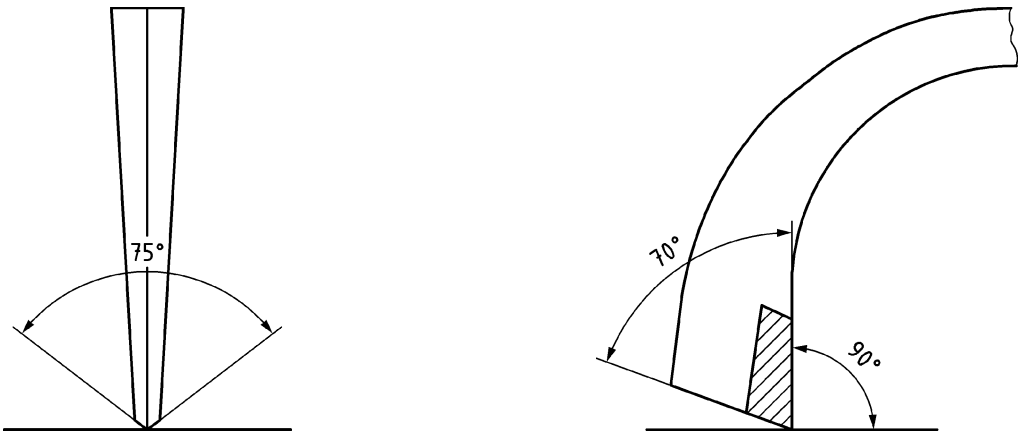
The safety group shall comply with the requirements as included in 9.3.2 of this standard.

At the same time, when visually inspected at a distance of approximately 300 mm, without a magnifying instrument and evaluated according to EN ISO 4628-3, the surface rusting degree of carbon iron alloy surfaces shall be ≤ R_i 3.

4.6 Coating adherence

4.6.1 Test method

At three different locations on the coated surface cut, with a cutting tool with a tungsten carbide tip of the type shown on Figure 2, crosses or V's approximately 10 mm x 10 mm in length. The crosses or Vs shall be cut by pulling the handle of the chisel parallel to the surface. The depth shall be such that they completely cut through the electrolytic deposit, without forcing that coating into the base metal.



a) Front view **b) Side view**

Figure 2 — Cutting tool

4.6.2 Requirements

The coating shall neither scale nor unstick.

4.7 Compatibility with the products used for disinfection of the networks

4.7.1 General

All the constituent parts of the device, and in particular those made of elastomer, shall be compatible with the treated water used for the disinfection of the networks using potassium permanganate or sodium hypochlorite.

4.7.2 Test method

This compatibility is checked by bringing the internal parts of the device:

a) for 96 h into contact with a solution containing 0,30 g of potassium permanganate per litre of deionized water (conductivity ≤ 2,5 µS/m);

b) for 24 h into contact with a solution containing 0,10 g of sodium hypochlorite per litre of deionized water (conductivity ≤ 2,5 µS/m).

Each of these contacts being carried out under a static pressure of 0,3 MPa ± 0,1 MPa (3 bar ± 1 bar) measured upstream, at a temperature T of 15 °C ≤ T ≤ 30 °C.

4.7.3 Requirements

After the performance of the test the valve shall comply with 9.3.2.

5 Design and dimensional requirements

5.1 General guidance

a) The pressure safety valve shall be of the type where the spring is isolated from the water by a diaphragm or equivalent.

b) All sliding elements of the safety valve shall be designed to prevent any risk of seizure or sticking.

c) Sliding or rotating parts of pressure safety valves shall not be in contact with water.

d) The components controlling the setting of the pressure safety valve shall not be accessible to the end user without damage to the valve.

e) Wing or similar guides for pressure safety valves shall not be used on the inlet side of the pressure safety valve.

f) The normal operation of the hydraulic safety valve shall not be changed by external forces.

g) The body of the hydraulic safety group shall have at least two suitable flats to apply a spanner.

h) The safety valve shall have an easing gear for checking its function at regular intervals; and if there is only one direction for operation of rotary controls of a pressure safety valve it shall be counter clockwise.

5.2 Dimensional characteristics

5.2.1 End connections

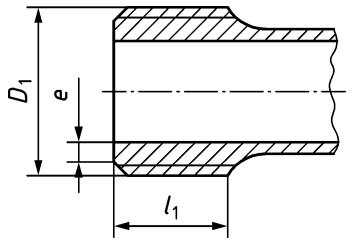
End connections for the inlet and outlet are given in Table 2. Other types of end connections can be used only for integrated devices if they allow the valve to be replaceable.

The size of the end connections shall be of the same size or one DN smaller than the nominal DN size (see Table 2 a), b), c)) of the hydraulic safety group.

The threading of the end connections shall comply with the requirements of EN ISO 228-1 as stated in Table 2.

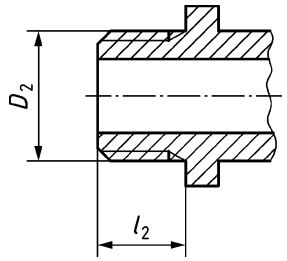
Table 2 — End connections and nominal sizes (DN)

Type a:



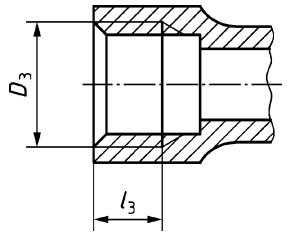
	DN 15	DN 20	DN 25
D_1	G ½ B	G ¾ B	G 1B
e min (mm)	1,7	2,0	2,2
l_1 min (mm)	8,0	9,5	11

Type b:



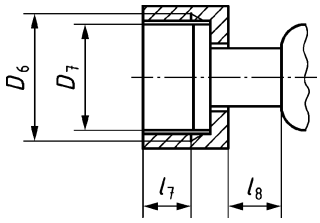
	DN 15	DN 20	DN 25
D_2	G ½ B	G ¾ B	G 1 B
l_2 min (mm)	11	12	14

Type c:



	DN 15		DN 20		DN 25	
D_3	G ½		G ¾		G 1	
l_3 (mm)	13,2	+1,8 -1,8	14,5	+1,8 -1,8	16,8	+2,3 -2,3

Type d:



D_6 (mm)	G ½	G ¾	G 1	G 11/4
D_7 (mm) min.	18	23,5	29,5	37
l_7 (mm)	9,8 $^{0}_{-1,8}$	10 $^{1,3}_{-1,5}$	11,5 $^{1,3}_{-1,5}$	13 $^{1,3}_{-2}$
l_8 (mm)	Equal or bigger than l_7 max			

For this type of nut, the diameter of the nut shall be equal to or greater than one DN of the safety group higher.

5.3 Test port

For dimensions of the test port see Table 3.

The bores of the test port shall have over their full length a minimum cross-section of 12,56 mm^2, the smallest dimension shall be 4 mm.

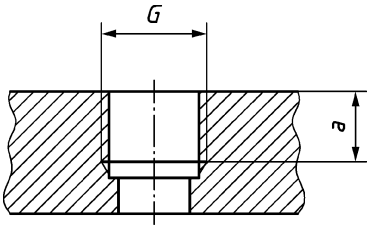


Figure 3 — Test port

Table 3 — Dimensions of test port

Nominal size DN	Thread size	a (mm)
≤ 15	G 1/8 or G 1/4	> 6,5
15 < DN ≤ 25	G 1/4	> 6,5
Thread shall be in accordance with EN ISO 228-1.		

The test port shall be produced so that the plug can be adequately sealed.

5.4 Pressure tapping

When the hydraulic safety group is fitted with a pressure tapping for the connection of equipment to measure pressure, the dimensions of the tapping shall be as follows (see Figure 4):

a) female thread diameter: G ¼;

b) depth of thread: a > 6,5 mm;

c) diameter: d > 6 mm.

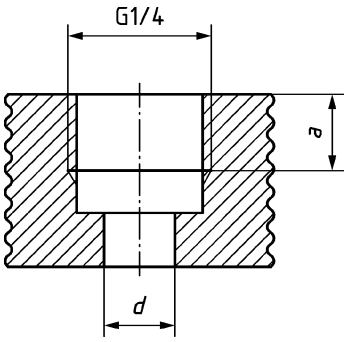


Figure 4 — Example of a pressure tapping

5.5 Hydraulic safety valve outlet connection to air break to drain

The hydraulic safety valve outlet connection to air break to drain shall have a minimum flow area of 78 mm^2. Each individual section shall be at least 25 mm^2 and the smallest dimension, used to calculate the cross-section, shall not be less than 4 mm.

5.6 Hydraulic safety valve discharge connection to drain device

The diameter of the discharge connection downstream of the air break to drain shall be at least one nominal size greater than that of the hydraulic safety group for DN 15 and DN 20, and at least equal to the nominal size for larger hydraulic safety groups. The dimensions shall fulfil the requirements of EN 1717:2000, Clause 9.

5.7 Exclusions

Connections requiring the use of heat to make or break a joint (e.g. capillary) are not permitted.

5.8 Replacing of the safety valve

If the safety valve is removable, it shall have the shape of a cartridge including the seat. Removing and replacing this cartridge shall not affect the performance of the safety group.

5.9 Check valve

A check valve of family E type B according to EN 13959 shall be used. The check valve shall comply with the functional requirements with exception of flow and acoustic requirements of EN 13959. Replacement of the check valve shall not affect the performance of the hydraulic safety group.

6 Apparatus

6.1 General

Examples shown in the figures are for guidance only. Laboratory equipment shall be designed to ensure that check valves can be tested in accordance with the requirements.

6.2 Tolerances of parameters and accuracy of measure instruments

6.2.1 Tolerances on set parameters

In the absence of any particular specifications:

a)	Flow rate (water) and pressure:	± 2 % of the value indicated;	
b)	Flow rate (Steam):	± 5 % of the value indicated;	
c)	Temperature:	cold water:	± 5 K of the value indicated;
		hot water:	± 2 K of the value indicated;
d)	Time:	- 0 / +10% of the value indicated;	
e)	Force:	unless otherwise specified, all tolerances shall be ± 5 %.	

6.2.2 Accuracy of measuring instruments

All the measuring instruments shall have an accuracy of ± 2 % of the measured value, except for temperature measurement accuracy shall be ± 1 K.

6.2.3 Test media

In the absence of any particular specification the test media shall be water with a maximum temperature of 30 °C.

7 Hydraulic tests and requirements

7.1 Flow rate test

7.1.1 Procedure

The flow rate shall be determined at a pressure drop of 0,1 MPa (1 bar) across the hydraulic safety group. The pressure losses occurring in the test apparatus shall be taken into account when determining the flow characteristics of the hydraulic safety group.

7.1.2 Requirement

The flow rate measured shall be at least equal to the appropriate flow rate in Table 4.

Table 4 — Minimum flow rates

Nominal size DN	15	20	25
Flow rate (l/h)	1 500	3 500	5 000

7.2 Tightness test

7.2.1 General

Subject the hydraulic safety group, at ambient temperature, to a water pressure to determine:

a) the tightness of the isolating valve;

b) the tightness of the entire hydraulic safety group.

7.2.2 Tightness test for the isolating valve at a pressure of 1,6 MPa (16 bar)

7.2.2.1 Procedure

Connect the hydraulic safety group to a test circuit. Flush the hydraulic safety group for a period of 5 min with water at the maximum specified temperature declared by the manufacturer. Close the hydraulic safety group's isolating valve and apply upstream of the seat a water pressure of 1,6 MPa (16 bar) for a period of 60 s.

7.2.2.2 Requirement

There shall be no leakage during the test period.

7.2.3 Hydraulic safety group tightness test

7.2.3.1 Procedure

Connect the hydraulic safety group to a test circuit. Flush the hydraulic safety group for a period of 5 min with water at the maximum specified temperature declared by the manufacturer. Close the hydraulic safety group's water heater connection, maintain the pressure safety valve closed and open the isolating valve. Apply for a period of 60 s a water pressure of 0,02 MPa (0,2 bar) to the inlet connection of the hydraulic safety group and then a water pressure of 1,6 MPa (16 bar) for a period of 60 s.

7.2.3.2 Requirement

There shall be no leakage from the hydraulic safety group during the test period.

8 Mechanical tests and requirements

8.1 Mechanical strength

8.1.1 Pressure test of the body of the hydraulic safety group

8.1.1.1 Procedure

Connect the hydraulic safety group to a test circuit by the valve's inlet connection and blank off the valve's water heater connection. Open the isolating valve and maintain the pressure safety valve closed. Apply a static cold water pressure of 2,5 MPa (25 bar) and maintain this pressure for a period of 120 s.

8.1.1.2 Requirement

The body of the hydraulic safety group shall not be fractured or permanently deformed.

Following this test, the hydraulic safety group shall not be the subject of further hydraulic testing.

8.1.2 Bending test of the body and pull out test of the drainage of the hydraulic safety group

8.1.2.1 Procedure

Bending test:

Attach the hydraulic safety group under test to the test apparatus by its inlet connection, as shown in Figure 5a, and apply gradually the bending moment according to Table 5 and maintain it for a period of (60 ± 3) s.

Pull out test of the drainage:

Attach the hydraulic safety group under test to the test apparatus by its outlet connection, as shown in Figure 5b, and apply gradually the pull-out force according to Table 5 and maintain it for a period of (60 ± 3) s.

Table 5 — Bending moment of the body and pull out force of the drainage

Nominal size DN	15	20	25
Bending moment (Nm) (F x L) for the outlet connection	75	95	150
Pull out force (N) for the drainage connection	500	500	500

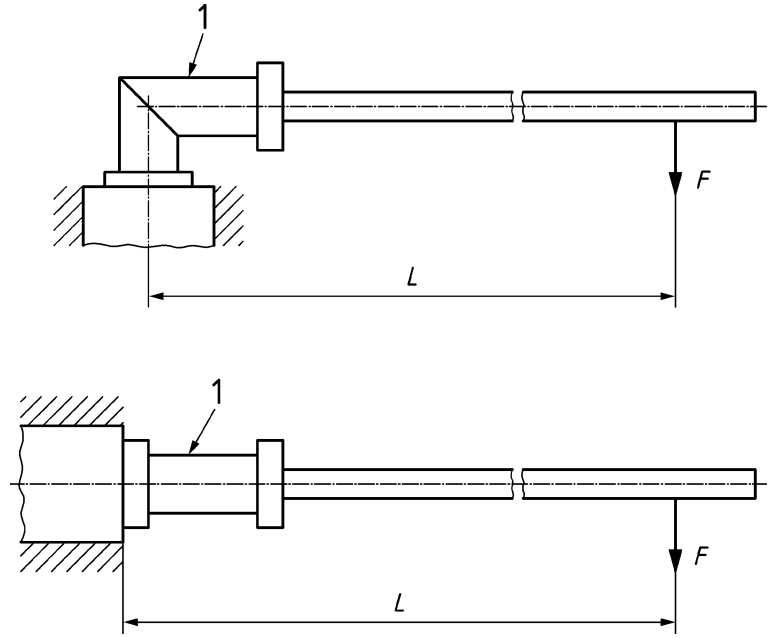
8.1.2.2 Requirement

Bending test:

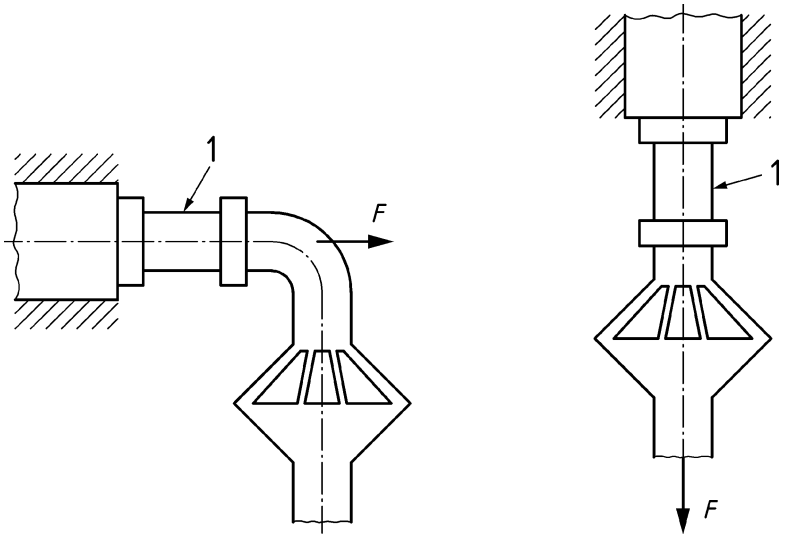
There shall be no visible damage to the product (fractures, splits or permanent deformation), including the point where the bending moment is applied (e.g. at the piping connection).

Pull out test of the drainage:

During the test, the air break to drain is to remain in place and there shall be no visible damage to the drainage.



a) Bending moment test



b) Pull out test

Key

1 hydraulic safety group

F force

L length of lever

Figure 5 — Bending moment test and pull out test for the drainage

8.1.3 Torsional strength of the hydraulic safety group's body

8.1.3.1 General

The body shall be suitably formed to enable tightening by a spanner.

Screwing on the connecting pipes shall not damage the unit.

8.1.3.2 Procedure

Screw the hydraulic safety group on the test rig the connection with the test rig complying with EN 10226-1 until there is a blockage. Gradually apply the tightening torque given in Table 6 and maintain it for a period of at least 10 s.

Table 6 — Torsional strength

Nominal size DN	15	20	25
Tightening torque (Nm)	75	100	125

8.1.3.3 Requirement

After unscrewing, no damage shall be detected. A slight deformation is permissible, but it shall not affect the tightness of the check valve or of the fitting.

8.1.4 Tensile strength of the captive rotating nuts

8.1.4.1 Procedure

a) On the outlet of the unit to be tested, install a male steel threaded bush complying with EN ISO 228-1.

b) Position the unit with an appropriate tool on a tensile machine or an equivalent machine.

c) Apply tensile force at a speed of 1 mm/min up to the value indicated in the Table 8, with a precision of $^{0}_{-500}$ N.

d) Maintain the force during 30 s, then release.

8.1.4.2 Requirement

The hydraulic safety groups' captive rotating nuts shall withstand, without deformation, the maximum tensile stresses in Table 7.

Table 7 — Tensile strength for captive rotating nuts

Nominal diameter of the nut	1/2	3/4	1
Loads (kN)	11	15	17,5

8.2 Mechanical strength of the easing gear of the pressure safety valve

8.2.1 Procedure

Lock the hydraulic safety group's operating mechanism in the closed position. For rotary controls, apply two tangential forces of 100 N at the periphery of the control device. For levers, apply a force of 75 N at the end of the lever.

8.2.2 Requirement

There shall be no visible damage or permanent deformation of the easing gear mechanism.

9 Tests and requirements of the components of the hydraulic safety group

9.1 Isolating valve

9.1.1 General

The function of the isolating valve shall be independent from the function of the check valve, e.g. the two sealing functions shall be separate.

9.1.2 Test of manual operation

9.1.2.1 Procedure

Verify the maximum opening and closing torque of the isolation valve by applying a torque not exceeding the values given in Table 8. Close the valve with the maximum allowable torque according to Table 8; check leak tightness by applying and maintaining a water pressure of 0,4 MPa (4 bar) for (60 ± 5) s.

9.1.2.2 Requirement

The isolating valve shall be water tight.

Table 8 — Maximum torques for isolating valves

Maximum torque for the preliminary cycle (Nm)	2,5
Maximum opening/closing torque (Nm)	1,5

9.1.3 Endurance test

9.1.3.1 Procedure

Connect the hydraulic safety group to a test circuit and apply water at a minimum temperature of 65 °C or the maximum temperature specified by the manufacturer and at a pressure of 0,4 MPa (4 bar) and subject it to the following procedures:

a) Operate the isolating valve 2 500 cycles applying an operating torque equal to the maximum torque for the preliminary cycle, see Table 8.

b) Keep the hydraulic safety valve installed at a minimum flow of 120 l/h for a period between 30 days and 35 days.

c) Repeat the test described in a).

d) At the end of this test, check the tightness of the isolating valve in accordance with the test in 7.2.1.

9.1.3.2 Requirement

During the test period there shall be no internal and external leakage from the isolating valve.

9.1.4 Test for manual operation

9.1.4.1 General

The operating construction (e.g. handle and spindle) shall be resistant against a torque to be applied after been not operated for a long term.

9.1.4.2 Procedure

Block the isolating valve in the open position. Apply at the handle a torque of 6 Nm for the period of 60 s.

9.1.4.3 Requirement

No functional damages or cracks shall occur. After the test the valve shall comply with 9.1.2.

9.2 Check valve

9.2.1 Verification of the leaktightness between the group's body and the check valve at low pressure

9.2.1.1 Test method

The leaktightness at low pressure is checked with a hydrostatic pressure of 0,003 MPa (0,03 bar) applied downstream from the check valve for a period of (180 ± 5) s.

9.2.1.2 Requirement

There shall be no leakage.

9.2.2 Verification of the leaktightness between the group's body and the check valve under high pressure

9.2.2.1 Test method

The leaktightness at high pressure is checked with a hydrostatic pressure of 1,6 MPa (16 bar) applied downstream from the check valve for a period of (180 ± 5) s.

9.2.2.2 Requirements

There shall be no leakage.

9.3 Pressure safety valve

9.3.1 Pressures

9.3.1.1 General

For the nominal set pressures below 0,3 MPa (3 bar) the same pressure differential as the one obtained for 0,3 MPa (3 bar) shall be used.

EXAMPLE A hydraulic safety group with a nominal set pressure P_{nr} of 0,1 MPa (1 bar) which has a rating pressure P_{dn} of 0,16 MPa (1,6 bar).

9.3.1.2 Nominal set pressure (P_{nr})

The nominal set pressure shall not be greater than 0,7 MPa (7 bar).

9.3.1.3 Water tightness pressure (P_e)

The water tightness pressure is related to the nominal set pressure (P_{nr}) by $P_{e\ minimum} = 0{,}9\ P_{nr}$

9.3.1.4 Rating pressure (P_{dn})

The rating pressure is related to the normal set pressure by $P_{dn} = 1{,}2\ P_{nr}$

9.3.1.5 Initial opening pressure (P_{dc})

For steam:

The initial opening pressure is related to the set pressure by P_{dc} ≤ 1,1 P_{nr}

For cold water:

The initial opening pressure is related to the set pressure by P_{dc} ≤ 1,2 P_{nr}

9.3.1.6 Opening pressure (P_o)

For steam:

The opening pressure is related to the set pressure by 0,9 P_{nr} ≤ P_o ≤ 1,05 P_{nr}

For cold water:

With P_o = 1,05 P_{nr} the flow through the safety valve shall exceed 2,4 l/h.

9.3.1.7 Closing Pressure (P_f)

For steam:

The closing pressure is related to the set pressure by $P_{f\,minimum}$ = 0,75 P_{nr}.

For cold water:

The closing pressure is related to the set pressure by P_f minimum = 0,9 P_{nr}.

9.3.2 Cold water pressure tests

9.3.2.1 General

The cold water pressure test is carried out on three different hydraulic safety groups.

9.3.2.2 Test method

The hydraulic safety group shall be stored in the closed position at ambient temperature (without water), for 8 days, before commencing testing.

Connect the hydraulic safety group by its water heater connection to a test apparatus having water at ambient temperature (maximum 25 ºC) without moving the easing gear.

9.3.2.3 Procedure and requirement

a) Increase the pressure (starting at 0,7 P_{nr}, gradually with an increment of 0,1 MPa (1 bar) every 20 s to 60 s) until the hydraulic safety valve opens. The opening pressure of the hydraulic safety valve shall be below P_{dn}.

b) Decrease the pressure to 0,4 P_{nr}. Increase the pressure (gradually with an increment of 0,1 MPa (1 bar) every 20 s to 60 s, without overshoot) to 0,95 P_{nr} (tightness pressure) and maintain it for a period of 120 s. The valve shall be water tight for a period of 120 s.

c) Continue to increase the pressure gradually until 1,05 P_{nr}. Stabilize for at least 30 s. The valve shall start to open (visible drops). The flow through the safety valve shall exceed 2,4 l/h.

d) Continue to increase the pressure gradually until 1,2 P_{nr}. Stabilize for at least 120 s. The flow shall exceed the rates given in Table 9.

e) Decrease the pressure until 0,4 P_{nr}. Increase the pressure gradually with an increment of 0,1 MPa (1 bar) every 20 s to 60 s until 1,05 P_{nr}.

f) Decrease the pressure 0,9 P_{nr} and wait 120 s. No visible leakage shall occur.

Table 9 — Discharge flow rates

Nominal Size DN	15	20	25
Nominal Set Pressure (P_{nr}) in MPa	Discharge flow rate in litre/hour		
0,1	125	250	0 500
0,2	175	350	0 700
0,3	200	425	0 850
0,4	225	475	0 975
0,5	275	550	1 100
0,6	300	600	1 200
0,7	325	650	1 300

9.3.3 Steam test

9.3.3.1 General

For this test the hydraulic safety groups subjected to the cold water test first are to be used. This is a destructive test. The hydraulic safety group subjected to the test shall not be used in other tests.

9.3.3.2 Procedure

a) The hydraulic safety group shall be stored in closed position (safety valve) at ambient temperature (without water) for 8 days before beginning the tests.

b) Connect the hydraulic safety group by its water heater connection to a test apparatus supplying saturated steam.

c) Raise the pressure until the pressure safety valve just opens. Requirement: the initial opening pressure shall be below P_{dc}.

d) Reduce the pressure to 0,4 P_{nr}. Raise the pressure to P_e (0,9 P_{nr}). Requirement: no leakage shall be detected for at least 30 s.

e) Raise the pressure until the pressure safety valve just opens. Requirement: the opening pressure shall be between 0,9 P_{nr} and 1,05 P_{nr}.

f) Raise the pressure to 1,2 P_{nr} (nominal set pressure) and maintain this pressure by applying a steam flow for a minimum of 2 min. Requirement: the flow rate shall be at least equal to the values shown in Table 10.

g) Reduce the pressure to 0,75 P_{nr}. Requirement: no leakage from the pressure safety valve or check valve shall be detected for at least 30 s.

h) Increase the pressure gradually until 1,2 P_{nr}. Maintain this pressure by applying a stream flow for 2 min, the flow shall exceed 0,9 times the values measured in 9.3.3.2, point e).

Table 10 — Steam flow rate values

Nominal Size DN	15	20	25
Nominal Set Pressure (P_{nr}) in MPa	Steam flow rate (kg/hour)		
0,1	025	075	100
0,2	050	100	125
0,3	050	125	175
0,4	075	150	200
0,5	075	175	250
0,6	100	200	275
0,7	100	225	325

9.3.3.3 Requirement

At the end of operations, b) to g) above, there shall be no visible deformation of the check valve component and all moving parts shall be operational.

9.4 Endurance test

9.4.1 Procedure

Before carrying out this test, a test according to 9.3.2 is to be performed.

Determine the opening pressure P_o of the safety group.

Use this opening pressure for the test.

The hydraulic safety group shall be connected to a test apparatus with a water supply at a minimum temperature of 65 °C or the maximum temperature specified by the manufacturer.

a) Operate the hydraulic safety group for 5 000 cycles, as follows:

   1) increase the pressure until P_o (previously determined) and maintain the pressure for 5 s;

   2) decrease the pressure to 0,7 P_{nr} and maintain the pressure for 5 s.

b) Store the hydraulic safety group for 28 days at ambient temperature.

c) Repeat a) on the hydraulic safety group that has been stored.

At the end of the endurance test, carry out the steam test as specified in 9.3.3.

9.4.2 Requirement

The test result from 9.3.3 shall be within ± 10 % of its original value.

9.5 Easing gear (manual control device)

9.5.1 Operation of the easing gear

9.5.1.1 Procedure

Install the hydraulic safety group in a test apparatus, apply a pressure of 0,3 P_{nr} and, as appropriate, apply either:

a) a force of 30 N at the end of levers; or

b) a torque of 1,2 Nm at the outer edge of the easing gear for rotary controls.

9.5.1.2 Requirement

Check that the manoeuvrability of the easing gear does not exceed that value as specified in 9.5.1.1 and that there is actual flow.

9.5.2 Easing gear endurance test

9.5.2.1 Procedure

Subject the hydraulic safety group to 300 opening operations as specified in 9.5.1 with water at a minimum temperature of 65°C and a minimum pressure of 0,1 MPa (1 bar).

9.5.2.2 Requirement

The safety valve shall be operated not exceeding the given values in 9.5.1.

9.6 Manual drainage device

9.6.1 General

The safety valve shall have a stable position for draining purposes.

9.6.2 Flow rate test

9.6.2.1 Procedure

Measure the flow rate at a supply pressure of 0,01 MPa (0,1 bar) at the inlet of the manual drainage device.

9.6.2.2 Requirement

The flow rate shall not be less than the value given in Table 11, as appropriate.

Table 11 — Minimum flow rates for manual drainage device

Nominal size DN	15	20	25
Minimum flow rate (l/h)	300	300	600

9.7 Air break to drain

The internal diameter (Ø) of the outlet of the air break to drain (or its equivalent for non-circular cross section) shall be as given in Table 12.

Table 12 — Internal diameter (Ø) of the outlet of the air break to drain

Nominal size of the group DN	15	20	25
Minimum internal diameter (Ø) (mm) of the outlet of the air break to drain	20	25	25

The dimensions shall be in accordance with EN 1717:2000, Clause 9.

Any water flow passages associated with the draining and normal operation of the hydraulic safety group shall be capable of taking the flow rate given in Table 11.

Spillage is allowed at a maximum flow rate of 200 ml/h.

10 Resistance to thermal shocks

10.1 Test method

Prepare the hydraulic safety group as specified:

a) Connect the water heater orifice and the water inlet of the safety group to the water supply.

b) Check valve is removed.

c) Drain device is in open position.

The unit is subjected to 120 cycles at a water pressure between 0,1 MPa (1 bar) and 0,3 MPa (3 bar) alternately at (80 ± 2) °C or the maximum specified temperature declared by the manufacturer, whichever is higher, for 30 min, then (20 ± 2) °C for 30 min (see Figure 6).

10.2 Requirement

Following that test, the characteristics of tightness, of operation and of integrity shall be maintained.

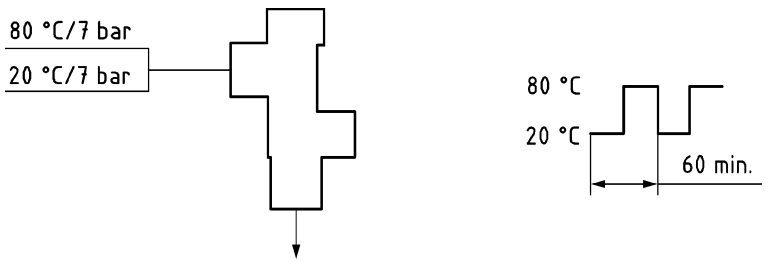


Figure 6 — Thermal shocks for testing plastic components

11 Acoustic tests and requirements

The noise generated by the water flow passages of the hydraulic safety group shall conform to the levels in Table 13, tested in accordance with EN ISO 3822-1 and EN ISO 3822-3.

Table 13 — Acoustic groups

Acoustic group	Marking	L_{ap} (dBA) at 0,3 MPa (3 bar)
I	a I	≤ 20
II	a II	20 < L_{ap} ≤ 30
Unclassified	a	> 30

12 Classification

Hydraulic safety groups shall be classified in accordance with their outlet diameter DN to a water heater. If the pressure safety valve of the group alone ensures the hydraulic safety of a water heater, the power shown in Table 14 corresponds to the maximum power output of the water heater to which the hydraulic safety group shall be installed.

Table 14 does not apply to installations with indirect heated hot water storages using a fluid to transfer heat and of which the temperature does not exceed 120 °C (for solar heated systems temporarily 160 °C) and is already equipped with one or more safety devices. For indirect heated systems the values given in EN 1488 apply.

Table 14 — Classification of the hydraulic safety groups

Size of the hydraulic safety group DN	Maximum electrical power output of the water heater kW for direct heating systems
15	4
20	10
25	18

13 Designation

A hydraulic safety group shall be designated by:

a) its nominal size (see Table 14);

b) its nominal set pressure P_{nr} (see 3.9);

c) its acoustic group (Table 13);

d) reference to this standard.

EXAMPLE Example of designation of a hydraulic safety group of nominal size 20, a nominal set pressure 7 bar (0,7 MPa) and an acoustic group I:

Hydraulic safety group, DN 20, P_{nr} 7 bar (0,7 MPa), acoustic group I, EN 1487

14 Marking

The hydraulic safety group shall be legibly and permanently marked with:

a) the manufacturer's name or trademark or identification mark;

b) the nominal DN size (see Table 14, column 2);

c) the nominal set pressure P_{nr} (see 3.9);

d) an arrow showing the direction of flow of the supply, on at least one face;

e) marking for the various operating positions of the control elements:

   1) safety valve (only in case of one direction of operation, see 5.1);

   2) drain device;

   3) isolating valve).

f) the month and year of manufacture or code relating to period of manufacture;

g) the acoustic classification (see Table 13);

h) the model reference;

i) the maximum operating inlet temperature if intended for hot water use; and

j) in the countries where the use of products made of dezincification resistant materials is

   1) not required, the dezincification resistant products according to EN ISO 6509 as well as the products which do not contain zinc are allowed to be marked "DR".

   2) required, the dezincification resistant products as well as the products which do not contain zinc shall be marked "DR".

15 Technical documents and presentation at delivery

The hydraulic safety groups are to come in a single element, grouping the unit's functional components together.

If they are not delivered in individual packs, the hydraulic safety groups are to be delivered with the orifices protected (connecting end fittings, drain).

The technical documentation that shall be delivered with the product shall be written at least in the language of the country in which the products are distributed giving all the necessary information for their installation and use.

That manual shall, in particular, include the following items:

a) The hydraulic safety group shall be connected directly to the potable water inlet fitting to the hot water storage.

b) In case of risk of corrosion, see EN 806-2. To minimize corrosion due to galvanic effects between two metals, the hydraulic safety group shall be connected to the hot water storage through a dielectric insulating connector being inserted.

c) Whenever the hydraulic safety group is fed at a working pressure greater than 0,75 P_{nr} (e.g. P_{nr} 7 bar max. pressure 5,25 bar), it is necessary to provide a pressure reducing valve in compliance with EN 1567, upstream from the unit, and preferably on the common cold water and hot water system (see EN 806-2) (by working pressure, is meant the usual pressure in the system, excluding exceptional rises).

d) During heating up, water dripping from the safety valve through the air-break-to-drain is normal (the volume of the expansion can be up to 3 % of the capacity of the storage), unless according to local regulations an expansion vessel (see EN 806-2) is used.

e) A description of proper inspection and maintenance procedures, as defined in EN 806-5.

f) The air break to drain shall remain free of any obstruction.

g) Between the air break to drain and the waste water system a siphon shall be used.

h) The sanitary rules according to EN 806 (all parts) and EN 1717 are to be followed.

i) Maximum inlet temperature.

Annex A
(informative)

Test sequences

Table A.1 — Test sequences for hydraulic safety groups

	Clause	Test	Sample number														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	4.3	Detection of residual test	X	X	X												
2	4.4	Outside visible surfaces				X											
3	4.5	Corrosion resistance				X											
4	4.6	Coating adherence				X											
5	4.7	Compatibility with product used for disinfection of network					X										
6	5.2	Dimensional characteristics					X	X									
7	5.3	Test port					X	X									
8	5.4	Pressure tapping					X	X									
9	5.5	Hydraulics safety valve outlet connection to air break to drain					X	X									
10	5.6	Hydraulics safety valve discharge connection to drain device					X	X									
11	5.7	Exclusions					X	X									
12	5.8	Replacing of the safety valve					X	X									
13	5.9	Check valve						X									
14	7.1	Flow rate test									X	X	X				
15	7.2.1	Tightness test for isolating valve					X										
16	7.2.2	Hydraulic safety group tightness test	X														

17	8.1.1	Mechanical test - Pressure test of the body of the hydraulic SG							X							
18	8.1.2	Mechanical test - Bending test of the body							X							
19	8.1.2	Mechanical test - Pull out force of the drainage							X							
20	8.1.3	Mechanical test - Torsional strength of the hydraulic SG							X							
21	8.1.4	Mechanical test – Tensile strength of the captive rotating nuts				X										
22	8.2	Mechanical strength of easing gear of pressure safety valve											X			
23	9.1.2	Isolating valve – Test of manual operation					X									
24	9.1.3	Isolating valve – Endurance test					X									
25	9.1.4	Isolating valve – Test for manual operation								X						
26	9.2.1	Check Valve – Leak tightness, Low pressure						X								
27	9.2.2	Check Valve – Leak tightness, High pressure						X								
28	9.3.2	Pressure safety valve – Cold water pressure test and flow measurement				X				X	X	X	X			
29	9.4	Endurance test								X						
30	9.3.3	Pressure safety valve – Steam pressure test and flow measurement								X	X	X	X			
31	9.5.1	Easing gear – Operating test											X			
32	9.5.2	Easing gear – Endurance test											X			
33	9.6.2	Manual drainage device – Flow rate test									X	X	X			
34	9.7	Air break to drain – Dimension					X	X								
35	9.7	Air break to drain – Water recovered									X	X	X			
36	Clause 10	Resistance to thermal shocks	Dedicated sample													
37	Clause 11	Acoustic test												X	X	X
38	Clause 14	Marking	X	X	X	X	X	X	X	X	X	X	X	X	X	X
39	Clause 15	Technical documents	X	X	X	X	X	X	X	X	X	X	X	X	X	X

This page deliberately left blank

This page deliberately left blank

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards -based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email bsmusales@bsigroup.com.

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Copyright

All the data, software and documentation set out in all British Standards and other BSI publications are the property of and copyrighted by BSI, or some person or entity that owns copyright in the information used (such as the international standardization bodies) and has formally licensed such information to BSI for commercial publication and use. Except as permitted under the Copyright, Designs and Patents Act 1988 no extract may be reproduced, stored in a retrieval system or transmitted in any form or by any means – electronic, photocopying, recording or otherwise – without prior written permission from BSI. Details and advice can be obtained from the Copyright & Licensing Department.

Useful Contacts:

Customer Services
Tel: +44 845 086 9001
Email (orders): orders@bsigroup.com
Email (enquiries): cservices@bsigroup.com

Subscriptions
Tel: +44 845 086 9001
Email: subscriptions@bsigroup.com

Knowledge Centre
Tel: +44 20 8996 7004
Email: knowledgecentre@bsigroup.com

Copyright & Licensing
Tel: +44 20 8996 7070
Email: copyright@bsigroup.com

bsi.

...making excellence a habit.™