BRITISH STANDARD

BS EN
1491:2000

Building valves — Expansion valves — Tests and requirements

The European Standard EN 1491:2000 has the status of a British Standard

ICS 91.140.60

National foreword

This British Standard is the official English language version of EN 1491:2000. It supersedes BS 6283-1:1991 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee B/504, Water supply, to Subcommittee B/504/7, Control and safety devices in drinking water systems, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

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

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Summary of pages

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FOREWORD

This European Standard 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of an identical text or by endorsement, at the latest by September 2000, and conflicting national standards shall be withdrawn at the latest by September 2000.

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

Annex A of this European Standard is informative.

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 expansion valves, of nominal sizes from DN 15 to DN 40, having working pressures[1)] from 0,1 MPa (l bar) to 1,0 MPa (10 bar).

Expansion valves are intended for fitting to the cold water supply of storage water heaters, having a maximum distribution temperature of 95 °C, for all energy sources.

Expansion valves do not control the temperature and alone does not constitute the protection required for storage water heaters. Expansion valves limit pressure, in the water heaters to what they are fitted, that is produced by thermal expansion of the water.

NOTE: The use of the device specified in this 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

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

EN 1254-2	Copper and copper alloys - Plumbing fittings - Part 2: Fittings with compression ends for use with copper tubes.
EN 1982	Copper and copper alloys - Ingots and castings.
EN 12420	Copper and copper alloys – Forgings.
EN ISO 6509	Corrosion of metals and alloys - Determination of dezincification resistance of brass (ISO 6509:1981).
ISO 7-1:1994	Pipe threads where pressure-tight joints are made on the threads - Part 1: Dimensions, tolerances and designation.
ISO 228-1:1994	Pipe threads where pressure-tight joints are not made on the thread - Part 1: Dimensions, tolerances and designation.
ISO 7005-3:1988	Metallic flanges - Part 3: Copper alloy and composite flanges.

3 DEFINITIONS

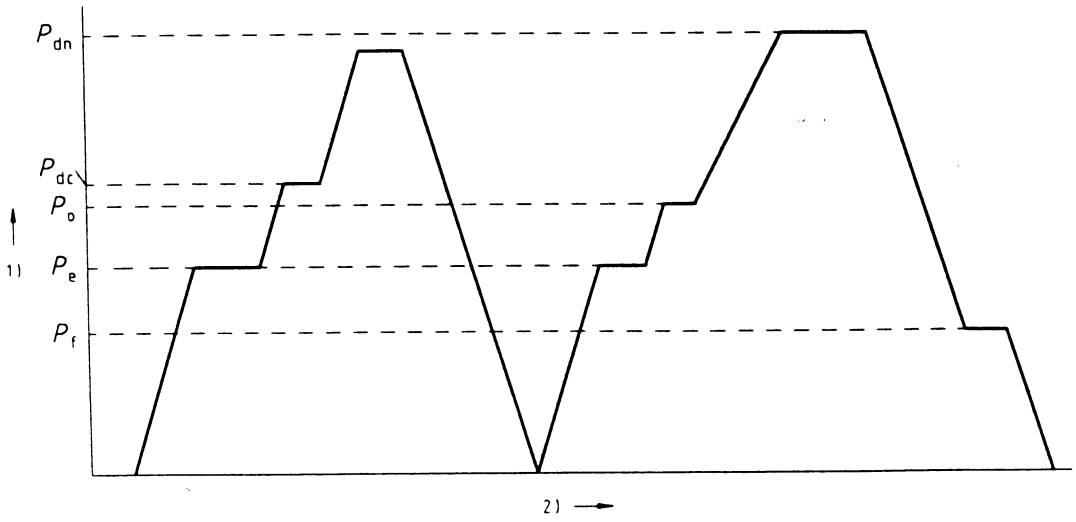
For the purposes of this standard, the following definitions apply.

3.1 expansion valve opens automatically at a specified set pressure to discharge fluid. It is fitted to prevent the pressure of the water in the water heater from exceeding the maximum working pressure by discharging a quantity of water to the drain

[1)] All pressures are gauge unless otherwise stated.

3.1 Pressures

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



Key

1) Pressure
2) Time

Figure 1 - Pressures - see Definitions

3.2.2 water tightness pressure (P_e) pressure up to which the expansion valve is still closed (see Figure 1)

3.2.3 initial opening pressure (P_{dc}) pressure at which the expansion valve opens for the first time, as indicated by the first droplet of water, after a period of storage (see Figure 1)

3.2.4 opening pressure (P_o) pressure at which a flow rate of 2,4 litre/hour of water is attained (see Figure 1) through the expansion valve

3.2.5 rating pressure (P_{dn}) pressure at which the water discharge capacity of the expansion valve corresponds to the rated flow (see Figure 1 and Table 3)

3.2.6 closing pressure (P_f) pressure at which the expansion valve closes after having reached the rating pressure (see Figure 1)

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 drinking water, when in normal or accidental contact;

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; and

d) the materials used shall not deteriorate at a temperature of 95 °C for 1 hour and be suitable under the temperatures specified in the tests in this standard.

4.2 Nature of materials

Examples of bronze and brass which may be used, without coating, for manufacturing purposes are given in Table 1.

Table 1 - Examples of copper alloys

Material designation		European Standard
Symbol	Reference number	
Cu Sn 5 Pb 5 Zn 5 - C	CC491K	EN 1982
Cu Sn 3 Zn 8 Pb 5 - C	CC490K	EN 1982
Cu Zn 39 Pb 3	CW614N	EN 12420
Cu Zn 40 Pb 2	CW617N	EN 12420
Cu Zn 36 Pb 2 As	CZ132	—

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 have to guarantee a dezincification depth less than 200 µm in any direction; they have to be tested in accordance with the standard EN ISO 6509 and have to be marked in compliance with the indications under section 11.

5 DESIGN AND DIMENSIONAL REQUIREMENTS

5.1 General guidance

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

b) All sliding elements shall be designed to prevent any risk of seizure, scaling or sticking.

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

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

e) The expansion valve shall be designed as to make the opening pressure in no case greater than 1,3 P_{nr} and under this pressure, manual lift of the expansion valve shall be in conformity with the requirements of the tests given in section 6.4.1.

f) Wing or similar guides of the expansion valve shall not be used on the inlet side of the expansion valve.

g) The normal operation of the expansion valve shall not be influenced by external forces.

h) The body of the expansion valve shall have two suitable flats to apply a spanner.

i) If there is only one direction for operation of rotary controls of an expansion valve, it shall be anti-clockwise.

5.2 Pressures

General: For set pressures below 0,3 MPa (3 bar) the same differential pressures shall be used as for 0,3 MPa (3 bar).

EXAMPLE: an expansion valve with the set pressure of 0,2 MPa (2 bar) shall have a rating pressure P_{dn} equal to 0,23 MPa (2,3 bar).

5.2.1 Nominal set pressure (P_{nr})

The nominal set pressure shall not be greater than 1,0 MPa (10 bar); and a set pressure of 0,6 MPa (6 bar) is recommended.

5.2.2 Water tightness pressure (P_c)

The water tightness pressure is related to the nominal set pressure (P_{nr}) by:

$$P_{e\ minimum} = 0{,}95\ P_{nr}$$

5.2.3 Opening pressure (P_o)

The opening pressure is related to the nominal set pressure (P_{nr}) by:

$$P_o = 1{,}1\ P_{nr}$$

5.2.4 Rating pressure (P_{dn})

The rating pressure is related to the nominal set pressure (P_{nr}) by:

$$P_{dn} = 1{,}2\ P_{nr}$$

5.2.5 Closing pressure (P_f)

The closing pressure is related to the nominal set pressure (P_{nr}) by:

$$P_{f\ minimum} = 0{,}75\ P_{nr}$$

5.3 Dimensional characteristics

The nominal outlet diameter of the expansion valve shall be at least equal to the inlet dimension.

5.3.1 End connections

Examples of end connections are given in Table 2.

5.3.2 Other connections (e.g. unions)

Connections, other than those specified in section 5.3.1, shall be tested in accordance with section 7.2.3.

5.3.3 Exclusions

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

6 HYDRAULIC TESTS AND REQUIREMENTS

6.1 Tolerances

Unless otherwise specified, all tolerances shall be ±5 %.

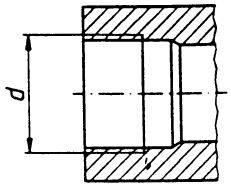
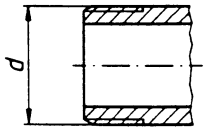
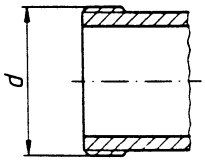
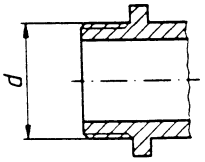
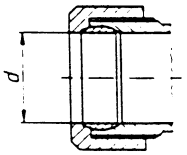
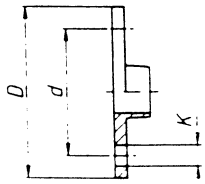
6.2 Cold water pressure tests

6.2.1 General

The expansion valve shall be stored, in the closed position, at ambient temperature for a minimum of period of 8 days before commencing tests.

Connect the expansion valve by its water heater connection to the test apparatus having water at ambient temperature (maximum 25 ºC).

Table 2 - Examples of end connections and nominal sizes (DN)

Type	[1)]	DN 15	DN 20	DN 25	DN 32	DN 40
 a) internal thread to ISO 7-1:1994	*d*	Rp 1/2	Rp 3/4	Rp 1	Rp 1 1/4	Rp 1 1/2
 b) External taper thread to ISO 7-1:1994	*d*	R 1/2	R 3/4	R 1	R 1 1/4	R 1 1/2
 c) Flat faced external thread to ISO 228-1:1994	*d*	G 3/4 B	G 1 B	G 1 1/4 B	G 1 1/2 B	G 1 3/4 B
 d) External thread with shoulder to ISO 228-1:1994	*d*	G 1/2 B	G 3/4 B	G 1 B	G 1 1/4 B	G 1 1/2 B
 e) compression fitting for copper pipe to EN 1254-2	*d*	15/18	22	28	35	42
 f) flange to ISO 7005-3:1998	*D* *d* *K*	95 75 14	105 75 14	115 85 14	140 100 18	150 110 18
[1)] reference dimension						

6.2.2 Water tightness pressure (P_e) *test*

Procedure:

Increase the pressure until the expansion valve opens.

Requirement:

The opening pressure of the expansion valve shall be in the range P_e to P_{dn}.

Procedure:

Decrease the pressure to 0,4 P_{nr}.

Increase the pressure to 0,95 P_{nr} (tightness pressure) for a period of 120 s.

Requirement:

The valve shall be water tight for a period of 120 s.

6.2.3 Nominal flow opening pressure (P_o) *test*

Procedure:

Increase the water pressure until a flow rate of 2,4 litre/hour is achieved. Record this as the opening pressure P_o.

Requirement:

P_o shall not be greater than 1,05 P_{nr}.

6.2.4 Nominal rating pressure (P_{dn}) *test*

Procedure:

Increase the flow rate to the appropriate value given in Table 3 and measure the pressure.

Requirement:

The pressure determined shall not be greater than 1,2 P_{nr}.

Table 3 - Discharge flow rate values

Nominal size, DN	15	20	25	32	40
Nominal set pressure, P_{nr}	Discharge flow rate in litre/hour				
0,1 MPa	25	50	101	151	248
0,2 MPa	25	76	151	201	349
0,3 MPa	50	101	176	248	425
0,4 MPa	50	126	202	299	500
0,5 MPa	50	126	227	324	551
0,6 MPa	76	151	248	349	601
0,7 MPa	76	151	274	374	652
0,8 MPa	76	176	299	400	702
0,9 MPa	76	176	324	425	752
1,0 MPa	76	176	324	450	799

6.2.5 Closing pressure (P_f)

Procedure:

Decrease the pressure to 0,4 P_{nr}.

Increase the pressure to 1,1 P_{nr} (opening pressure).

Decrease the pressure to 0,85 P_{nr}.

Requirement:

There shall be no leakage or discharge from the expansion valve for a period of 300 s.

6.2.6 Repeat tests

Procedure:

Repeat the tests in sections 6.2.2 to 6.2.5 using the same expansion valve to give a total of three determinations of each parameter.

Requirement:

Each determination shall meet the stated requirements in sections 6.2.2 to 6.2.5.

6.3 Endurance test

Procedure:

The expansion valve shall be connected to test apparatus with a water supply at (65 ± 2) ºC, a minimum flow rate of 2,4 litre/hour, and a pressure greater than the rating pressure P_{dn} of the expansion valve to be tested.

a) subject the expansion valve to 5 000 cycles, as follows:

i) increase the pressure to obtain a flow rate of 2,4 litre/hour and maintain the pressure for a period of 5 s; and

ii) decrease the pressure to 0,8 times the pressure in i) and maintain it for a period of 5 s.

b) store the expansion valve for 28 days at ambient temperature.

c) repeat a) on the expansion valve that has been stored.

At the end of the endurance test, carry out the nominal opening flow pressure test as specified in section 6.2.3.

Requirement:

The test result from section 6.2.3 shall be within ±5 % of its original value.

6.4 Easing gear (manual control device)

6.4.1 Operation of the easing gear

Procedure:

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

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

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

Requirement:

The expansion valve disc shall be lifted at least 1,5 mm.

6.4.2. Easing gear endurance test

Procedure:

Subject the expansion valve to 100 opening operations as specified in section 6.4.1 with water at 80 °C and a pressure of 0,1 MPa (1 bar).

The test shall be repeated three times, with a storage period of 28 days between tests.

Requirement:

The requirement of section 6.4.1 shall be satisfied at the end of the test.

7 MECHANICAL TESTS AND REQUIREMENTS

7.1 Tolerances

Unless otherwise specified, all tolerances shall be ±5 %.

7.2 Mechanical strength

7.2.1 Pressure test of the body of the expansion valve

Procedure:

Connect the expansion valve to the test circuit by the inlet connection. Maintain the expansion valve disc closed.

Apply a static cold water pressure of 2,5 MPa (25 bar) for a period of 120 s.

Requirement:

The body of the expansion valve shall not be fractured or permanently deformed.

Following this test, the expansion valve shall not be the subject of further testing.

7.2.2 Bending moment test of the body of the expansion valve

Procedure:

Attach the expansion valve under test to the test apparatus by its inlet connection, as shown in Figure 2 and apply to its outlet connection the appropriate bending moment specified in Table 4 for a period of (30 ± 3) s.

Table 4 - Bending moments

Nominal size, DN	15	20	25	32	40
Bending moment, (Nm) ($F \times L$)	75	95	150	190	220

Requirement:

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

7.2.3 Bending moment test for expansion valves with unions

Procedure:

Attach the expansion valve under test to a test apparatus. Apply an hydrostatic pressure of (0,02 ± 0,005) MPa [(0,2 ± 0,05) bar] for a period of (60 ± 5) s. Increase to a pressure equal to (85 ± 2) % of the nominal set pressure, P_{nr}, for a period of (60 ± 5) s. Apply for (60 ± 5) s, the appropriate bending moment, given in Table 4 by way of the other connection. Release the applied bending moment and retain the pressure at (85 ± 2) % of the nominal set pressure. Reduce the pressure to (0,02 ± 0,005) MPa [(0,2 ± 0,05) bar] for a period of (60 ± 5) s.

Requirement:

There shall be no leakage, visible damage or permanent deformation of the expansion valve.

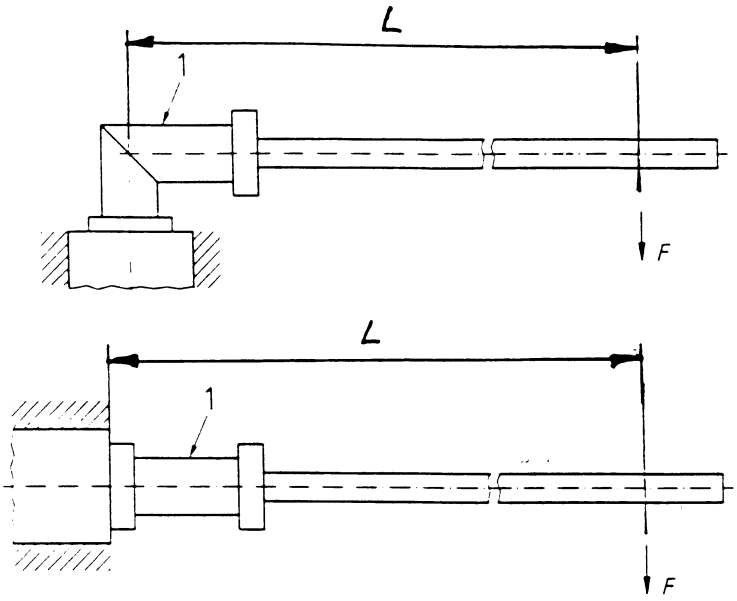
7.3 Mechanical strength of the easing gear of the expansion valve test

Procedure:

Lock the expansion valve'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.

Requirement:

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



Key

1 Test valve

Figure 2 - Bending moment test

8 ACOUSTIC TESTS AND REQUIREMENTS

Expansion valves are not subject to acoustic testing.

9 CLASSIFICATION

The expansion valves shall be classified in accordance with the outlet diameter DN to the water heater (see Table 5).

Table 5 - Classification of expansion valves

Outlet diameter to heater	Nominal size, DN	Maximum power output of water heater, kW	Maximum volume of water heater, litre
G1/2	15	75	200
G 3/4	20	150	1 000
G 1	25	250	5 000
G1 1/4	32	350	—
G 1 1/2	40	600	—

10 DESIGNATION

An expansion valve is designated by:

a) its nominal size of inlet connection (Table 5);

b) its nominal set pressure P_{nr} (see section 3.2.1); and

c) reference to this standard.

Example for the designation of an expansion valve of nominal size 15 and a nominal set pressure P_{nr} 0,6 MPa (6 bar):

Expansion valve, DN 15, P_{nr} 0,6 MPa (6 bar), EN 1491.

11 MARKING

The expansion valve shall be legibly and permanently marked with:

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

b) the nominal size, DN (Table 5);

c) the nominal set pressure, P_{nr} (see section 3.2.1);

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

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

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

g) the model reference; and

h) in the countries where the use of products made of dezincification resistant materials is not required, the dezincification resistant products according to EN ISO 6905 as well as the products which do not contain zinc are allowed to be marked "DR". In the countries where the use of products made of dezincification resistant materials is required, the dezincification resistant products as well as the products which do not contain zinc shall be marked "DR".

ANNEX A (INFORMATIVE)

A.1 SAFETY EQUIPMENT FOR WATER HEATERS

The safe operation of water heater installations is ensured only if the safety devices fitted are appropriate, correctly located on the water vessel and operate in the correct sequence.

In addition to the control thermostat (TC), a non-self resetting thermal cut-out (TL or STL) and a device according to EN 1487:2000, EN 1488:2000, EN 1489:2000, EN 1490:2000 or EN 1491:2000, as appropriate in accordance with the rules and regulations of the country where the water heater is installed.

The following tables show some of the combinations of safety equipment, used in various countries, appropriate to the method of heating.

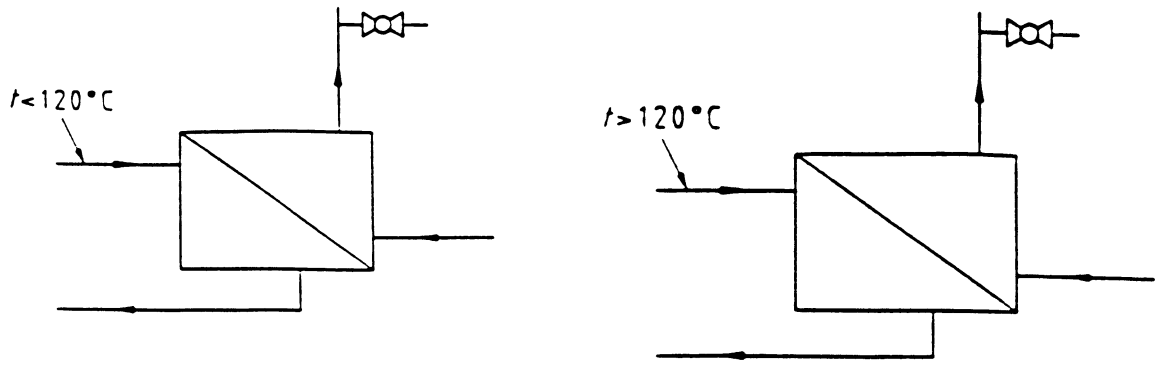
Table A.1 - Summary of temperature controls.

Abbreviation	Definition	Function	Operation	Special characteristics	Means of adjustment
TC	Control thermostat	To operate at a temperature in a fixed range	Automatically reset	—	Manually or with a tool
TL	Thermal cut-out	Interruption of energy or fuel supply	Reset manually or with a tool	—	Factory set
STL	Thermal cut-out with special features	Interruption of energy or fuel supply	Reset manually or with a tool	Additional features[1)]	Factory set

[1)] The special feature allows a warning to be given if there is a fault with the component parts.

A.2 Classification of water heaters according to heating method

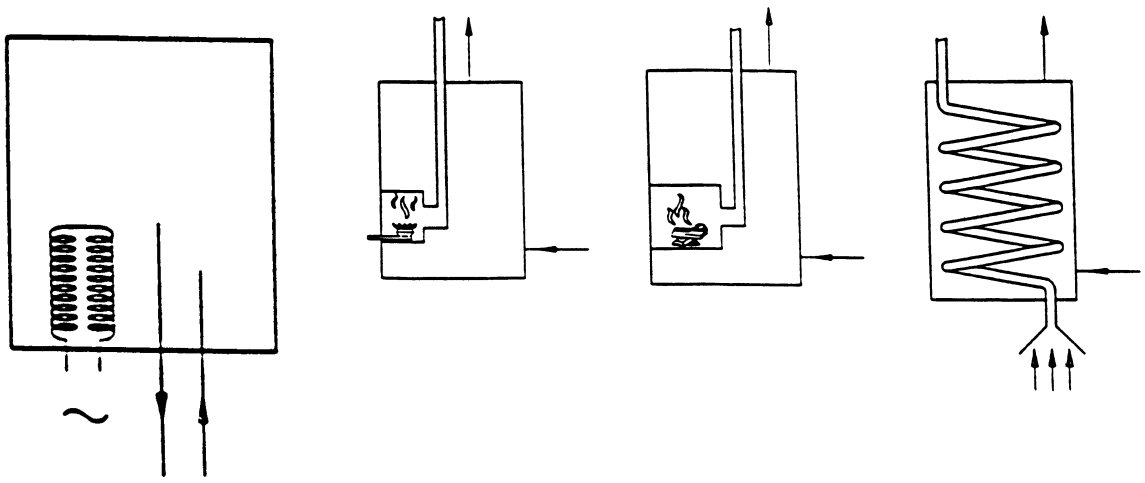
A.2.1 Indirect heating



System: A1 A2

Figure A.2.1 - Indirect heating

A.2.2 Direct heating



System	B1	B2	B3	B4
Energy	Electric power	Oil/gas	Solid fuels	Waste heat

Figure A.2.2 – Direct heating

Decision matrix for selection of safety devices

	Type of water heater		A1	A1, A2 B1, B2	A1, A2 B1, B2	B3, B4
Temperature operated switch	temperature control (thermostat)	TC				
	thermal cut-out	TL				
	thermal cut-out with special features	STL				
Mechanical device	expansion group					
	expansion valve					
	hydraulic safety group[1)]					
	pressure safety valve					
	combined temperature and pressure relief valve					
Water valves and controls	isolating valve					
	test port					
	check valve					
	pressure gauge tapping					

[1)] Only for maximum heating power up to 5 kW; installation at the cold water inlet.

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