UDC 628.1.033 : 696.11 : 620.152 DEUTSCHE NORM December 1988

Drinking water supply systems

Materials, components, appliances, design and installation (DVGW Code of practice)

DIN 1988 Part 2

Technische Regeln für Trinkwasser-Installationen (TRWI); Planung, Ausführung, Bauteile, Apparate und Werkstoffe (Technische Regel des DVGW)

This standard, together with DIN 1988 Part 1 and Parts 3 to 8, December 1988 editions, supersedes DIN 1988, January 1962 edition.

In keeping with current practice in standards published by the International Organization for Standardization (ISO), a comma has been used throughout as the decimal marker.

This standard has been prepared in agreement with *DVGW Deutscher Verein des Gas- und Wasserfaches e.V.* (German Society of Gas and Water Engineers). It has been included in the body of DVGW Codes of practice for water.

Dimensions in mm

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1 Scope and field of application

This standard, in conjunction with DIN 1988 Part 1 and Parts 3 to 8, applies to drinking water supply systems ('systems', for short) inside buildings and their curtilages. It specifies requirements for the design, installation, operation and maintenance of and alterations to such systems and gives particular attention to materials, components and appliances installed to supply a building with drinking water.

2 General

This standard deals both with the components that are used in almost all drinking water supply systems and with those designed for special applications. Designers and installers should take care to ensure that only such equipment and appliances are installed as are essential to the proper functioning of the system (cf. clause 8), this applying in particular to appliances which require inspection and servicing. Inspection and servicing shall be carried out regularly, as otherwise the function of the appliances may be adversely affected and the drinking water may become polluted to the extent that it represents a health hazard.

The design of the system should enable the water to be used economically.

When installing the system, both the recognized rules of the art and the manufacturer's instructions shall be followed.

2.1 Documentation

The following documentation is required:

a) a binding site plan;

b) drawings of the cellar and each floor (plan view), with simplified pipework diagram and sectional drawings;

c) pipe sizing calculation in accordance with DIN 1988 Part 3;

d) detailed pipework diagram showing lengths of pipe runs, pipe nominal sizes ('sizes' for short), bore diameters, material, draw-off points (type, number and size or bore diameter), minimum flow pressure required, and the fitting group as defined in the standards of the DIN 4109 series of standards, where necessary.

The graphical symbols specified in DIN 1988 Part 1 shall be used for pipework diagrams.

2.2 Requirements to be met by materials, components and appliances

Materials, components and appliances in contact with drinking water are considered to fall within the scope of the *Lebensmittel- und Bedarfsgegenständegesetz* (German Federal Foods Act).

Where synthetic materials or other nonmetallic materials are used, these shall comply with the *KTW-Empfehlungen* (KTW Recommendations) issued by the *Bundesgesundheitsamt* (German Federal Health Board).

Where product standards or test specifications require conformity marking (by way of third party inspection), only products thus marked shall be used.

2.2.1 Compliance with the *Verordnung über Allgemeine Bedingungen für die Versorgung mit Wasser* (Regulation on the general conditions for water supply)

In accordance with § 12, section 4 of the *Verordnung über Allgemeine Bedingungen für die Versorgung mit Wasser*, only materials, components and appliances (as defined in clause 5) designed in accordance with the recognized rules of the art shall be used. A test mark granted by a recognized testing centre (e.g. DIN/DVGW or DVGW test mark) may be taken as proof of compliance with this requirement.

2.2.2 Marking

Components and appliances shall be permanently and legibly marked by the manufacturer with his name or trademark, so as to permit identification of the product. Where DIN Standards or *DVGW-Arbeitsblätter* (DVGW Worksheets) exist, the manufacturer shall apply the marking specified in these.

2.2.3 Pressure and temperature

To ensure adequate strength of all parts of the systems, these shall be rated for a permissible working pressure of 10 bar (except for water heaters covered in subclause 6.1.2) unless higher pressures[1]) are to be allowed for.

Increases in the temperature of cold water pipes shall be avoided wherever possible, and the temperature at the taps shall not exceed 25 °C after any stagnant water (see subclause 10.2.2) has been drawn off. The temperature in hot water pipes shall generally not exceed 60 °C in order to conserve energy, to prevent corrosion damage and to avoid the formation of scale (which may result in a reduction in pipe cross section).

Pipes and pipe joint assemblies shall be designed for a service life of 50 years, taking into account the operating conditions (temperature, pressure and frequency of use) given in table 1.

Table 1. **Operating conditions for pipes and pipe joint assemblies**

	Range of working pressure (fluctuating), in bar	Temperature, in °C	Frequency of use, in hours per year
Cold water pipes	0 to 10	Up to 25*)	8760
Hot water pipes	0 to 10	Up to 60	8710
		Up to 85	50

*) Reference temperature for creep rupture strength: 20 °C.

If the system is operated at temperatures and working pressures higher than given in the table, the appropriate provisions are to be made.

2.2.4 Surge pressure

The sum of surge pressure and static pressure shall not exceed the permissible working pressure. The level of the positive surge pressure when valves or appliances are operated shall not exceed 2 bar, measured immediately upstream of these; the negative surge pressure shall not be less than 50 % of the flow pressure then produced. Valves and appliances shall be designed to ensure that these requirements will be satisfied, assuming proper operation of the system.

This requirement does not extend to valves in fire extinguishing and fire protection systems which are operated no more than once a month for test purposes and otherwise, only in the event of fire.

2.3 Transport and storage

All parts of a system shall be transported and stored so as to prevent contamination of the inside by dirt, mud, foul water, etc., taking into account the relevant instruction issued by the manufacturer.

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[1]) Cf. DIN 2401 Part 1.

3 Pipework

3.1 Pipes and fittings

The following pipe and fitting types and materials may be used in accordance with the recognized rules of the art. (Pipes and fittings listed in Supplement 1 to DIN 1988 Part 2 shall comply with the standards and codes of practice given there.)

3.1.1 Steel

a) Hot-dip galvanized steel pipes, with additional nonmetallic corrosion protective coating.
b) Stainless steel pipes.
c) Galvanized assemblies and units manufactured from separate elements (e.g. of pipes, fittings and flanges) by welding or brazing.
d) Galvanized malleable cast iron fittings for use with galvanized threaded pipes.
e) Galvanized threaded steel fittings, also with extra long threaded section made from malleable cast iron, for use with galvanized threaded pipes.
f) Couplings for steel spigot pipes, if the corrosion protective pipe lining is not damaged in proper use.
g) Stainless steel couplings for use with stainless steel pipes.

3.1.2 Copper

a) Copper pipes.
b) Copper and copper alloy capillary solder fittings.
c) Detachable fittings.
d) Weld-on copper bends.
e) Copper or copper alloy assemblies and units manufactured from separate elements (e.g. pipes, fittings and flanges) by welding or soldering.

3.1.3 Ductile cast iron

a) Ductile cast iron socket pipes, with cement mortar lining.
b) Ductile cast iron fittings.

3.1.4 Fibre cement

a) Fibre cement pipes.
b) Fibre cement fittings.
c) Cast iron fittings for fibre cement pressure pipes.

3.1.5 Unplasticized polyvinyl chloride (PVC-U)

a) PVC-U pipes.
b) PVC-U pipe joint assemblies.
c) PVC-U pipe fittings.
d) Metal pipe couplings and connectors.

3.1.6 High and low density polyethylene (PE-HD and PE-LD)

a) PE-HD and PE-LD pipes.
b) PE-HD pipe joint assemblies.
c) PE-HD pipe fittings.
d) Metal pipe couplings and connectors.

3.1.7 Cross-linked polyethylene (PE-X) pipes

a) Pipe series 2 PE-X pipes.
b) Metal pipe couplings and connectors.
c) Plastic pipe couplings and connectors.

3.2 Pipe joints

Pipe joint assemblies may be designed for resistance to axial tension, the joints may be compression joints or joints using a seal, and be disconnectable or permanent. Suitable fixing points shall be provided to accommodate the hydraulic forces acting on joints not resistant to axial tension. If such joints occur in buried pipework, properly sized supports shall be sited at bends and branches.

Pipe joints shall be permanently tight under the alternating stresses occurring in operation. A *DVGW-Arbeitsblatt*[2]) will list pipe joint assemblies that may be used without special proof being required, and specify requirements and methods of test for other types of pipe joint assembly.

The system shall be designed to ensure unobstructed flow at joints and where the pipes change direction. This will be achieved by using standardized fittings or fittings of an equivalent hydraulic design. Galvanized pipes shall not be bent except for slight changes in direction, and then only if this will not damage the pipe lining.

3.2.1 Pipe threads shall comply with DIN 2999 Part 1. Screw threads complying with ISO 228 Part 1 are suitable for cases where pressure-tight joints are not made on the thread, and may otherwise only be used for sealing if the sealing effect is produced by compressing a gasket between the end face of the socket of the component and that of the threaded spigot end of the other.

Steel pipes shall not be welded unless any damage to the lining can be repaired or if welding does not hinder the application of such a lining being applied.

Brazing of galvanized steel pipes is only permitted if the joints are made in accordance with the brazing alloy manufacturer's instructions. It should be noted here that hard zinc coatings with a reduced corrosion resistance may form at the brazing point as a result of brazing; cf. DIN 50930 Part 3.

3.2.2 *DVGW-Arbeitsblatt* GW 2 shall apply for joints in copper pipes.

3.2.3 DIN 19532 and DIN 19533 shall apply for joints in pipes made from PVC-U, PE-HD and PE-LD, PE-X pipe joints being dealt with in a *DVGW-Arbeitsblatt*[2]).

3.2.4 The manufacturer's instructions shall be followed when welding ductile cast iron pipes.

3.2.5 The manufacturer's instructions shall be followed when making joints in stainless steel pipes.

3.3 Accessories and jointing materials

3.3.1 Pipe brackets for horizontal pipework

Pipe brackets are designed to secure pipes directly to the structure and shall not be used for fixing components other than pipes. Parts of the structure to which brackets are fastened shall have adequate strength, otherwise additional connections to loadbearing members shall be provided.

Pipes up to size DN 50 shall be fixed to trapezoidal steel sheeting and to gas concrete or pumice concrete slabs, fixing holes in such slabs being located no less than 150 mm from the slab edge. Both brackets and rawl plugs for use with fire fighting supply pipes shall be made from non-flammable materials. The length of the plugs shall be selected as a function of their type of pin and of the properties of the material in which they are to be inserted.

The spacing of brackets for carbon steel, stainless steel, copper, PVC-U and PE-HD pipes shall be as recommended in table 2. Pipe brackets for use with PVC-U drinking water pipes shall comply with *DVGW-Arbeitsblatt* W 328, and those for use with PE-X pipes with the manufacturer's instructions.

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[2]) A *DVGW-Arbeitsblatt* is to be published soon.

Table 2. **Recommended spacing of pipe brackets**

Steel pipes		Copper pipes and stainless steel pipes		PVC-U pipes			PE-HD pipes		
Nominal size DN	Spacing of brackets, in m	Outside diameter, d_a, in mm	Spacing of brackets, in m	Outside diameter, d_a, in mm	Spacing of brackets at 20 °C, in m	Spacing of brackets at 40 °C, in m	Outside diameter, d_a, in mm	Spacing of brackets at 20 °C, in m	Spacing of brackets at 40 °C, in m
10	2,25	12	1,25	–	–	–	–	–	–
–	–	15	1,25	16	0,80	0,50	16	0,70	0,60
15	2,75	18	1,50	20	0,90	0,60	20	0,75	0,65
20	3,00	22	2,00	25	0,95	0,65	25	0,80	0,75
25	3,50	28	2,25	32	1,05	0,70	32	0,90	0,85
32	3,75	35	2,75	40	1,20	0,90	40	1,00	0,95
40	4,25	42	3,00	50	1,40	1,10	50	1,15	1,05
50	4,75	54	3,50	63	1,50	1,20	63	1,30	1,20
–	–	64	4,00	–	–	–	–	–	–
65	5,50	76,1	4,25	75	1,65	1,35	75	1,40	1,30
80	6,00	88,9	4,75	90	1,80	1,50	90	1,55	1,45
100	6,00	108	5,00	110	2,00	1,70	110	1,70	1,60
–	–	–	–	–	–	–	125	1,85	1,70
125	6,00	133	5,00	140	2,25	1,95	140	1,95	1,80
150	6,00	159	5,00	160	2,40	2,10	160	2,05	1,90

3.3.2 Marking

To facilitate identification and to avoid operating errors, the parts of the drinking and fire fighting supply system that are essential to their operation shall be adequately and permanently marked using plates. The minimum size of the plates, which are to comply with DIN 825 Part 1, should not be less than 50 mm × 100 mm, with a minimum character height of 7 mm. The plates shall be permanently affixed to the system components.

Draw-off points for non-drinking water shall be identified with the words 'Non-drinking water' or by prohibition sign V 5 as specified in DIN 4844 Part 1, shown in figure 1. If the majority of draw-off points on industrial premises are for non-drinking water, the draw-off points for drinking water may be identified by the words 'Drinking water' or by the 'Drinking water' symbol specified in ISO 7001, provided that notices are posted to draw attention to this deviation from normal practice.

The standards dealing with information signs as listed in Supplement 1 to DIN 1988 Part 2 shall also be observed.

3.3.3 Expansion joints

Expansion joints shall be installed in accordance with the manufacturer's instructions and so as to be easily accessible.

Metal bellows expansion joints shall be designed for a maximum temperature of 85 °C and for not less than 10 000 load cycles (expansion/contraction). Proof of compliance with this requirement shall be provided by the manufacturer and recorded in the product description.

Use of elastomeric joints in drinking water supply systems is only permitted if the joints have been type tested, which implies that a suitability certificate covering both the joint design and the material can be submitted.

3.3.4 Hoses

Hoses shall be installed in accordance with the manufacturer's instructions and so as to be easily accessible.

Metal hoses may be used to compensate for displacement and angular deflection if they are capable of maintaining the movement limits set by the manufacturer at temperatures up to 85 °C. Proof of compliance with this requirement shall be provided by the manufacturer and recorded in the product description.

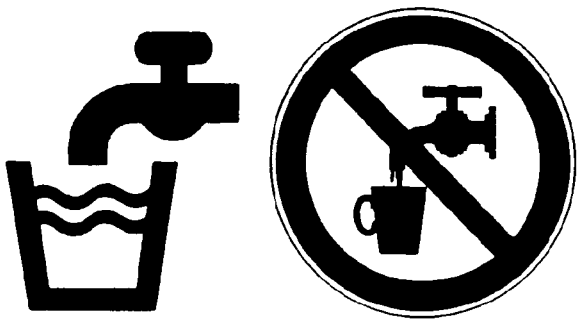

Figure 1. Symbol 'Drinking water' and prohibition sign 'Non-drinking water'

Use of elastomeric joints in drinking water supply systems is only permitted if the joints have been type tested, which implies that a suitability certificate covering both the joint design and the material can be submitted.

Only hose assemblies (hose with hose union) complying with the requirements specified in DIN VDE 0700 Part 600 shall be used for the connection of dishwashers, washing machines, laundry dryers and similar appliances.

3.3.5 Thread sealants

Thread sealants shall comply with the requirements specified in DIN 30660, and their packaging shall bear the DIN/DVGW test mark and registration number.

3.3.6 Seals

Seals shall comply with the *KTW-Empfehlungen* and be rated for a maximum temperature of 85 °C (see table 1). Seals for use with fittings designed exclusively for cold water systems need only be rated for 25 °C (see table 1). DIN 28617 shall apply for seals for use with cast iron pipes, *RAL-Richtlinie* (RAL Code of practice) R 30.5.1 for seals for use with plastics spigot-and-socket joints in cold water systems and a *DVGW-Arbeitsblatt*[2]) for elastomer seals for use with other types of pipe joint assembly. Gaskets made from lt materials as specified in DIN 3754 Part 1 for flanged joints shall comply with DIN 2690.

Proof of compliance with this requirement shall be provided by the manufacturer and recorded in the product description.

3.3.7 Jointing materials

Jointing materials are also considered to fall within the scope of the *Lebensmittel- und Bedarfsgegenständegesetz*. Under this law, such materials may only be used if they do not contaminate the internal surfaces of the system or the water itself. Excepted from this ruling are pollutants that are technically unavoidable but which occur in such negligible quantities that they affect neither the taste nor smell of the water, nor the health of its consumers. Except for valve lubricants, the jointing materials shall be removable by flushing as described in subclause 11.2 (cf. subclause 4.4).

3.3.7.1 Brazing alloys and solders for copper pipes

Only those brazing alloys and solders listed in *DVGW-Arbeitsblatt* GW 2 and marked accordingly shall be used for soldering or brazing.

3.3.7.2 Fluxes for copper pipes

Fluxes for brazing and soldering shall meet the requirements specified in *DVGW-Arbeitsblatt* GW 7. Only products the packaging of which bears the DVGW test mark and registration number shall be used.

3.3.7.3 Thread cutting emulsions

Thread cutting emulsions shall meet the requirements specified in *DVGW-Arbeitsblatt* W 521. Only those products whose packaging bears the DVGW test mark and registration number shall be used.

3.4 Pipe laying

3.4.1 Service pipes

3.4.1.1 Unless otherwise specified below, the specifications of DIN 19630 shall apply, by analogy, for service pipes.

3.4.1.2 Service pipes shall be capable of being shut off in the immediate vicinity of the public water main. Marking of the service stopvalve shall preferably be in accordance with DIN 4067.

3.4.1.3 The service pipe shall, as far as possible, be laid in a straight line, at right angles to the site boundary and along the shortest path from the water main to the building, particular care being taken to protect it from freezing, to meet local conditions. This shall also apply, by analogy, to service pipes.

3.4.1.4 Water in buried service pipes may be polluted by waste water. Thus, where the distance between drinking water pipes does not exceed 1 m, the former shall not be laid deeper than the latter. The minimum clear distance drinking water pipes and other pipes or cables shall be 0,2 m. Where this distance cannot be maintained, protective measures (e.g. enclosing pipe in a duct) shall be taken.

3.4.1.5 Since service pipes shall be readily accessible, they shall not be laid under a building.

3.4.1.6 The service pipe shall end in a meter chamber, meter pit or meter cabinet (cf. DIN 18012 and *DVGW-Arbeitsblatt* W 355).

3.4.1.7 Laying service pipes to undeveloped sites in advance of actual requirements shall be eschewed (cf. DIN 1988 Part 8).

3.4.1.8 For buried metal service pipes, an isolator complying with DIN 3389 shall be installed near the service stopvalve in the building, care being taken to ensure that this isolator cannot be bridged accidentally. Any bye-laws regarding the laying of service pipes issued by the public water supplier shall be observed.

Isolators shall bear the DIN/DVGW test mark and registration number and be colour-coded 'green' to indicate that they are to be used for water applications. Isolating joints other than DIN 3389 isolators (e.g. isolating screwed joints) may be used if they have been tested on the lines of DIN 3389 and shown to be of equivalent quality and performance.

Buried metal service pipes that service a number of buildings shall be fitted with isolators both before leaving one building and after entering another. The pipework within each building shall be connected to potential equalizing bars. Special measures (e.g. protective insulation) shall be taken if electrical actuators are installed in such pipes (see figure 2 for example).

3.4.2 Pipework inside buildings

3.4.2.1 No pipe shall be secured to another pipe or used as a support for other pipes.

3.4.2.2 The arrangement of pipes shall facilitate their identification, plates being used where required (cf. subclause 3.3.2).

3.4.2.3 Pipes shall be laid so as to prevent the formation of air locks. Where pipes are likely to suffer from frost damage, drainage fittings shall be provided at the lowest points of the system.

3.4.2.4 Where pipes are laid above one another, uninsulated cold water pipes shall be bottommost in order to minimize the risk of condensation.

3.4.2.5 Rising mains ('risers', for short) shall be capable of being shut off and drained separately. Stopvalves in such pipes shall be arranged so as to be easily accessible. For example, in a house divided into flats where the risers are centrally located, the valves shall be installed in a room to which normal access is possible and otherwise (separate location of risers), in the cellar passage.

Where a system provides water to two or more buildings, a riser shall be installed in each building.

3.4.2.6 The supply pipes for each storey and those in the individual flats shall be capable of being shut separately.

3.4.2.7 Where draw-off points on a storey require backflow prevention but are not individually isolated (cf. DIN 1988 Part 4), the main branch pipe shall branch off from the riser not less than 300 mm above the maximum possible water level on the storey.

For [2]), see page 3.

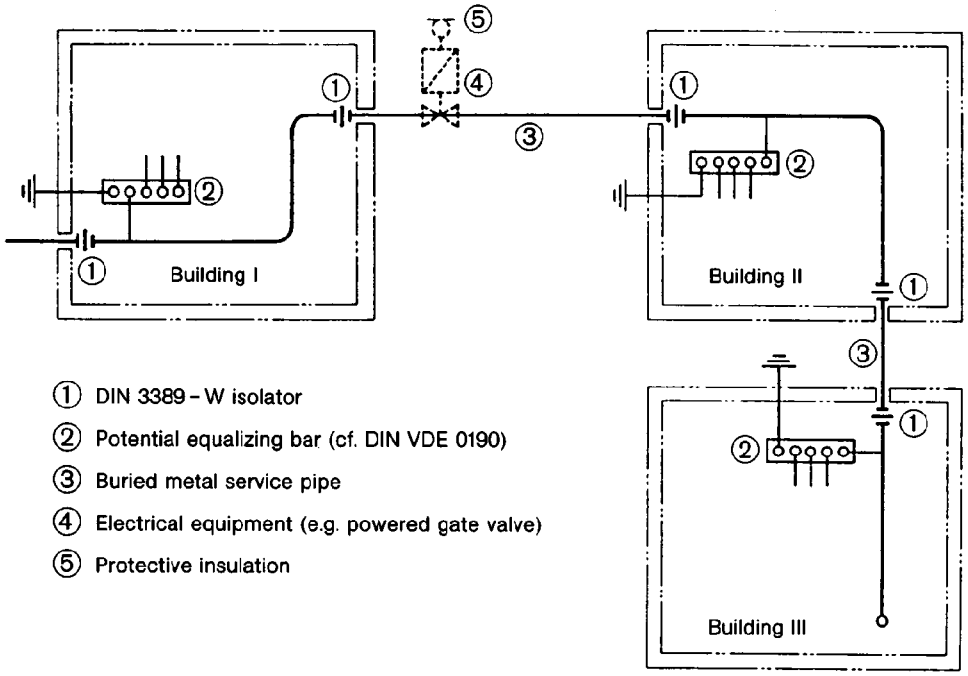

Figure 2. Example of the arrangement of isolators in metal pipes

3.4.2.8 The specifications of subclauses 3.4.2.5 and 3.4.2.6 need not be complied with where less frequent use is made of the draw-off capacity, such as in the case of single-family houses or similar dwellings.

3.4.2.9 Stopvalves shall be installed immediately upstream of hose connections.

3.4.2.10 Pipes that are only very rarely used, or likely to be damaged by frost (e.g. supply pipes to unheated outbuildings, gardens, courtyards, fountains) shall be provided with stopvalves and draining taps and marked appropriately by plates, as specified in subclause 3.3.2.

3.4.2.11 No pipework should be laid beneath cellar level nor laid beneath the floor of rooms not located above cellars. If this cannot be avoided, the pipes shall be protected against corrosion as specified in clause 5 of DIN 1988 Part 7.

Where pipes are located in unheated surroundings such as open passages, they shall be laid at a depth sufficient to afford protection against freezing, if frost protection cannot be provided by other means.

Pipe ducts shall be capable of being vented and drained.

3.4.2.12 Stopvalves, drain valves and backflow prevention devices shall be located so as to be readily accessible for operation and maintenance.

3.4.2.13 Components that give off heat when properly operated shall not be installed in hot water supply systems.

3.4.2.14 Exposed pipes shall be laid at a sufficient distance from a wall, floor and from other pipes and be fixed so as to accommodate the stresses occurring in service. Pipe brackets or clips (cf. subclause 3.3.1) used, even as a provisional measure, for pipes embedded in a building element (e.g. wall or floor) shall be compatible with the pipe material. Unless otherwise specified, the manufacturer's instructions shall be followed when laying and securing pipes. Expansion due to heating shall be allowed for, where necessary, by the provision of elastic pipe brackets or expansion joints. When designing the fixing points, the forces resulting from expansion shall be taken into consideration. Pipes embedded in a building element (e.g. wall or floor) shall be suitably wrapped or coated so as to ensure that the pipe and building element are not in direct contact.

3.4.2.15 Pipe joints shall only be clad, plastered over or otherwise covered after having been pressure tested as described in subclause 11.1.

3.4.2.16 All inlets and outlets of finished pipework to which draw-off fittings have not yet been installed shall be tightly closed with stoppers, caps or blind flanges made of a suitable metallic material. Closed stopvalves shall not count as tight closures.

3.4.2.17 According to DIN 1053 Part 1, recesses and chases in masonry are only permitted if the structural integrity of the building is not impaired. Unless formed in the masonry itself, these openings shall be cut; mortising, however, is not permitted. Without prejudice to the specifications of DIN 1053 Part 1 regarding permissible location and dimensions of vertical, horizontal and inclined chases, the actual use of such chases, whether formed in the masonry itself or subsequently cut, for laying drinking water pipes (particularly lagged pipes) shall be restricted to exceptional cases only. It is therefore recommended that laying of risers and main branch pipes be based on the principle of surface mounting[3]), i.e. the pipe runs are mounted, either pipe for pipe or as preassembled units, directly on the wall, and are then enclosed. Thus, the strength of walls bearing the load of the pipes and their insulating properties (sound and heat) and fire behaviour are not adversely affected.

3.4.2.18 Ready-to-install prefabricated components (fixing blocks or fixing walls), where the enclosed pipes cannot be checked after installation, shall satisfy the requirements specified in the relevant product standards or the recognized rules of the art (cf. *DVGW-Arbeitsblatt* GW 3).

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[3]) See *ZVSHK-Merkblatt* (Instruction sheet issued by the Association of Sanitary, Heating and Air Conditioning Equipment Suppliers) on surface-mounted installations.

3.4.3 Pipes passing through walls and floors

The structural integrity of loadbearing members shall not be adversely affected by chases or penetrations (cf. DIN 1053 Part 1). Piping through (internal and external) walls shall be sleeved by the installer.

Underground pipes entering a building shall be accommodated in a sleeve that has been properly bonded into the external wall and that projects beyond it on both sides. The space between the sleeve and the pipe shall be filled with elastic or plastic sealant so as to protect the pipe from undue compression against the sleeve edge and to prevent the passage of water or gas. The use of sleeves that provide a seal between both pipe and sleeve and between sleeve and structure is also permitted.

Any bye-laws issued by the water supplier on the passage of service pipes through walls shall be observed.

4 Valves

4.1 Concepts

See DIN 1988 Part 1 for concepts.

4.2 General requirements

The general requirements to be complied with are specified in the standards and codes of practice listed in Supplement 1 to DIN 1988 Part 2.

Valves in cold and hot systems shall only have a common outlet if this cannot be closed or if the passage of hot water into the cold water pipe (and vice versa) is prevented by the provision of suitable components such as approved check valves.

Note. If, in domestic applications, the water temperature at the draw-off points exceeds 45 °C, mixing valves with safety stops will have to be installed to prevent scalding when hot water is drawn. As stipulated in the *Arbeitstättenverordnung* (Workplaces Regulation), this temperature shall also not be exceeded where water is used at places of work. To ensure this, the actuator shall be fitted with a safety stop that prevents the temperature of the mixed water at the outlet rising above 40 °C.

4.3 Installation

4.3.1 In-line valves

Only valves that do not unduly obstruct the flow (e.g. oblique pattern valves, gate valves and ball valves) shall be installed in pipes (cf. table 27 of DIN 1988 Part 3, December 1988 edition).

DIN 3512 straight pattern valves shall only be installed in main branch pipes where the pressure is adequate.

Only valves that have been tested for noise emission as specified in DIN 52 218 Part 2 shall be used to control the flow.

Valves that can be opened and closed by a single turn through 90° shall not be used as in-line valves unless they are intended to serve as servicing valves.

4.3.2 Taps

Where taps for hot and cold drinking water are arranged next to or above one another, the hot water tap shall be located left of or above the cold water tap.

Hot water taps shall be identified. If a colour code is used for this purpose, red shall identify hot, and blue shall identify cold water.

Installation of valves designed on the principle of water economy shall be given preference.

4.3.3 Valves with a safety function

4.3.3.1 Check valves

Check valves are valves designed to prevent reversal of flow in a pipe.

Check valves of size up to and including DN 100 may be used as a separate unit, as part of a valve combination or be purpose-built for integration in a water meter.

Check valves shall comply with DIN 3269 Part 1.

Check valves of size greater than DN 100, for which requirements have not been specified, shall comply with the following specifications, as appropriate.

The as-installed position of check valves shall permit their function to be checked and the valve or its internal components to be replaced without making any alterations to the connected pipework.

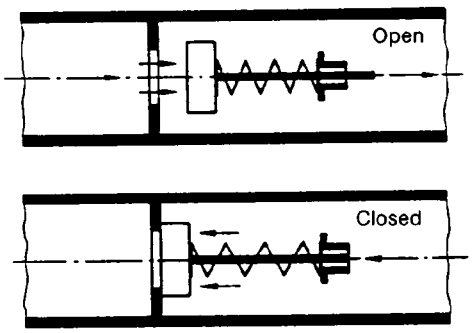

Figure 3. Check valve

To ensure reliable performance, check valves shall be installed horizontally or vertically. Oblique pattern valves shall be installed so that the valve closure element (obturator) is located above the seat. Check valves as part of valve combinations shall be installed in the position specified by the manufacturer.

Check valves may be installed as follows:

a) in service pipes, downstream of or integral with the water meter;

b) in the cold water feed pipe of unvented water heaters with a nominal capacity exceeding 10 l (cf. subclause 6.2.1);

c) as backflow prevention devices (cf. DIN 1988 Part 4);

d) in pressure boosters, on the outlet pressure side of pumps and in the associated compressed air pipes (cf. DIN 1988 Part 5);

e) as part of valve combinations (combined check valves and vacuum breakers) and of threaded hose connections.

Check valves shall be selected as a function of the peak flow rate as specified in DIN 1988 Part 3. The size of check valves may be selected one size smaller than required on the basis of design calculations.

4.3.3.2 Types A 1 and A 2 pipe interrupters

Types A 1 and A 2 pipe interrupters are intended to raise the pressure in a system by automatically admitting air in the event of vacuum pressure so as to prevent non-drinking water from entering the supply system. Such a pressure increase will only be produced if no shutoff device is installed downstream of the pipe interrupter. Water only flows through pipe interrupters when the system is in operation.

A distinction is made between the following:

a) Type A 1: without moving parts; the air inlet apertures are always open;

b) Type A 2: with moving parts; the air inlet apertures are only open if atmospheric pressure obtains inside the pipe.

Types A 1 and A 2 pipe interrupters are used for single-unit backflow prevention.

The downstream pipework shall be designed so as to prevent water from backing up and thus escaping through the air inlet apertures in the pipe interrupter.

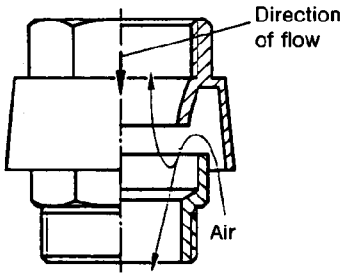

Figure 4. Type A 1 pipe interrupter

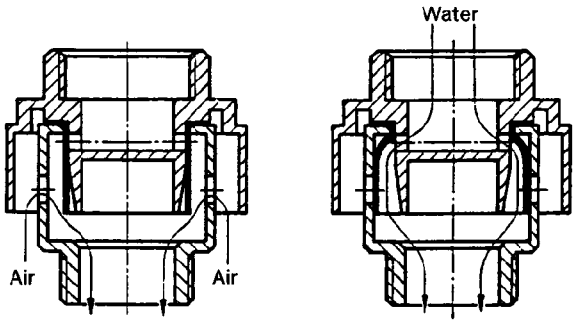

Figure 5. Type A 2 pipe interrupter

See DIN 1988 Part 4 for connecting dimensions and application of pipe interrupters.

The size of pipe interrupters shall correspond to that of the connecting pipework; in cases of mismatch, the next largest size of pipe interrupter may be installed (cf. DIN 3266 Part 1).

4.3.3.3 Types C, D and E anti-vacuum valves

Anti-vacuum valves are intended to raise the pressure in a system by automatically admitting air in the event of vacuum pressure in order to prevent backflow of non-drinking water into the supply system.

See DIN 1988 Part 4 for connecting dimensions and application of anti-vacuum valves.

A distinction is made between the following.

Type C: in-line anti-vacuum valves

The obturator of this type has two functions to fulfil.

a) When the system is working correctly, the obturator closes the air inlet apertures against the escape of water.

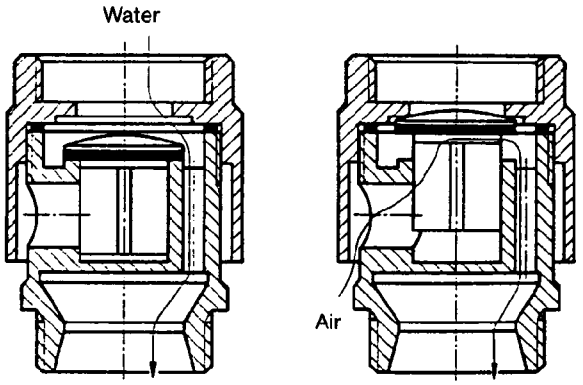

Figure 6. Type C, in-line anti-vacuum valve

b) If vacuum pressure develops, the obturator is raised, which closes the feed pipe and simultaneously admits air into the discharge pipe by opening the air inlet apertures.

The nominal size of type C anti-vacuum valves is to correspond to that of the associated screwed end connection (see DIN 3266 Part 1).

Type D: anti-vacuum valves without dripping water conduit

The air inlet aperture of this type is kept closed by a float as long as the working pressure is maintained. If vacuum pressure develops, the float disengages under its own mass and opens the air aperture. The quantity of water escaping through the aperture is not limited.

Type D anti-vacuum valves shall only be installed where escaping water can cause no damage (e.g. in closed shower cabinets).

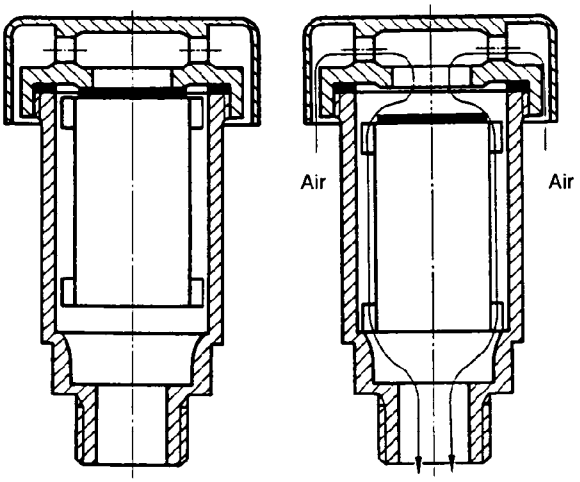

Figure 7. Type D anti-vacuum valves without dripping water conduit

The number of anti-vacuum valves required where type D, DN 15 valves are installed shall be as given in table 3 as a function of the maximum size of the pipe into which air is to be admitted.

Table 3. **Number of type D anti-vacuum valves**

Nominal size of pipe DN	Number of DN 15 anti-vacuum valves
Up to 40	1
Over 40 and up to 50	2
Over 50	3

Type E: anti-vacuum valves with dripping water conduit

The air inlet aperture of this type is kept closed by a float as long as the working pressure is maintained. If vacuum pressure develops, the float disengages under its own mass and opens the air aperture.

The nominal size of type E anti-vacuum valves is to correspond to that of the associated screwed end connection (see DIN 3266 Part 1).

The number of anti-vacuum valves required where type E, DN 15 and DN 20 valves are installed shall be as given in table 4 as a function of the maximum size of the pipe into which air is to be admitted.

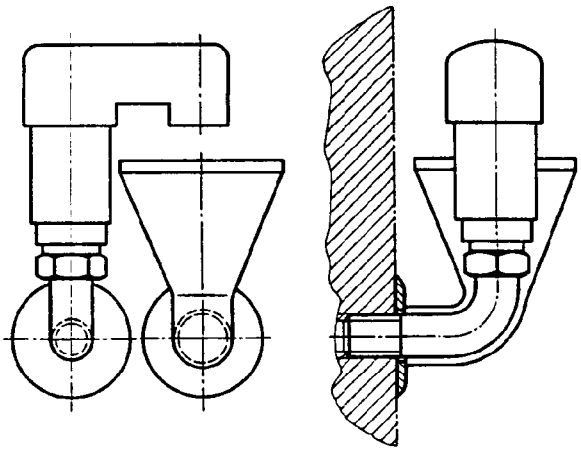

Figure 8. Type E anti-vacuum valves with dripping water conduit

Water escaping through the air inlet aperture is captured and discharged via a funnel, this being connected to the drainage system as specified in DIN 1986 Part 1.

The dripping water conduits serve to discharge the dripping water which is collected by the funnel.

The dripping water conduits shall be laid at a gradient and the materials used for their manufacture shall be sufficiently resistant to heat and corrosion (see DIN 1986 Part 1).

The minimum nominal size of the dripping water conduit shall be as given in table 4.

It shall be possible for the escape of dripping water from the anti-vacuum valve to be monitored at a suitable point. This requirement shall also be deemed to be satisfied if the dripping water conduit passes through a number of storeys as illustrated in figure 11.

4.3.3.4 Combined check valve and type C anti-vacuum valves

Where a check valve and a type C anti-vacuum valve are combined to form an assembly, the check valve element shall be installed upstream of the anti-vacuum valve assembly.

4.3.3.5 Air gaps

Air gaps are valves intended to maintain atmospheric pressure in a pipe before vacuum pressure can develop, disconnecting the pipe thus preventing the backflow of non-drinking water into the supply system.

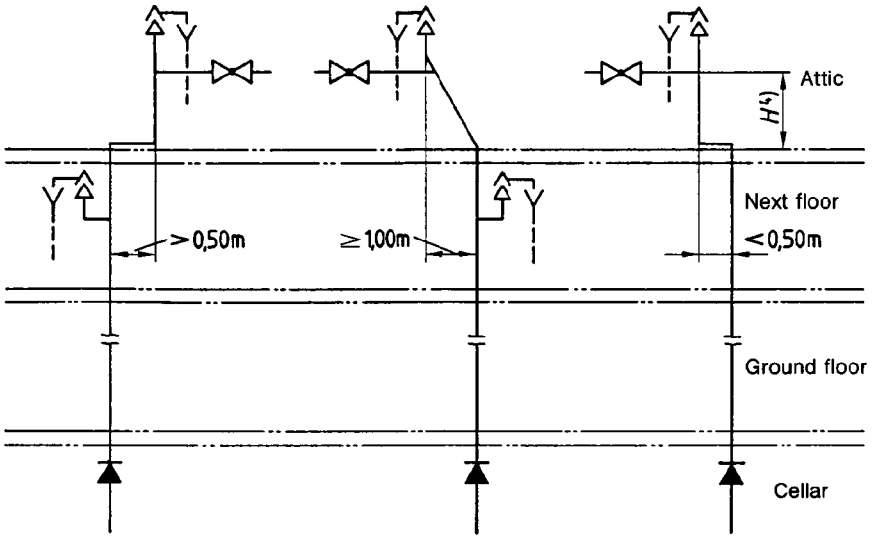

Figure 9. Arrangement of anti-vacuum valves in a backflow prevention system, with risers offset

Table 4. **Number of type E anti-vacuum valves**

Nominal size of riser DN	Number of anti-vacuum valves DN 15		DN 20	Minimum nominal size of connecting pipe DN	Minimum nominal size of dripping water conduit DN
Up to 25	1		-	15	20
32 to 50	2	or	1	20	25
Over 50	3	or	2	32	25

[4]) Cf. subclause 3.4.2.7.

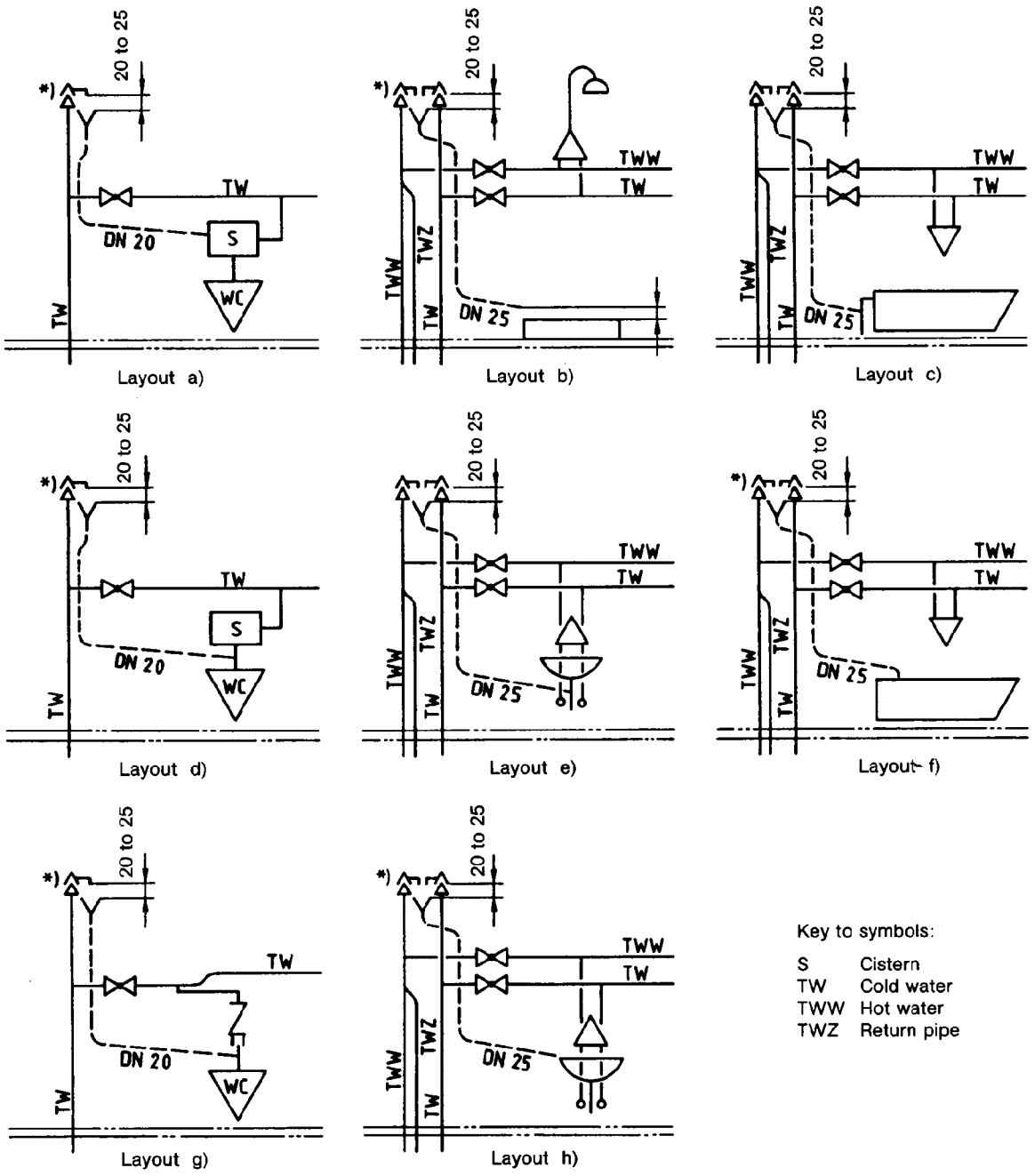

Figure 10. Examples of dripping water conduit installations

*) Enclosed installation of the anti-vacuum valve permitted.

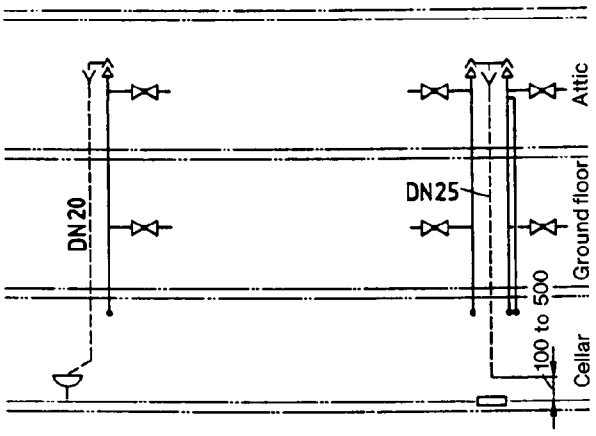

Figure 11. Passage of dripping water conduit through a number of storeys

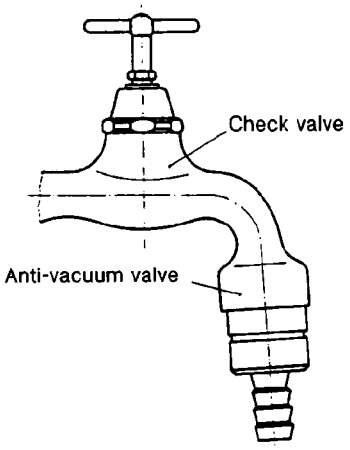

Figure 12. Example of a combined check valve and anti-vacuum valve as specified in DIN 3266 Part 1

When the upstream pressure drops below a specified safe level, i.e. before vacuum pressure can develop, air gaps effect a visible disconnection of the conduit with a minimum clearance of 20 mm. The air gap becomes operative once the upstream pressure drops to 0,5 bar above the maximum possible downstream pressure or back pressure (a safety factor of 0,5 bar). If, for example, the maximum possible non-drinking water level in a system or the highest draw-off point is located 10 m above the air gap, then disconnection shall be effected as soon as the upstream pressure drops to 1,5 bar (set pressure).

The size of the air gap shall be selected in accordance with the manufacturer's instructions.

The following shall be installed, in the sequence stated below, immediately upstream of the air gap:

a) a stopvalve;

b) a strainer, if required;

c) a closable pressure tapping.

A distinction is made between the following types of air gap:

Type 1: Disconnection in the event of pressure drop

The air gap is permanently in the position for normal flow and disconnects once the upstream pressure drops below the set pressure of the air gap.

Type 2: Normal-flow position only if water is drawn

The air gap is in the disconnecting position and shall only be in the position for normal flow for the time that water is being drawn. This shall be ensured by means of a suitable circuit.

Type 3:

Installation conditions as for type 2, except that the air gap is to be mounted at least 300 mm above the maximum possible non-drinking water level and immediately upstream of the appliance or system.

4.3.4 Safety devices

4.3.4.1 Pressure-relief valves

A pressure-relief valve is a valve that automatically discharges to atmosphere when a preset working pressure is exceeded and that closes again automatically once pressure has decreased.

Pressure-relief valves shall comply with the specifications of TRD 721.

4.3.4.1.1 Pressure-relief valves in unvented water heaters

Unvented drinking water heaters shall be fitted with at least one diaphragm valve which is type approved and provided with a test mark (except for instantaneous water heaters with a nominal capacity not exceeding 3 l; see DIN 4753 Part 1). Only spring loaded diaphragm valves shall be used for capacities up to 5000 l (see DIN 4753 Part 1).

The minimum nominal size of pressure-relief valves shall be as specified in table 5.

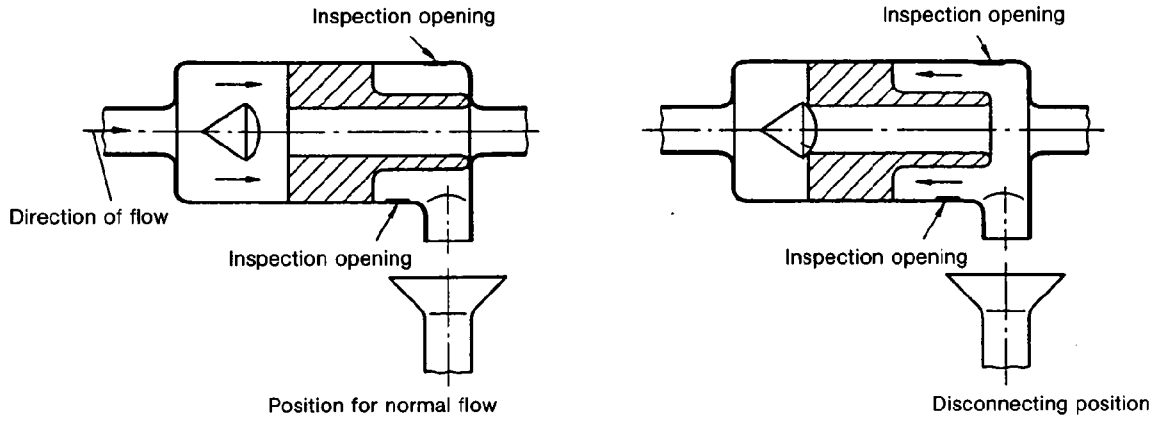

Figure 13. Air gap

Table 5. **Minimum nominal size of pressure-relief valves for unvented water heaters**

Capacity, in l	Minimum nominal size*) DN	Maximum heating capacity, in kW
≤ 200	15 (R/Rp ½)**)	75
> 200 ≤ 1000	20 (R/Rp ¾)	150
> 1000 ≤ 5000	25 (R/Rp 1)	250

*) The nominal size refers to the nominal size of the inlet connection.

**) R taper Whitworth external thread } as in DIN
Rp parallel Whitworth internal thread } 2999 Part 1

The pressure-relief valves to be installed in unvented water heaters with a capacity of more than 5000 l and/or heating power of more than 250 kW shall be selected in accordance with the manufacturer's instructions.

The following specifications shall apply for the installation of diaphragm valves.

a) The valves shall be installed in the cold water feed, no stopvalves, constrictions or strainers being located in the pipe connecting the pressure-relief valve and the water heater.

b) The valves shall be installed in an accessible position, as close as possible to the water heater. The nominal size of the pipe feeding into the pressure-relief valve shall be at least the same as that of the pressure-relief valve.

c) The valve shall be located at a sufficiently high level for the connecting vent pipe to be laid at a gradient. It is recommended that the pressure-relief valve be mounted above the water heater so that replacing it is possible without draining the heater.

The following specifications shall apply for the installation of vent pipes.

a) Proper installation shall ensure that persons are not endangered by the hot water escaping from a responding pressure-relief valve. For this reason, each pressure-relief valve requires a vent pipe that is adequately protected against freezing and made from a sufficiently heat-resistant and corrosion-resistant material. The vent pipe shall end 20 mm to 40 mm above a drainage fitting or discharge funnel inside buildings and be mounted in a visible position.

b) Vent pipes shall be sized so as to suit the outlet cross section of the pressure-relief valve, have not more than two bends and be no longer than 2 m. If more bends or pipes longer than those specified are required, then the next highest nominal vent pipe size shall be installed. More than three bends or a pipe length exceeding 4 m are not permitted.

c) A plate with the following text shall be mounted near the vent pipe, preferably on the pressure-relief valve itself:

> When the water heater is in operation, water may escape from the vent pipe.
> Do not obstruct the outlet.

d) The nominal size of the pipe draining the funnel shall be at least equal to twice that of the vent pipe.

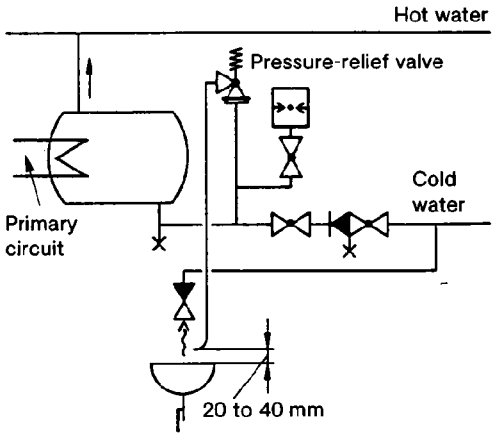

Figure 14. Installation of pressure-relief valve and water heater in the same room

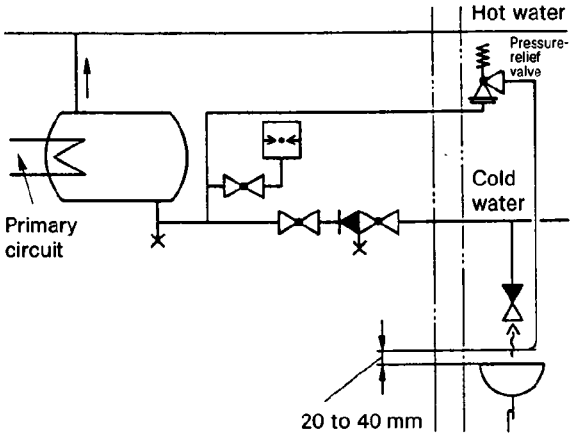

Figure 15. Installation of pressure-relief valve and water heater in different rooms

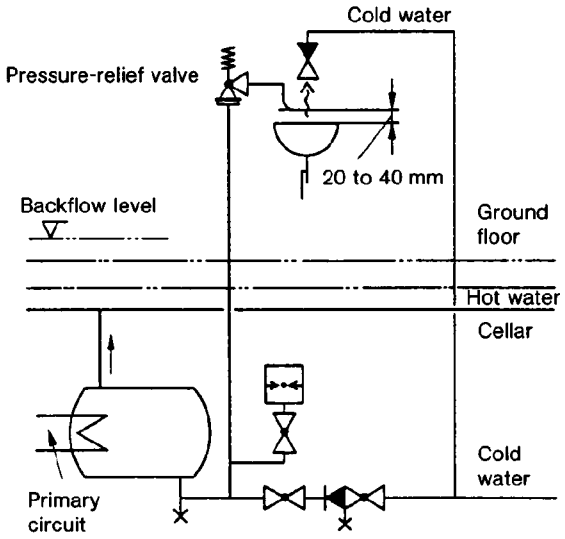

Figure 16. Installation of pressure-relief valve and water heater in different rooms on the ground floor

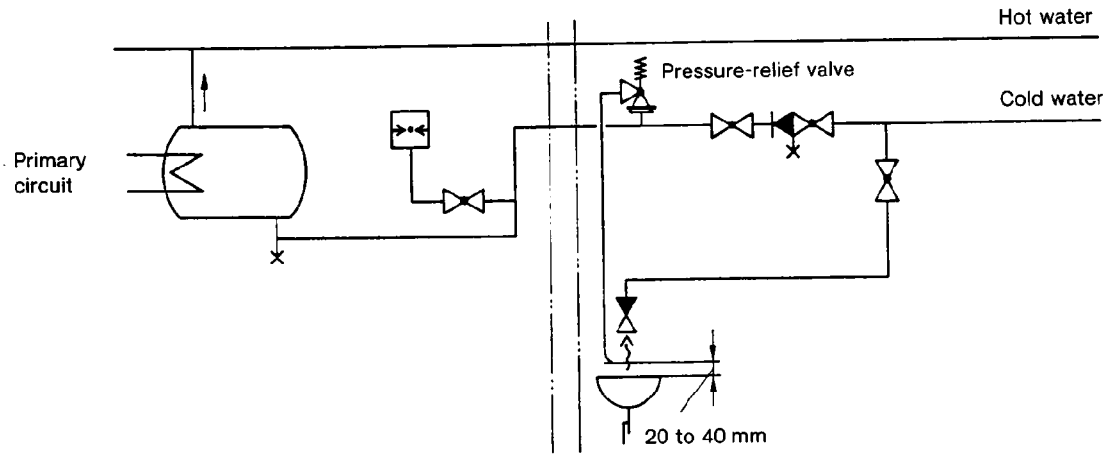

Figure 17. Installation of complete safety system and water heater in different rooms

The following shall apply for the set pressure of pressure-relief valves.

Pressure-relief valves shall be supplied with the set pressure already adjusted by the manufacturer. Pressure-relief valves shall be used, the set pressure of which is equal to or less than the permissible working pressure of the water heater. The maximum pressure in the cold water feed shall be at least 20 % below the set pressure of the valve (see table 6). If the set value is exceeded, a pressure reducing valve shall be installed.

Table 6. **Set pressure of pressure-relief valves as a function of pressure in cold feed pipes**

Maximum pressure in cold feed pipe, in bar	Permissible working pressure of water heater, in bar	Set pressure of pressure-relief valve, in bar
4,8	6	6
8	10	10

4.3.4.1.2 Pressure-relief valves for pressure vessels in pressure boosters

Since drainage of water escaping from the pressure-relief valve of a pressure booster is generally complicated, pressure vessels in pressure boosters should be designed to have a maximum permissible working pressure greater than the sum of the maximum inlet pressure and maximum delivery pressure of the pumps.

A pressure-relief valve complying with *AD-Merkblatt* A 2 shall be mounted to the pressure vessel of a pressure booster if the sum of maximum inlet pressure and maximum delivery pressure of the pump exceeds 1,1 times the maximum working pressure of the vessel (see DIN 1988 Part 5). This shall apply by analogy for the air supply generating and maintaining the compressed air cushion.

Sizing and adjustment of the pressure booster is a function of the pump characteristic and the operating conditions. The pressure-relief valve shall open no later than at the permissible working pressure of the vessel, and be capable of discharging the water supplied from the pump at 1,1 times the permissible working pressure. The valve shall close before the pressure decreases to 20 % below the set pressure.

The following specifications shall apply for feed and vent pipes.

a) The nominal size of feed pipes for air and water pressure-relief valves shall be selected as a function of the pipe length so that no pressure drop greater than 3 % of the set pressure can occur. Thus, for pipes up to 2 m in length, the size selected shall be equal to that of the pressure-relief valve inlet, and for pipes 2 to 4 m in length, to the next largest size.

b) Vent pipes for pressure-relief valves shall be sized so that the flow into the pressure-relief valve is not unduly reduced by excessive back pressure. Vent pipes shall always be one size greater than the inlet connection of the pressure-relief valve, or two nominal sizes where vent pipes are longer than 2 m. The instructions of the pressure-relief valve manufacturer shall be taken into account in this respect.

c) An air pressure-relief valve is frequently installed between compressor and check valve in the pipe feeding the pressure vessel of compressed air generators (e.g. compressors, pumps). Built-in valves often vent to the atmosphere, i.e. have no connection for a vent pipe. Such a pipe is to be provided, however, if the escape of water in the event of failure is a design feature of the system.

d) Pressure-relief valves in systems including pressure vessels shall be installed on the air cushion side.

4.3.4.1.3 Pressure-relief valves for appliances other than pressure vessels

In addition to a pressure reducing valve, a pressure-relief valve shall be installed at the drinking water inlet of appliances if the maximum possible static pressure of the water at the point of connection exceeds the permissible working pressure in the components in which the water flows.

The size of the pressure-relief valve and the set pressure shall be specified in agreement with the appliance and valve manufacturers. The pressure-relief valve shall open no later than at the permissible working pressure of the vessel and be capable of discharging the water so that a pressure equal to 1,1 times the permissible working pressure is not exceeded.

4.3.4.2 DIN 3440 temperature control device

A temperature control device, type tested as specified in DIN 3440, shall be provided for:

a) water heaters that are directly heated by solid fuels;

b) water heaters that are or may be heated indirectly with solid fuels via a closed primary circuit complying with DIN 4751 Part 2 (convertible boilers).

See DIN 1988 Part 4 for the installation of temperature control devices in heating systems.

4.4 Valve lubricants

Valve lubricants shall be suitable for use with water supply systems. They shall not impair the drinking water quality as, by reason of their function, they are required to remain in the valves in small quantities, nor shall they damage any non-metallic seals. Proof of compliance with this requirement shall be provided by the lubricant manufacturer and recorded in the product description.

5 Appliances

5.1 Concept

In this standard, 'appliance' is used as a generic concept covering appliances (such as X-ray equipment, automatic film processors, distillation and sterilization apparatus), equipment (such as used for agricultural and catering purposes, laboratory apparatus, dialysers), vessels (such as agitator vessels, drums, shakers, containers and barrels), and machines (such as pumps, compressors and washing machines). It also covers all devices that are part of a drinking water supply system or are temporarily connected to it (cf. DIN 1988 Part 4).

5.2 Requirements

The requirements specified in subclause 2.2 shall be complied with.

5.3 Backflow prevention

DIN 1988 Part 4 shall be complied with when installing backflow prevention devices.

6 Hot water supply systems

All the specifications of this standard, unless expressly restricted to cover only cold water systems, shall apply to hot water supply systems ('hot water systems', for short).

A distinction is made between the following types of hot water system.

a) Single point supply system
In a single point supply system, each draw-off point is supplied from a separate heater.

b) Multiple-point supply system
In a multiple-point supply system, a number of draw-off points located close together in a dwelling or part of a building are supplied from one water heater.

c) Central supply system
In a central supply system, all water draw-off points in one or a number of dwellings or buildings are supplied from one or a number of water heaters via a common distribution system.

Hot water systems consist of a water heater, the equipment necessary for the safe operation of the system, heating equipment and the associated pipework with valves and fittings.

6.1 Water heaters

Water heaters are vessels or pipework to which energy is supplied for the purposes of water heating.

6.1.1 Classification

Water heaters are classified according to function as follows.

a) Instantaneous water heaters
Instantaneous water heaters are heaters in which the water is heated as it is drawn, i.e. as it passes through the appliance.

b) Storage water heaters
Storage water heaters are heaters in which the water is heated before being drawn, and stored until used.

Water heaters are classified according to design as follows.

a) Vented water heaters
Vented water heaters are permanently connected to the atmosphere, either directly or via an open expansion vessel. They are not under mains pressure. In proper operation, a working pressure of 1 bar is not exceeded.

b) Unvented water heaters
Unvented water heaters have no permanent open connection to atmosphere, or this connection does not comply with the requirement specified for vented water heaters.

Water heaters are classified according to the heating system as follows.

a) Direct heating system
System in which the water is heated directly by the thermal energy given off by the fuel from the combustion chamber through a wall to the water.

b) Indirect heating system
System in which the energy supply is transferred via a heating medium (steam, hot water, fluids in solar heating systems or heat pumps).

The transfer medium heat exchanger is a particular variant of the indirect heating system in which the heat transfer surfaces on the heating medium and drinking water sides are separated by a safety system.

6.1.2 Material, design, equipment and testing

Subclause 2.2 and DIN 1988 Part 7 shall be taken into consideration in the selection of materials for water heaters and pipework. The design, equipment, testing and marking of water heaters shall be as specified in DIN 4753 Parts 1 to 7 and 9 to 11 (at present at the stage of draft), electric water heaters also complying with DIN VDE 0700 Parts 1, 15, 21, 35 and 243.

PN 6 unvented water heaters shall only be used if a pressure reducing valve is installed in the system in addition to a pressure-relief valve (cf. subclause 6.2.3 and DIN 1988 Part 5). The former need not be installed, however, if, owing to the conditions of installation (e.g. high-mounted heater), the working pressure at the heater inlet will not exceed 4,8 bar[5]).

6.1.3 Physiological safety

The quality of water in heaters may undergo unintended changes, be impaired, or the water polluted. Impairment of the water quality and a hazard to health may originate from the materials, heating media and the transfer medium used.

6.1.3.1 Materials

The materials used for the manufacture and operation of pipes, fittings and appliances shall not constitute a health hazard (cf. DIN 1988 Part 4) and shall comply with all relevant technical rules. Where no such rules exist, particular care shall be taken to ensure that only materials are used that are unobjectionable or, if irreplaceable for technical reasons, are acceptable in terms of the smell and taste of the water and the health of its consumers.

Where nonmetallic materials are used, the relevant *KTW-Empfehlungen* shall also be observed. Marking as specified in DIN 4753 Part 2 may be taken as proof of compliance with this requirement.

6.1.3.2 Protection of drinking water from pollution by the heating medium

Water heaters shall be manufactured and operated so as to ensure adequate protection of the water from being polluted by the heating medium (cf. DIN 1988 Part 4), i.e. there shall be no contact between heating medium or transfer medium and the drinking water in service.

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[5]) This is to be checked by consulting the local water suppliers.

6.1.4 Water heaters with indirect heating

Water heaters are distinguished according to the corrosivity of their heat transfer surfaces, by analogy with DIN 4753 Part 1, as follows.

Type A: Heat transfer surface protected against corrosion

Identical with the design specified in DIN 4753 Part 1, protected against corrosion by metal coatings and by coatings on the drinking water side not requiring type testing.

Type B: Corrosion-resistant heat transfer surface

Identical with the corrosion-resistant design specified in DIN 4753 Part 1, the corrosion protection being provided by

a) using corrosion-resistant materials;
b) applying a corrosion-resistant lining on the drinking water side;
c) applying corrosion-resistant coatings on the drinking water side which require type testing.

Type C: Highly corrosion-resistant heat transfer surface

Identical with type B, except that it complies with the following additional requirements.

To preclude contact between drinking water and heating medium, there shall be no disconnectable joints in the enclosed pipe run. Other joints, made by soldering, welding or welting, should not be used unless technically unavoidable and the quality of the joints has been verified in service tests, e.g. as described in the HP series of *AD-Merkblätter*.

Type D: Transfer medium heat exchanger

Identical with type B, except that a fluid-operated safety system is installed to ensure that there is no contact between heating medium and drinking water.

The fluid in the safety system, as the most hazardous substance present, shall be of class 3 or less as defined in DIN 1988 Part 4. The safety system shall be protected against pollution and shall offer no possibility for unauthorized refilling.

The pressure in the safety system shall not exceed atmospheric pressure by more than 1,5 bar. Where there is the risk of contact between the heating medium circuit and the safety system or between the safety system and the hot water, excessive pressure in the safety system greater than 1,5 bar shall be prevented by a safety device (e.g. pressure-relief valve, bursting disc or vent to the atmosphere).

6.1.5 Determination of the heat requirement

The heating energy required for central water heaters for the hot water supply in blocks of flats shall be determined in accordance with DIN 4708 Part 2, and those for point-of-supply and multiple outlet heaters, in accordance with the given conditions (e.g. type and number of draw-off points).

6.1.6 Siting

Vented water heaters shall only be sited in the vicinity of hot water draw-off points.

6.2 Installation

The installation of water heaters shall be as illustrated in figures 18 to 22, taking into consideration the requirements of DIN 4753 Part 1.

6.2.1 Prevention of reverse flow in hot water systems

Irrespective of the water heating system used, a check valve shall be installed in the cold water feed if the capacity of the instantaneous or storage water heater exceeds 10 litres.

One stopvalve each shall be installed, in an accessible position, upstream and downstream of the check valve to allow inspection and replacement. The downstream stopvalve is not required for wall-mounted water heaters with a capacity of not more than 150 litres.

A device for checking the valve shall be provided between the upstream stopvalve and the check valve.

6.2.2 Safety equipment for hot water systems

The safety equipment of gas-fired hot water systems shall comply with DIN 4753 Part 1 and that of electric water heaters, with DIN VDE 0700 Parts 1, 15, 21, 35 and 243.

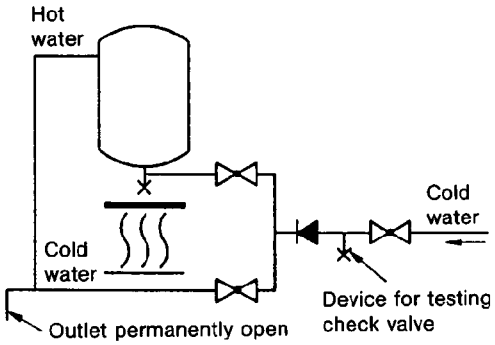

Figure 18. Vented, direct heated system, with heater of capacity greater than 10 l

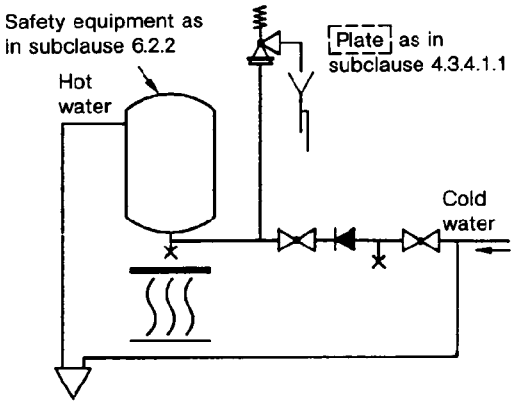

Figure 19. Unvented, directly heated system with heater of capacity greater than 10 l

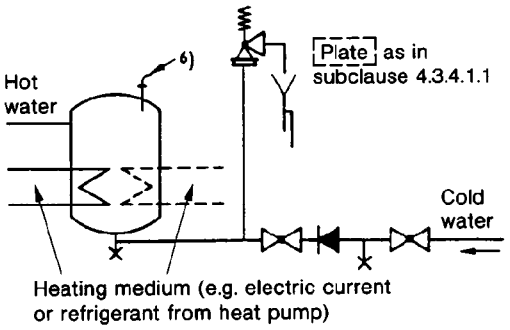

Figure 20. Unvented, indirectly heated system (storage water heater) with heater of capacity greater than 10 l

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6) Thermostat complying with DIN 4753 Part 1.

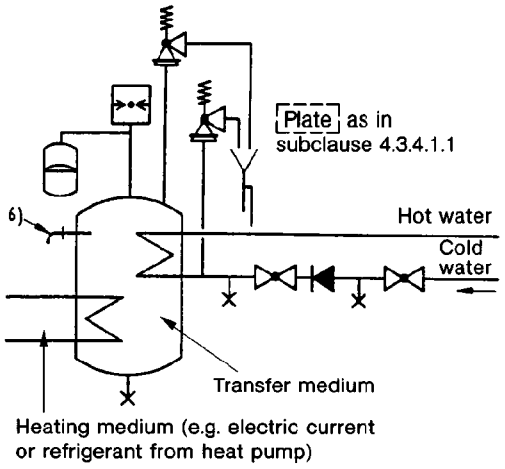


Figure 21. Unvented system, indirectly heated via a transfer medium (instantaneous water heater)

6.2.2.1 Vented water heaters

For health reasons, vented water heaters with feed cisterns should not be used to heat drinking water, but if used, the cistern shall have a capacity corresponding to that of the system, so as to be capable of accommodating the expansion of the water as it is heated. It shall be fitted with an automatic feed control and an overflow pipe (see DIN 1988 Part 4) and satisfy the requirements specified in clause 7.

The cold water feed of instantaneous water heaters with open outlet and vented storage water heaters with a capacity of up to 10 litres (small storage water heaters) need not be safeguarded.

6.2.2.2 Unvented water heaters

The requirements specified in DIN 4753 Part 1 shall apply for the safety equipment of unvented water heaters.

A spring loaded diaphragm valve that cannot be shut off shall be installed as the safety device. It is recommended that this valve be arranged above the vessel. Subclause 4.3.4.1.1 shall apply for the sizing and installation of the pressure-relief valve.

6.2.3 Installation of a pressure reducing valve

A pressure reducing valve shall be installed upstream of the water heater if the working pressure exceeds 80 % of the set pressure of the pressure-relief valve.

It is recommended that the pressure reducing valve be installed downstream of the water meter assembly so as to maintain approximately uniform pressure conditions in the cold and hot water systems of a building.

6.2.4 Pressure tapping

The cold water feed of unvented water heaters shall be provided with a pressure tapping.

6.3 Connections between cold and hot water pipes

Connections between cold and hot water pipes may only have a common draw-off point if the feeding pipes are fitted with check valves.

Where mixing valves feed into hot water pipes, the feed pipes shall each be fitted with a check valve.

7 Storage cisterns

Storage cisterns shall be designed and installed such that the full content of the tank is renewed in the course of operation so as to prevent water becoming stagnant. To protect drinking water from pollution, preference shall be given to cisterns operating at working pressure.

Use of unpressurized cisterns is only permitted if operational reasons (e.g. storage conditions, safety, prevention of transient pressures and connection to different distribution systems) preclude the installation of pressurized cisterns.

7.1 Requirements

7.1.1 Cisterns under working pressure

The water quality shall not be impaired by the presence of a gas cushion (air) in direct contact with the water surface.

Cisterns with capacities of not less than 200 litres shall be provided with openings for inspection and cleaning.

7.1.2 Cisterns under atmospheric pressure

Drinking water may be stored in closed cisterns (i.e. cisterns provided with a tightly fitting cover) under atmospheric pressure under the following conditions.

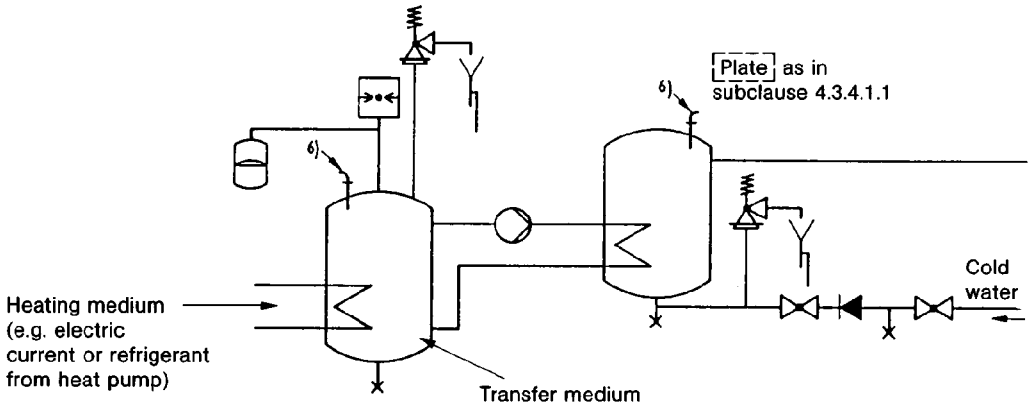


Figure 22. Unvented system, indirectly heated via a transfer medium (storage water heater) with a capacity greater than 10 l

For 6), see page 15.

a) The cistern shall be located in a room that can be locked, is accessible only to authorized persons and satisfies hygienic and technical requirements such as cleanliness, adequate ventilation, tightness to harmful gases and adequate insulation against frost. The room shall not be used for the storage of materials that might constitute a risk to the water.

b) The cistern shall be easily accessible and easy to clean. The cover shall be secured against displacement and be provided with adequate means of ventilation.

c) All connections to the atmosphere shall be secured against animals and harmful substances (e.g. by fitting a narrow mesh screen for vent pipes, hydraulic trap for overflow, frog flap).

Note. Drinking water shall not be stored in uncovered cisterns.

7.2 Installation

Connections between cisterns, pipework and valves shall comply with DIN 1988 Part 4, the following requirements also being satisfied.

a) Cistern feed pipes shall be provided with a manually operated stopvalve located at an easily accessible point close to the cistern. Immediately upstream of the cistern, a further stopvalve shall be installed.

b) Water level control elements shall be easily accessible.

c) Only valves that take longer than 0,5 s to open or close and that are water level controlled shall be used. A servicing valve shall be installed upstream of such valves, and a pressure reducing valve provided if required.

d) The nominal size of float-operated valves shall not exceed DN 50. For systems with a high flow rate, as and when required, several valves shall be installed next to each other, their floats being adjusted for different water levels, or a diaphragm valve with a nominal size greater than DN 50 shall be used.

e) For feed pipes with a low flow rate and a consequent risk of stagnation, subclause 3.5 of DIN 1988 Part 4 shall be complied with.

8 Use of water treatment equipment

Since the drinking water supplied from public suppliers is required to comply with legal requirements (e.g. *Trinkwasserverordnung* (German Drinking Water Regulation) or *Lebensmittel- und Bedarfsgegenständegesetz* and with the quality requirements laid down in the recognized rules of the art, it is regularly analyzed by the water authorities as one of their duties under the health inspection regulations. Thus, it requires no further treatment for drinking or cooking purposes. Increasingly, water is being used in the operation of household appliances, for which some form of water treatment is often recommended (e.g. filtering, use of dosing apparatus and softeners). Compliance with the following requirements is required to ensure the reliable operation of these appliances.

a) Their manner of operation shall be adjusted to the water quality and pipework materials, consultation with the responsible water supplier being recommended.

b) Water treatment should be restricted to the water requirement for the particular application (e.g. treatment of hot water only).

c) Only appliances bearing the DIN/DVGW test mark shall be installed if additional safety valves as specified in DIN 1988 Part 4 are to be dispensed with.

d) The appliances shall be installed by a contractor registered with the water authorities.

e) The appliances shall be carefully and regularly serviced as specified in DIN 1988 Part 8.

8.1 Filters

8.1.1 Criteria for use

Occasionally, solid matter (such as rust particles or grains of sand) may enter the waterways and thus the domestic supply system. Such matter can cause corrosion damage to the pipework in the form of wide or deep pitting, gradually clog up shower heads or aerators, or impair the functioning of valves. Filters with pore sizes as specified in DIN 19 632 largely prevent such damage.

Where metal pipes are used, a DIN 19 632 filter shall be, and where plastics pipes are used, should be installed downstream of the water meter.

8.1.2 Filter size

The filter size shall be selected on the basis of the specifications of DIN 1988 Part 3.

8.1.3 Installation

A filter shall be installed before the system is filled for the first time and be located directly downstream of the water meter assembly.

To prevent detrimental effects on the filter (e.g. loss of pressure, lack of water or microbial contamination), only filters bearing the DIN/DVGW test mark shall be used and shall be regularly serviced as specified in DIN 1988 Part 8.

The installation of an additional filter at the point of transition between existing pipework and any extension or at points where large sections of a system are renewed may be useful to prevent solid matter from sections of existing pipework entering the new system.

To obviate the need for interrupting the water supply during servicing work, it is recommended that filters that can be backwashed or parallel systems (but not a bypass pipe) be installed. A pipe discharging the backwashed water shall be provided with a free outlet as specified in DIN 1988 Part 4.

8.2 Dosing apparatus

8.2.1 Criteria for use

DIN 1988 Part 7 specifies where dosing apparatus are needed and how they are to be operated.

The decision as to whether the installation of dosing apparatus is required shall be taken on the basis of local conditions (e.g. water quality, materials used, system layout, service conditions).

8.2.2 Size of apparatus

The size of dosing apparatus shall be selected as a function of the measured or probable peak flow in the system (in m^3/h) and the likely average monthly water consumption (in m^3).

In the absence of available data on the probable water consumption, a consumption 120 m^3 per year for each dwelling shall be assumed, if both cold and hot water, and 60 m^3 per year if only water feeding the hot water system is to be treated.

The upper working limit of the dosing apparatus, in m^3/h, shall be at least equal to the peak flow rate determined in accordance with DIN 1988 Part 3.

The dosing volume per filling (as specified in DIN 19 635) shall not exceed the probable consumption of water in a six-month period.

8.2.3 Installation

Only dosing apparatus bearing the DIN/DVGW test mark shall be installed, no additional safety devices being required for this equipment in accordance with DIN 1988 Part 4.

If the dosing apparatus is intended to treat all the drinking water supplied, it shall be installed downstream of the water meter, and of the filter and any pressure reducing valve.

If only water feeding the hot water system is to be treated, the dosing apparatus shall be installed upstream of the valve assembly in the cold water feed to the water heater.

Dosing apparatus shall be operated and inspected as specified in DIN 1988 Part 8.

8.3 Water softeners

8.3.1 Criteria for use

DIN 1988 Part 7 specifies where water softeners to prevent scale formation are needed and how they are to be operated. The decision as to whether the installation of softeners is required shall be taken on the basis of local conditions (e.g. water quality, materials use, system layout, service conditions).

The complete water supplied should not be softened.

For particular applications (e.g. photographic developing equipment, swimming pools, washing machines), drinking water not intended for heating may be softened. The maximum sodium chloride content of 150 mg/l permitted by the *Trinkwasserverordnung* shall not be exceeded if a softener is installed in a drinking water supply system.

8.3.2 Softener size

The softener size shall be selected as a function of the nominal flow rate, the softener, however, being capable of accommodating flow peaks.

The nominal capacity (which is expressed in mols of alkaline earths, as specified in DIN 19 636) shall not exceed the values specified in table 7 for an assumed daily consumption of 80 l per person for softening the water to be used for heating, washing machines and dishwashers.

Table 7. **Maximum nominal capacity of water softener and required quantity of resin for a water consumption of 80 l per person and day, as a function of the type of building**

Type of building	Maximum nominal capacity, in mol	Required resin quantity*), in l, ≈
Single and two family housing (up to 5 persons)	1,6	4
Three to five family housing (up to 12 persons)	2,4	6
Six to eight family housing (up to 20 persons)	3,6	8
Nine or more family housing (more than 20 persons)	8,0	15
*) According to the current state of the art.		

If a water quantity greater than that specified in table 7 is to be softened, the maximum nominal capacity of the softener shall not exceed 1,5 times the values given in table 7.

8.3.3 Installation

Only softeners bearing the DIN/DVGW test mark shall be installed, no additional safety devices being required for this equipment in accordance with DIN 1988 Part 4.

The pipe shall be provided with a free outlet to drain away the flushing and regeneration water as specified in DIN 1988 Part 4.

If only water feeding the hot water system is to be treated, the softener shall be installed upstream of the valve assembly in the cold water feed to the water heater. If the softener is intended partially to soften the drinking water, the appliance shall be installed downstream of the water meter, any filter and any dosing apparatus.

Water softeners shall be operated and inspected as specified in DIN 1988 Part 8.

9 Water meters and pressure gauges

9.1 Water meters

9.1.1 Concepts and requirements

Cold water meters are flowmeters designed for water at a temperature of up to 30 °C. They shall comply with section 1 of appendix 6 to the *Eichordnung* (German Weights and Measures Regulation) and with ISO 4064 Part 1.

Heated water meters are flowmeters designed for water with a maximum temperature of 90 °C.

Hot water meters are flowmeters designed for water at a temperature above 90 °C.

Heated water meters and hot water meters shall comply with section 2 of appendix 6 to the *Eichordnung*.

All types of water meter require type approval.

Water meters shall be calibrated or verified if they are used for revenue charging purposes.

9.1.2 Installation

Water meters shall be installed inside a building, near the wall closest to the road, protected against frost, and be easily accessible so as to facilitate reading, replacement and inspection.

Water meters are part of the water meter assembly which, viewed in the direction of flow consist of

a) inlet stopvalve (may be identical with service stopvalve);
b) straight length of pipe;
c) water meter;
d) connector, variable in length, or flexible joint;
e) outlet stopvalve;
f) check valve.

Mounting fixtures shall be installed in new assemblies and if old systems are altered.

Mounting of water meter assemblies shall ensure that stresses induced on removal of the water meter can be accommodated by the remaining pipework.

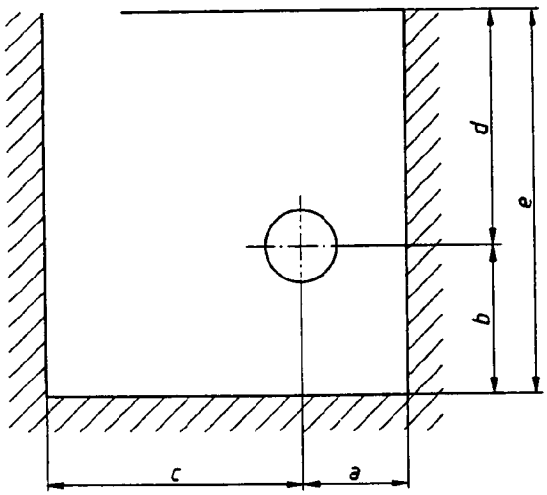
The water meter assembly shall be installed in the room in which the service pipe enters the building.

Water meter assemblies shall be designed so that water that escapes when the water meter is replaced is collected and drained away.

For health reasons, use of fixed bypass pipes is not permitted.

When installing Woltman meters, the following stipulations of appendix 6 to the *Eichordnung* shall be complied with.

a) A straight run of pipe with a nominal size equal to that of the meter and a length equal to at least three times its size shall be installed upstream of the meter.
b) If pipe bends are located in the pipe immediately upstream of the pipe run where meters with a wheel axis perpendicular to the pipe axis, the length of the pipe run shall be at least five times its nominal size, or a device compensating for irregularities in the flow velocity distribution shall be installed. To facilitate replacement of the meter, the length of the pipe run upstream of the meter shall generally be equal to five times its size.
c) If stopvalves (used to control water flow in operation), centrifugal pumps or offsets are located in the pipe immediately upstream of the pipe run, a flow rectifier suitable for controlling the turbulence caused by these appliances shall also be installed upstream of the pipe run.



See table 8 for dimensions.

Figure 23. Design clearances for water meter installations

d) Gate valves may be installed immediately upstream or downstream of Woltman meters if they are always fully open in operation.

e) There shall be no sudden restriction in cross section immediately downstream of Woltman meters (except for combined meters).

There shall be adequate clearance between the meter assembly and the adjacent walls and floor for easy installation, fixing, supporting, as well as reading and replacement of the meter.

The installation dimensions shall be as specified in figure 23 and table 8.

Any chamber or pit inside or outside the building accommodating the water meter assembly shall be constructed in accordance with *DVGW-Arbeitsblatt* W 355.

For service pipes of nominal size up to and including DN 40, the chamber shall be 1200 mm in length, 1000 mm in breadth, 1800 mm in depth and have a 700 mm × 700 mm square or a 700 mm diameter circular access opening (all dimensions are clear dimensions).

The meter chamber for service pipes larger than DN 40 shall be designed to comply with the installation dimensions specified in table 8.

Meter chambers shall not be located in traffic areas. They shall be easily accessible and, in accordance with the relevant accident prevention regulations, be provided with ladders, or steps for service pipes of size DN 100 or larger.

No foul water pipes shall pass through the chamber; gas pipes, high voltage and low voltage cables, etc. shall only pass through it if ducted.

Potential equalizing bars and cross bonds, if required, shall be so arranged that they do not obstruct work on the water meter assembly.

9.1.3 Apartment water meters

Provision shall be made for the installation of a separate water meter in each apartment in apartment blocks.

9.2 Pressure gauges

It is recommended that either pressure gauges or a DN 15 pressure tapping be installed in the service pipe.

10 Protective measures

10.1 Safeguarding against electric shock

Before disconnecting or jointing metal pipes, the joint zone shall be bridged by a metal conductor unless a bond already exists (e.g. in the form of a meter yoke), to provide protection against electric shock or sparking.

Electrical cross bonding using screw terminals shall be designed as follows.

A highly flexible, insulated copper braid complying with DIN 46 440 with a cross section of at least 16 mm^2 and a maximum length of 3 m shall be used as the cross bond, the terminals being selected to suit the pipe diameter. To ensure a good electrical contact between pipe and terminals, the pipe surface shall be abrasively cleaned prior to fitting the terminals. Use of metallic foil to improve contact is not permitted. Safeguarding against electric shock shall be the responsibility of a qualified electrician in new buildings, the same applying to existing buildings undergoing substantial alterations.

Metal service and supply pipes shall only be replaced by pipes made from electrically nonconductive materials after a qualified electrician has established that the electrical safety is not affected (cf. subclause 4.5 of DIN VDE 0190, May 1986 edition). Where isolators are to be installed in existing pipework, the householder is to be informed of the nature of the work so that he may advise the electrician accordingly.

Table 8. **Installation dimensions for water meter assemblies**

Dimensions		Requirements	
		Flowmeters, vane type water meters	Woltman meters
a	Minimum clearance to wall (from pipe axis)	Equal to maximum nominal size of service pipe plus 200 mm*).	
b	Clearance to floor (from pipe axis)	Equal to maximum nominal size of service pipe plus 300 mm, but not larger than 1200 mm.	
c	Minimum clearance in front of water meter assembly (related to pipe axis)	800 mm.	Equal to maximum nominal size of service pipe plus 1200 mm.
d	Minimum clearance above water meter assembly (related to pipe axis)	Equal to maximum nominal size of service pipe plus 700 mm.	
e	Minimum room height	1800 mm clear height.	
*) This clearance may be smaller if a water meter yoke is used.			

10.2 Insulation of pipes

10.2.1 General

Pipe insulation shall be designed to meet the following requirements.

a) Legal and other obligations (e.g. those in the *Länder* building regulations) shall be complied with.

Note. DIN 4140 Parts 1 and 2 do not apply to drinking water supply systems.

b) Insulating materials shall be adequately protected against moisture.

c) The insulating material shall ensure that the water is maintained at the designed operating temperature.

The insulating effect is mainly a function of the thickness of the insulation and its thermal conductivity, and increases in direct proportion to the temperature. The performance of insulating materials is impaired if they are moist. Open-cell and fibrous insulating materials shall be provided with a vapour barrier bonded to the outer surface of the insulation.

Condensation can form on any insulating material if the cold water pipes are inadequately lagged; in the case of unsuitable materials, this may lead to the moisture penetrating to the pipe. Thus, closed-cell materials with a high moisture resistance should be used to insulate cold water pipes.

All butt joints, cuts, seams and ends shall be sealed.

If pipes are located in areas where frost damage is likely, even insulation cannot always prevent freezing if the system is not in service. The pipes shall, therefore, be drained or otherwise protected.

10.2.2 Protection of cold water systems against warmth and condensation

Cold water pipework shall be adequately protected against heat sources and condensation, if necessary.

Cold water pipes shall be installed sufficiently clear of heat sources (e.g. hot pipes, chimneys, boilers). Where this is not possible, the pipes shall be insulated so that the water quality is not impaired by warmth.

For residential applications, the insulation thickness specified in table 9 shall be used, assuming normal service conditions. Insulation will not provide permanent protection of the water against warmth.

The specifications of table 9 are also applicable where the protection against condensation on the outer surface of the insulation is concerned, assuming a water temperature of 10 °C.

Protection against condensation is not required if the pipe is provided with a suitable sheathing (e.g. ducted pipe).

10.2.3 Protection of hot water pipes against heat loss

The minimum requirements specified in the *Heizungsanlagen-Verordnung* (Heating Systems Regulation) shall be complied with for restricting the heat loss of hot pipes, including circulation pipes.

10.3 Noise control

The DIN 4109 series of standards shall apply in respect of noise control. These standards specify permissible noise levels in rooms requiring sound insulation and give details of the design, installation and operation of systems and of methods of verifying the sound insulation provided (cf. *ZVSHK-Merkblatt*[3]).

10.4 Structural fire protection

Structural fire protection is covered by the *Länder* building regulations.

For [3], see page 6.

Table 9. **Recommended minimum thickness of insulation for cold water pipes**

Location of pipe	Thickness of insulation, in mm, for $\lambda = 0{,}040$ W/(mK)*)
Exposed pipes, in unheated room (e.g. cellar)	4
Exposed pipes, in heated room	9
Ducted pipes (cold water only)	4
Ducted pipes (cold and hot water)	13
Chased pipes, risers	4
Pipes in wall recess, next to hot pipes	13
Pipes on concrete floor	4

*) For other values of λ, the thickness is to be obtained by conversion, on the basis of a pipe diameter of 20 mm.

11 Testing, flushing and commissioning

11.1 Filling and testing the system

For pressure testing, pressure gauges that allow reading of changes in pressure of 0,1 bar shall be used, fitted at the lowest possible point in the system.

11.1.1 Steel pipes and copper pipes

For the purposes of leakage testing, the finished pipework, whilst still accessible, shall be filled with filtered water, completely vented and subjected to a test pressure equal to 1,5 times the permissible working pressure.

Where there are considerable differences (about 10 K) between the ambient temperature and the water temperature, a period of 30 minutes shall be allowed to permit temperature equilibrium to be established once the test pressure has been applied. Following that, the pressure shall be maintained for ten minutes. Over this period, there shall be no pressure drop or signs of leakage.

11.1.2 Plastics pipes

Owing to their material properties, plastics pipes expand when subject to pressure, which influences the test result.

This may also be affected by differences in temperature of pipe and test medium resulting from a high thermal expansion coefficient of the pipe material, a change in temperature of 10 K corresponding to a pressure change of 0,5 to 1 bar. Thus, the test medium shall, as far as possible, be kept at constant temperature throughout the test.

11.1.2.1 Test procedure

Whilst still accessible, the finished pipework shall be filled with filtered water and completely vented.

Pressure testing shall be carried out in two stages, the first stage being sufficient for smaller sections of the system (e.g. for the test of supply pipes and branch pipes in wet rooms).

a) For the first stage, a test pressure equal to the permissible working pressure plus 5 bar shall be produced twice within 30 minutes at 10-minute intervals. Then it shall be checked whether, over a further period of 30 minutes, the pressure has dropped by more than 0,6 bar (with a rate of 0,1 bar per minute) and leakage has occurred.

b) The second stage shall follow the first stage without interval and shall last two hours. Then, it shall be checked whether the pressure has dropped by more than 0,2 bar and the pipework shows any signs of leakage.

11.2 Flushing the pipework

Drinking water pipes shall be thoroughly flushed as soon after pipe laying as possible and immediately after pressure testing.

Cold and hot water pipes shall be flushed separately using a water/air mixture, intermittently under pressure. If possible, water from the mains should be used for flushing, the minimum flow rate in the largest pipe being 0,5 m/s. This requires a certain number of taps (cf. table 10) to be open. A reservoir and pump are to be used for flushing if the maximum flow rate is not achieved when the pipework section tested is completely filled. The water used for flushing shall be filtered.

The compressed air (e.g. supplied from cylinders or from compressors) shall be available in sufficient quantity and in a quality harmless to health (e.g. oil-free), with the air pressure equal at least to the static pressure of the water.

The system shall be flushed in sections depending on its size and layout, no section exceeding 100 m of pipe run. The direction of flushing shall be from bottom to top and the sequence of flushing, by riser, from the closest to the most remote. Each riser shall be flushed from bottom to top, storey by storey. At least as many taps per storey as specified in table 10, normally all the taps, shall be opened, one after the other, starting with the most remote one. The flushing period is a function of the length of pipe run and shall be not less than 15 seconds per metre and not less than two minutes per draw-off point. After flushing with the last tap opened, the taps shall be closed in reverse sequence. The flushing effect shall be reinforced by periodic opening and closing of the air and water supply at regular intervals, pressure surges produced by rapid opening and closing valves (e.g. globe valves) having proved particularly effective. For manual operation of the taps, an 'open' interval of about five seconds and a 'closed' interval of less than two seconds are recommended.

Table 10. **Minimum flow rate and minimum number of draw-off points to be opened for flushing (with a minimum flow rate of 0,5 m/s)**

Maximum nominal size DN	25	32	40	50	65	80	100
Minimum flow rate with the pipework section completely filled, in l/min	15	25	38	59	100	151	236
Minimum number of DN 15 taps to be opened	1	2	3	4	6	9	14

A higher pressure surge frequency may be generated by automatic flushing (e.g. by using a special flushing appliance in accordance with the manufacturer's instructions).

Figure 24 shows an example of an arrangement for intermittent flushing of the pipework.

To protect sensitive valves and appliances (e.g. water heaters) from damage by solid matter flushed into them, such components should only be installed after flushing, interim fittings being used instead during pressure testing.

System sections with covered valves and pipe runs with a nominal size larger than DN 50 may be flushed by the method described above until suitable interim fittings or flushing appliances are available.

11.3 Preparation for commissioning and handover

The system installer shall prepare handover and acceptance reports. He shall also make available the servicing and operation instructions supplied by the manufacturers of the safety devices (cf. DIN 1988 Part 8).

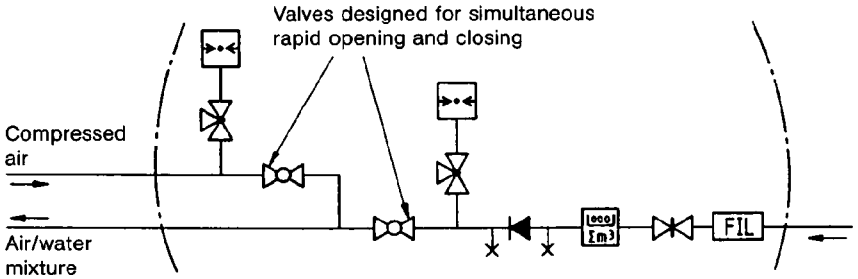


Figure 24.
Arrangement for intermittent flushing of pipework

Standards and other documents referred to

DIN 825 Part 1	Nameplates; dimensions of square and rectangular nameplates
DIN 1053 Part 1	Masonry; design and construction
DIN 1986 Part 1	Site drainage systems; principles, design and installation
DIN 1988 Part 1	Drinking water supply systems; general (DVGW Code of practice)
Supplement 1 to DIN 1988 Part 2	Drinking water supply systems; summary of standards and other technical rules relating to materials, components and appliances (DVGW Code of practice)
DIN 1988 Part 3	Drinking water supply systems; pipe sizing (DVGW Code of practice)
Supplement 1 to DIN 1988 Part 3	Drinking water supply systems; examples of calculation (DVGW Code of practice)
DIN 1988 Part 4	Drinking water supply systems; protection of drinking water and drinking water quality control (DVGW Code of practice)
DIN 1988 Part 5	Drinking water supply systems; pressure boosting and reduction (DVGW Code of practice)
DIN 1988 Part 6	Drinking water supply systems; fire fighting and fire protection installations (DVGW Code of practice)
DIN 1988 Part 7	Drinking water supply systems; measures for the prevention of corrosion and scale formation (DVGW Code of practice)
DIN 1988 Part 8	Drinking water supply systems; operation (DVGW Code of practice)
DIN 2401 Part 1	Components subjected to internal or external pressure; pressure and temperature data; terminology; pressure ratings
DIN 2690	Gaskets for PN 1 to PN 40 flanges with flat facing
DIN 2999 Part 1	Whitworth pipe threads for threaded pipes and fittings; parallel internal threads and taper external threads; thread dimensions
DIN 3266 Part 1	Valves for domestic drinking water installations; PN 10 pipe interrupters, pipe disconnecters, anti-vacuum valves
DIN 3269 Part 1	Valves for domestic drinking water installations; PN 10 check valves; requirements
DIN 3389	Ready-to-install isolators for gas and water service pipes; requirements and testing
DIN 3440	Temperature control and limiting devices for heat generating systems; safety requirements and testing
DIN 3512	Stopvalves for domestic drinking water systems; PN 10 in-line valves with vertical bonnet
DIN 3754 Part 1	Gaskets; It gaskets; dimensions, requirements and testing
DIN 4067	Water; information plates for local and long-distance water service pipes
DIN 4109 series	Noise control in buildings
DIN 4140 Part 1	Insulation of service installations; thermal insulation
DIN 4140 Part 2	Insulation of service installations; low temperature insulation
DIN 4708 Part 2	Central water heating systems; determination of the energy required to heat water for residential buildings
DIN 4751 Part 2	Safety equipment for heating installations with flow temperatures up to 110 °C; vented and unvented hot water systems up to 300 000 kcal/h with thermostatic protection
DIN 4753 Part 1	Water heaters and hot water systems for drinking water and service water; design, equipment and testing
DIN 4753 Part 2	Hot water systems for drinking water and service water; certification procedure for water heaters and hot water systems
DIN 4753 Part 3	Water heaters and hot water systems for drinking water and service water; corrosion protection on the water side by enamelling; requirements and testing
DIN 4753 Part 4	Water heating installations for drinking water and service water; corrosion protection on the water side by means of thermosetting resin bonded lining materials; requirements and testing
DIN 4753 Part 5	Water heating installations for drinking water and service water; corrosion protection on the water side by natural or synthetic rubber coatings; requirements and testing
DIN 4753 Part 6	Water heating installations for drinking water and service water; cathodic corrosion protection of enamelled steel vessels; requirements and testing
DIN 4753 Part 7	Water heating installations for drinking water and service water; corrosion protection on the water side by corrosion-resistant metallic materials; requirements and testing
DIN 4753 Part 9	(at present of the stage of draft) Water heating installations for drinking water and service water; corrosion protection on the water side by means thermoplastic coatings; requirements and testing
DIN 4753 Part 10	(at present at the stage of draft) Water heating installations for drinking water and service water; cathodic corrosion protection for uncoated steel vessels; requirements and testing
DIN 4753 Part 11	(at present at the stage of draft) Water heating installations for drinking water and service water; transfer medium heat exchangers; requirements, testing and marking
DIN 4844 Part 1	Safety marking; concepts, principles and safety signs
DIN 18 012	Services entry rooms in buildings; design principles
DIN 19 532	Unplasticized polyvinyl chloride (PVC-U) pipes for drinking water supply systems; pipes, fittings and pipe joint assemblies (DVGW Code of practice)

DIN 19 533	Rigid and plasticized polyethylene (PE-HD and PE-LD) pipes for drinking water supply systems; pipes, fittings and pipe joint assemblies
DIN 19 630	Installation of water pipes (DVGW Code of practice)
DIN 19 632	Mechanical filters for drinking water systems; requirements and testing (DVGW Code of practice)
DIN 19 635	Dosing apparatus for drinking water treatment; operation, requirements and testing (DVGW Code of practice)
DIN 19 636	(at present at stage of draft) Water softeners (cation exchangers) for drinking water treatment; requirements, testing and operation (DVGW Code of practice)
DIN 28 617	Gaskets for cast iron pressure pipes and fittings for use in water supply systems; requirements and testing
DIN 30 660	Sealants for use in gas and water supply and hot water systems; non-curing sealants for metal threaded pipes in domestic installations
DIN 46 440	Braided copper wires
DIN 50 930 Part 3	Corrosion of metals; corrosion behaviour of metallic materials in contact with water; assessment criteria for hot dip galvanized ferrous materials
DIN 52 218 Part 2	Testing of acoustics in buildings; laboratory measurement of noise emitted by appliances and equipment used in water supply systems (identical with ISO 3822/2, 1984 edition)
DIN VDE 0190	Inclusion of gas and water services in the potential equalization of electrical installations (DVGW Code of practice)
DIN VDE 0700 Part 1	Safety of household and similar electrical appliances; general requirements (modified version of IEC 335-1)
DIN VDE 0700 Part 15	Safety of household and similar electrical appliances; appliances for heating liquids (modified version of IEC 335-2-15, 1980 edition)
DIN VDE 0700 Part 21	Safety of household and similar electrical appliances; hot water storage cisterns and hot water boilers (modified version of IEC 335-2-21)
DIN VDE 0700 Part 35	Safety of household and similar electrical appliances; instantaneous water heaters
DIN VDE 0700 Part 243	Safety of household and similar electrical appliances; heat pumps for water heating purposes
DIN VDE 0700 Part 600	Safety of household and similar electrical appliances; connection to hot water systems, washing machines and dishwashers
ISO 228 Part 1	Pipe threads where pressure-tight joints are not made on the thread; designation, dimensions and tolerances
ISO 4064 Part 1	Measurement of water flow in closed conduits; meters for cold drinking water; specification
ISO 7001	Public information symbols
DVGW-W 328**)	*Ausführung von Trinkwasserleitungsanlagen aus PVC hart innerhalb von Gebäuden* (Installation of rigid PVC drinking water pipework inside buildings)
DVGW-W 355**)	*Leitungsschächte* (Pipe ducts)
DVGW-W 521**)	*Gewindeschneidmittel; Anforderungen und Prüfung* (Thread cutting; requirements and testing)
DVGW-W 532**)	*Anforderungen und Prüfungen von Klemmverbindern aus Metall für Rohre aus VPE für die Trinkwasser-Hausinstallation* (Requirements and testing of metal clamps for cross-linked polyethylene (PE-X) pipes for domestic drinking water supply systems)
DVGW-GW 2**)	*Verbinden von Kupferrohren für die Gas- und Wasserinstallation innerhalb von Grundstücken und Gebäuden* (Jointing of copper pipes for domestic gas and water supply systems)
DVGW-GW 3**)	*Technische Regeln für Bau und Prüfung von vorgefertigten Bauteilen mit Gas- und Wasserinstallationen* (Code of practice for the installation and testing of prefabricated elements of gas and water pipework)
DVGW-GW 7**)	*Flußmittel zum Löten von Kupferrohren für die Gas- und Wasserinstallation; Anforderungen und Prüfbestimmungen für die Eignungsprüfung* (Fluxes for soldering copper gas and water pipes; requirements and suitability testing)
AD-Merkblatt A 2***)	*Sicherheitseinrichtungen gegen Drucküberschreitung; Sicherheitsventile* (Pressure-relief devices; safety valves)
AD-Merkblätter, HP series***)	
TRD 721***)	*Sicherheitseinrichtungen gegen Drucküberschreitung; Sicherheitsventile für Dampfkessel der Gruppe II* (Pressure-relief devices; pressure-relief valves for group II steam boilers)

ZVSHK-Merkblatt Vorwandinstallation; Sanitär- und Heizungsinstallationen im Mauerwerksbau unter Beachtung geltender Vorschriften und anerkannter Regeln der Technik (Surface-mounted installations; sanitary and heating installations in masonry construction on the basis of regulations and recognized rules of the art), August 1981 edition, issued by the *Zentralverband Sanitär Heizung Klima*

**) Obtainable from *Wirtschafts- und Verlagsgesellschaft Gas und Wasser mbH*, Postfach 14 01 54, D-5300 Bonn 1.

***) Obtainable from *Beuth Verlag GmbH*, Postfach 11 45, D-1000 Berlin 30.

RAL R 30.5.1***) *Dichtringe aus Elastomeren für Steckmuffenverbindungen bei Druckwasserrohren aus PVC hart mit dem Gütezeichen der Gütegemeinschaft Kunststoffrohre e.V.* (Elastomer seals for socket joints in PVC-U water pressure pipes bearing the *Gütegemeinschaft Kunststoffrohre e.V.* quality mark)

KTW-Empfehlungen des Bundesgesundheitsamtes, published in the *Bundesgesundheitsblatt* (German Federal Health Gazette), obtainable from *Carl Heymanns Verlag KG*, Luxemburger Straße 449, D-5000 Köln 41

*Heizungsanlagen-Verordnung zum Gesetz zur Einsparung von Energie in Gebäuden*****)

*Lebensmittel- und Bedarfsgegenständegesetz*****)

*Verordnung über energieeinsparende Anforderungen an heizungstechnische Anlagen und Brauchwasseranlagen*****)

*Eichordnung*****)

*Verordnung über Allgemeine Bedingungen für die Versorgung mit Wasser*****)

*Trinkwasserverordnung*****)

*Arbeitsstättenverordnung*****)

Other relevant standards and documents

DIN 2000	Central drinking water supply; basic requirements for drinking water; design, construction and operation of systems
DIN 2001	Private and individual drinking water supply systems; basic requirements for drinking water; design, construction and operation of systems (DVGW Code of practice)
DIN 4046	Water supply; terminology (DVGW Code of practice)
DIN 18 380	Tendering and performance stipulations in contracts for construction work (VOB). Part C: General technical specifications in contracts for construction works (ATV); installation of central heating and water heating systems
DIN 18 381	Tendering and performance stipulations in contracts for construction work (VOB). Part C: General technical specifications in contracts for construction works (ATV); installation of gas, water and drainage pipework inside buildings
VBG 74	*Leitern und Tritte* (Ladders and steps), October 1980 edition******)

Gerätesicherheitsgesetz (German Equipment Safety Law)*****)

Verordnung über Druckbehälter, Druckgasbehälter und Füllanlagen (Pressure Vessels Regulation)*****)

Previous editions

DIN 1988: 08.30, 09.40, 03.55, 01.62.

Amendments

In comparison with the January 1962 edition of DIN 1988, the contents of the standard has been expanded, completely revised and split up into DIN 1988 Parts 1 to 8.

Explanatory notes

This standard has been prepared by *NAW* Technical Committee IV 7 in close cooperation with the *DVGW Deutscher Verein des Gas- und Wasserfaches e.V.*

DIN 1988 now covers comprehensively the field of water supply systems by including the relevant DVGW Codes of practice in its specifications.

The problem of Legionellae is not specifically dealt with in this standard, as knowledge of this disease at the time of publication was not adequate to permit inclusion of concrete procedures to be specified for its prevention.

International Patent Classification

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B 08 B 9/06
C 02 F 1/00
E 03 B 7/04
E 03 C 1/02
F 16 L 15/00
F 17 D 1/00
F 24 H 1/00 – 1/44
G 05 B 9/00
G 09 F 7/12

For ***), see page 23.

*****) Obtainable from *Deutsches Informationszentrum für Technische Regeln (DITR)* of *DIN*, Burggrafenstraße 6, D-1000 Berlin 30.

******) Obtainable from *Carl Heymanns Verlag KG*, Luxemburger Straße 449, D-5000 Köln 41.