1. INTRODUCTION

Water supply companies and authorized installation companies undertake the important task of providing the consumers with drinking water. The water quality must be ensured from the water treatment side up to the point of supply. The Public Health Departments are responsible for monitoring the adherence to the quality requirements. The work of water supply companies and plumbers is thus subject to an official surveillance.

A hygienically perfect water supply depends on a large number of factors. A major point is the protection of the drinking water in the pipe system against contamination by non-drinking water. Possible protective methods are formulated in the national DIN 1988-4. In parallel to that standard, DIN EN 1717, which deals with this topic too, is already valid.

The Drinking Water Regulations request drinking water up to the point of supply (Figure: J. Scheele)

The following pages discuss the problems that arise in drinking water installations, and compare the standards for the protection of the drinking water. In addition to a presentation of the function and the installation of safety fittings, their situation-related selection is one of the main topics. A very imporant point is also the contractual agreement, since the standards cannot both be the basis of a contract.

This manual is intended to provide information and assistance for the protection of the drinking water in practical aplications. Important installation and selection criteria are clearly listed in tables. This shall enable the reader to determine quickly and safely the necessary safety fitting on site.

2. THE SIGNIFICANCE OF THE DRINKING WATER REGULATIONS FOR DESIGNERS AND PLUMBERS

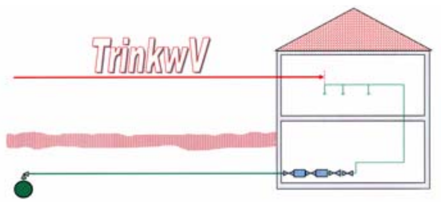
All creatures on the earth substantially consist of water, and are unable to survive witout water.

A drinking water expert who starts a discussion with the consumers of the precious liquid gets the impression that these consumers are not aware of the fundamental significance of this substance. And you can't even blame the water consumers for this "ignorance". In Germany, water is omnipresent. Since it is always available, it is taken for granted. A matter of course, however, is nothing special in the understanding of the consumer.

Water - omnipresent

The role of the water in the daily life becomes obvious when the water is shut down in a building - for repair purposes, for example. It does not even take 30 minutes until the first inhabitant comes down in the basement asking when the supply shortage will be over. While the inhabitant will presumably ask for "water", the expert must differentiate a little bit more clearly. The substance delivered to the parlour is not just water - it is drinking water.

The drinking water quality is described in DIN 2000 [1], and defined exactly by limit values in the Drinking Water Regulations [2]. From the water treatment side up to the point of supply, drinking water must comply with these requirements. The Drinking Water Regulations thus apply "up to the consumer's cup".



The Drinking Water Regulations (abbreviated TrinkwV) are in force since

Regularly inspected systems

The systems and pipes of the water supply company are subject to continuous supervision. The Drinking Water Regulations (TrinkwV) require systems on estates or in buildings that provide drinking water for the general public to be inspected once a year.

Unfortunately, the term "public system" is misleading. A public system in the sense of the Regulations is, for example, an old people's home. Which is everything but public! The proper meaning becomes more obvious when we understand a public system as a unit that provides for persons who need protection or change frequently.

Persons needing protection include children, ill or elderly persons since these persons are assumed to have a restricted physicogenic defensive power. Frequently changing groups of people can be found in restaurants or hotels, for example.

If a guest catches an infection here, he or she probably moved on already to a different hotel when the first symptoms of a disease become apparent. Localization thus becomes a time-consuming and awkward task. This shows the necessity of regular yearly inpections. If there are no reasons for major complaints inside a surveillance period of four years, defining longer inspection intervals is at the discretion of the Public Healt Department. However, even then the inspection period should not be longer than two years.

Sporadically inspected systems

The number of people in a residential building who suffer from a weakend immune system is not usually above average. Furthermore, there is a more or less invariable group of persons in such a building. The allocation of cause and effect in the event of a water-related desease (such as a legionella infection) is easy here. Authorities therefore request an inspection of the systems in private areas only if there seems to be a reason for it. However, this situation can arise faster that expected: An inspection is due if one of the inhabitants of a house addresses the Public Health Department, expressing a concern about the quality of the drinking water.

No right of continuance for drinking water systems

Even if everything was built according to the applicable rules - there is no right of continuance for drinking water systems (Figure: J. Scheele)

The Public Health Department merely order the inspection, they do not carry them out. The owner of the drinking water system must initiate the examination. The Public Health Department only accepts the result of the examination if the laboratory tasked with carrying out the examination has been approved for performing all necessary inspections. This is called an accredited laboratory. The operator of the drinking water system must notify the Public Health Department of the result of the examination inside of two weeks after the samples were taken.

The Public Health Department must be notified immediately if the examination yields the result that the water gives reasons for complaint. The Public Health Department then decides on the actions to be taken. In some cases, eliminating such a cause means restructuring the drinking water system.

Although there is a constructional right of continuance for old systems, this cannot expediently be employed. The Drinking Water Regulations do not describe the structure of a drinking water pipe - they define the quality requirements for the drinking water that comes out of this pipe. The regulations apply to food, not to a constructional system. If a pipe was installed according to the state-of-the-art valid at the time of installation, and the quality of today's drinking water has deteriorated, in terms of building regulations the pipe is actually protected by the right of continuance. However, it may no longer be used as a drinking water pipe.

People must have drinking water for personal hygiene, food preparation and cleaning dishes and washing. Consequently, the operator can not just declare the poor pipes in his or her house as domestic water pipes. There is need for action. Who does not act commits an offence: A person who intentionally provides water that does not comply with the Drinking Water Regulations as drinking water to a third party acts negligently. According to the Law for the Protection Against Infections, this is punished with a prison sentence up to one year or a fine.

Mistakes no longer go undetected

Mistakes that were made when the drinking water system was designed or installed, are frequently the reason of a poor drinking water quality. Since installation in residential buildings were not subject to official inspections until 2003, these mistakes remained undetected for a long time.

Today, the drinking water systems of the building are included in the scope of control of the Drinking Water Regulations. This drastically reduced the probability of planning and installation mistakes remaining undetected. In first instance, a mistake revealed during an inspection is the problem of the system operator. After all, he or she has control over the system. However, the operator is usually a layman. This is why he had his drinking water system set up by an expert. Consequently, he can assume that the expert designed everything such that there will permanently be drinking water available at the points of supply. If it emerges that this is not the case, the contract for services was not fulfilled: The order was "constructing a drinking water system". This fact results in civil claims against the performing specialist firm.

In this context, "discussing the price" will not do. A drinking water system that does not supply drinking water is useless. The specialist firm must modify it such that it fulfills its intended purpose. The resulting costs can be considerable. This means: A situation-related implementation of the Technical Rules is indispensable when building drinking water plants.

3. RISKS FOR THE DRINKING WATER SUPPLY

As described above, the perfect quality of the drinking water must be maintained up to the points of supply. Preventing the infiltration of non-drinking water into the drinking water system is a major prerequisite. The available protective measures and the proper selection of these measures are the main topics of this manual. Correctly used safety fittings, however, do not prove sufficient to ensure the drinking water quality in a house installation. If mistakes are made when a system is planned and installed, the drinking water is also jeopardized when non-drinking water cannot penetrate the system. Let's have a look at some typical installations that do not exactly contribute to maintaining the quality.

The material

Drinking water pipes carry food to the consumer. Already this aspect should make it obvious that pipes, fittings and faucets must be clean.

The way of handling material that can frequently be seen in practice does not fulfil this requirement. For example, pipes are unprotected when they are carried to the construction site on the roof rack of the sevice car - already blown through with city air. Arrived at the site, the pipes are usually stored in the basement of the new building, frequently right in the dirt. These are poor preconditions for a future drinking water pipe.

Pipes used for building drinking water systems must be protected against contamination by suitable packaging or caps (Figure: Polytherm)

It is obvious that you cannot expect "clinical working conditions" in a craft. But we already achieve a lot when we protect the material against easily avoidable pollution. For water supply companies it is a matter of course to protect pipes with caps until they are used.

Lead pipes should be removed from drinking water systems as quickly as possible (Figure: SBZ)

Besides the problem of the building-related pollution, there is the occasional "sin from past days" to be fought: The lead pipe. Up to 30 November 2013, a limit of 0.025 mg/l lead in the drinking water is tolerated. After that date, the upper limit is 0.01 mg/l. However, systems that consist in whole or partly of lead pipes are not even able to comply with today's limit.

Obviously, removing existing lead pipe installations at once is impossible. In cases where this cannot be done, metering units should be used for adding orthophosphates of the maximum permissible concentration on 6.7 g/m³ in order to keep the drag-out of lead at a minimum. The people living in the building must be informed about the added chemical substance.

Excessive pipe dimensions

Drinking water is perishable food, and does not keep forever. This is why adequate water change must be ensured in all parts of the system. The drinking water pipes must therefore be dimensioned according to the requirements.

Unfortunately, the nominal witdth of the pipes were frequently merely estimated in the past, or a "panic supplement" was added. Frequently, this produced pipes that were larger than necessary. A hygienically acceptable water change was often more than doubtful.

This problem exists as an "abandoned pollution" in systems with fire-extinguishing pipes, in particular. DIN 1988-6 [4], which was valid until April 2002, virtually decreed excessive pipe dimensions. With respect to the installation of fire-extinguishing pipes, minimum nominal diameters were specified according to the number of wall hydrants. To feed four wall hydrants, for example, a DN 80 pipe was compulsory. A fire-extinguishing pipe of such a nominal width, which is a part of the house installation for the supply of drinking water, is much too voluminous for normal operation. A sufficient water change that protects against stagnation, can rarely be achieved in an office building, for example, where only a few toilets and kitchenettes are connected.

A water change according to the old standard would be adequate if 1.5 times the pipe contents were changed per week at a minimum of 20 per cent of the designed volume flow of the wall hydrant. Instead of feeding the entire sanitary installation via the fire-extinguishing pipe, there is frequently just one single kitchenette at the end of the pipe. These 4.2 liters per minute that can be taken out of the system in the kitchen at the most, are opposed to the requirement of 300 liters per minute and more for fire fighting. There surely can not be any adequate water change.

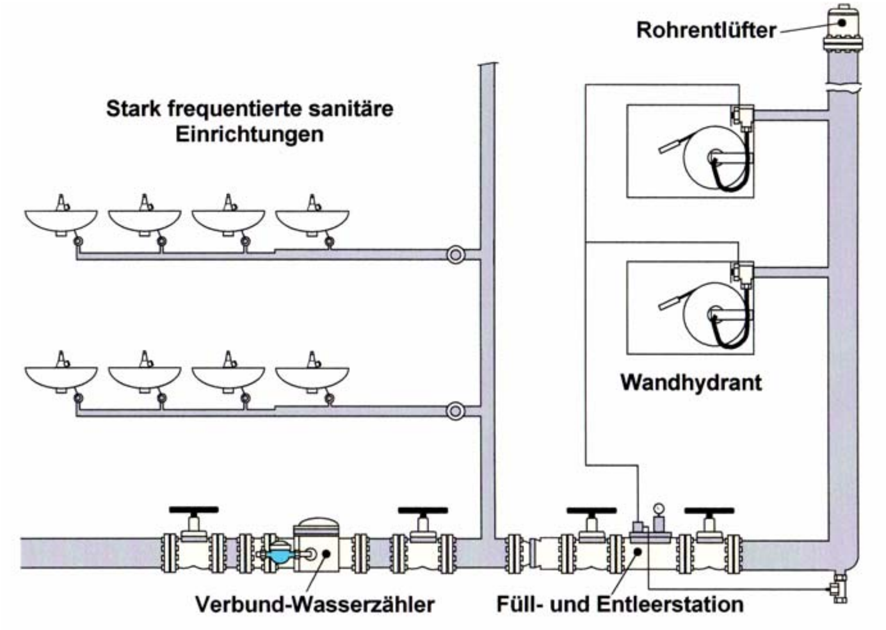
Fire-extinguishing pipes frequently require a nominal width that does not permit the pipes to be flushed sufficiently by the normal water consumption of a house (Figure: J. Scheele)

Stagnation in feeder pipes

The new DIN 1988-6 [5], too, can only provide a partial solution of the stagnation problem in fire-extinguishing pipes. The requirement for minimum nominal diameters for fire-extinguishing pipes no longer exists. And wall hydrants may only be connected to the drinking-water-carrying pipes when the volumetric flow rate of the connected sanitary equipment exceeds the volumeric flow rate required for the fire-extinguishing water.

If, however, wall hydrants are employed that shall be used by the fire brigade, the water flow required here can hardly be achieved via a "normal" water consumption. These hydrants must be fed with 100 liters per minute each. It must also be agreed how many of the existing wall hydrants are to be used simultaneously. If the required fire-extinguishing water volume exceeds the drinking water volume, the fire-extinuishing pipe is no longer allowed to carry drinking water.

This situation quickly takes us to the idea of separating the systems for drinking water and fire-extinguishing water. However, the assumption of having solved all problems is not justified. If fire-extinguishing water is not required, there will be no water flow in the feeder pipe to the indirect connection. The stagnation problem is thus shifted to the point before that connection.



If the systems for drinking water and fire-extinguishing water are separated via a filling and draining station, there must be an adequate water change up to a point immediately before the fitting (Figure: J.

If the fire-extinguishing water pipe is not a drinking water pipe, at least 1.5 times the pipe contents must be changed per week, at a minimum of 20% of the designed volume flow, in the feeder pipe to the indirect connection of the wet pipe and/or in the feeder pipe to the filling and draining station of the wet/dry fire-extinguishing pipe. In other words: An adequate volume flow must be "tapped off" the end of the feeder pipe.

Rarely used or unused pipe sections

More complicated is the water supply of rarely used points of supply. These include, for example, guest toilets or occasionally used rooms, such as cellar bars.

Care should also be taken with the point of supply in the garden. In order to save the trouble of closing and draining the pipe, frost-free closing valves are installed frequently.

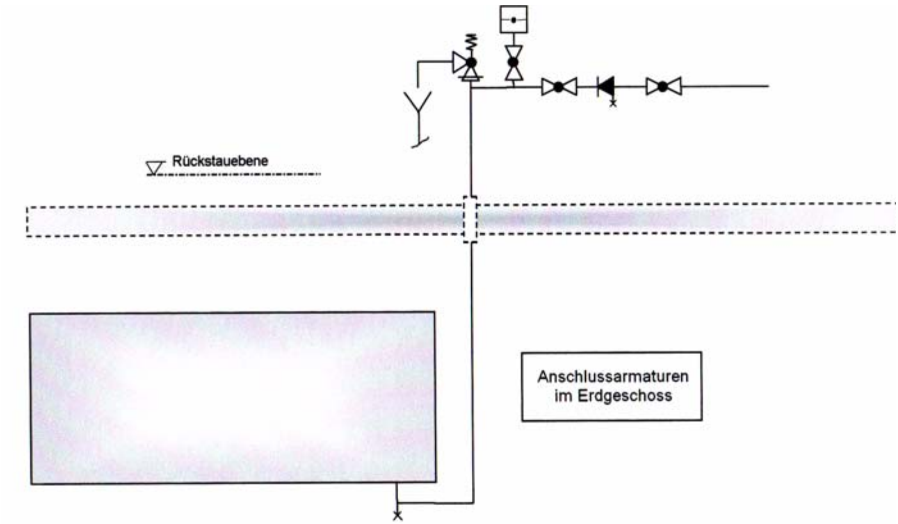
This eliminates the risk of frozen pipes, but not the risk of stagnation. At low outside temperatures, neither the garden is watered nor the patio swept - the water remains still in the feeder pipe. Providing such connections with feeder and return pipes helps. One solution could be to route the water to the kitchen first via the connection of the frost-free outdoor closing valve.

There are serious doubts about drinking water coming out of this point of supply of the bar sink in a forgotten cellar bar (Figure: J. Scheele)

This hygienical necessity shows that a mere "plugging off" of no longer needed points of supply or to "stock" drinking water pipes is not permitted. Such pipes, which are in connection with the drinking water system offer bacteria ideal living conditions. Installing reserve pipes for future use is possible - as long as such pipes are not yet connected to the drinking water system. In most cases this can be done without any problems: The pipes for a future conversion of the attic may be preinstalled, but end at an accessible point in the cellar - ready to be connected to the drinking water system by the plumber when the moment comes.

Long pipes to safety fittings

DIN 1988-2 [6] does not limit the length of the feeder pipe to the safety valve of a drinking water heater. The safety valve can be found above the heater or even on a different floor. The reason for this recommended installation was the former assumption that a steady dripping of the safety valve prevents the production of stagnation water. Today we know that there is actually no stagnation water in those pipes - but the length of pipe offers bacteria ideal living conditions. The bacteria (legionella, for example) prefer the inside pipe surface at these points. Since the safety valve merely drips, the flow rate is very low which makes "living" there very cosy. If the valve is to be arranged above the heater, the cold water supply must also be from above. Thus there is an adequate flow in the pipe up to a point immediately before the valve.



There must always be an adequate flow in the feeder pipe to the savety valve (Figure: J. Scheele)

The stilling section towards the pipe aerator at the end of the rising pipe is another stagnation section that was requested by the former standard. Here, the feeder pipe without connection should be at least 50 cm long. Since a pipe aerator is usually closed, the water in these pipe sections frequently stays there for a lifetime.

Circulation, but no equalization

The control options of the Drinking Water Regulations also discover the "sins of the past" in water heating. With a central hot water supply, the problem starts in the basement. Frequently, the drinking water heaters of the systems are overdimensioned. Adequate water change is seldom reached and leads - with a non-uniform heating of the boiler - to a legionella problem.

Missing, incomplete or inadequate heat insulation of the hot water pipes additionally care for the legionellae to feel comfortable in the pipe system. Due to the water meters, generously dimensioned floor piping is not included in the circulation system. Here, too, dropping water temperatures mean that a contamination risk is accepted.

Another problem is the missing hydraulic equalization of circulation systems: If several hot water rising pipes are installed with circulation, the system is largely ineffective without a hydraulic equalization via pipe system regulation valves. Only equalization ensures that the water temperature at any point in the system does not drop below 55 °C.

4. STANDARDS FOR THE PROTECTION OF DRINKING WATER

To avoid a quality loss due to the penetration of non-drinking water, safety fittings must be installed at the points of supply at which non-drinking water could be pressed, sucked or flow back. The protective measures are regulated in the currently valid DIN 1988-4 [7]. Since May 2001, DIN EN 1717 [8] is available as a standard that also deals with measures for the protection of drinking water.

Replacement only possible in a package

Currently, both standards are valid in parallel. This is due to the fact that the EC members must convert approved EN standards into national Technical Rules (in Germany DIN-EN standards). At the same time, DIN 1988 with its eight parts is a block standard (also known as "package solution"). Only the entire standard can be declared invalid, not individual parts of it. Consequently, DIN 1988 can only be dropped when there are corresponding European equivalents for all eight parts.

And there is a good reason for it: The eight parts of DIN 1988 mesh like the gears of a clockwork. A partial replacement of individual parts of the standard would only be conceivable if a change did not affect this "mechanical system". This is why there are currently two standards that deal with the "protection of drinking water". There is only one problem - they contradict each other in some parts.

Agree only one standard in a contract for services

Frequently it is said that DIN-EN standards are not a patch on DIN standards. A prejudice that frequently results in the "European standards" being completely ignored. If, however, you dare looking at the DIN EN 1717 you will see that - compared with DIN 1988-4 - the requirements are higher. If ATV DIN 18381 [9] is used as the basis of a contract for services, both standards should be agreed in parallel. In terms of protection, both definitions cannot be fulfilled equally..

Example:

Situation 1:

For a temporary hose connection, the point of supply for filling the heating to DIN 1988-4 was only equipped with a backflow preventer. The customer complains that this installation is unsafe and does not fulfil the safety requirements of the "new" DIN EN 1717.

Situation 2:

The heating filling system was installed with a fixed connection and a pipe separator (or system separator) to DIN EN 1717. The customer complains that this is too expensive and that a "cheaper" backflow preventer to DIN 1988-4 would have been sufficient.

Prior to carrying out any work, the standard to be used must contractually be agreed on (Figure: ZVSHK)

It is obvious: Who takes both standards as the basis of the implementation, or picks the best parts for the current installation from both directives, can easily end up "between the standards" - acoording to the motto: Whatever you do - it's wrong. It is thus indispensable - diffferent to VOB - to agree on one of the two standards - DIN 1988-4 or DIN EN 1717 - as the contractual basis and consistently employ only one standard for the work.

Prefer DIN EN 1717

DIN EN 1717 should be preferred. If this standard is used for the safety fittings that have been tried and tested in Germany for a long time, the frequently feared break to the other parts of DIN 1988 does not happen. On the contrary: The new standard enables you to select the best protections in an even more dedicated way.

5. THE STANDARDS IN PRACTICE COMPARISON

In practice, people are frequently reluctant to take the step to the application of DIN EN 1717 [8]. After all, we are quite familiar with the "old" DIN 1988-4 [7] and expect something completely new from the European standard. This impression results from protections that are described in the standard, which are not yet employed in Germany up to now. However, if you bear in mind that there is no necessity to employ unusual safety options now, the differences between the standards are in the details. We want to show these details below.

Collective protections are obsolete

The reason for penetrating non-drinking water can be, that the water is pressed or sucked back or flows back. Points of supply at which this is possible are known as vulnerable points of supply. A vulnerable point of supply can be, for example, a mixing valve for filling the bath tub that is equipped with a shower head. It possesses a shower attachment that can drop into the tub and lie underneath the water surface. A safety device must prevent the water from the tub to be sucked into the shower attachment and thus into the drinking water pipe.

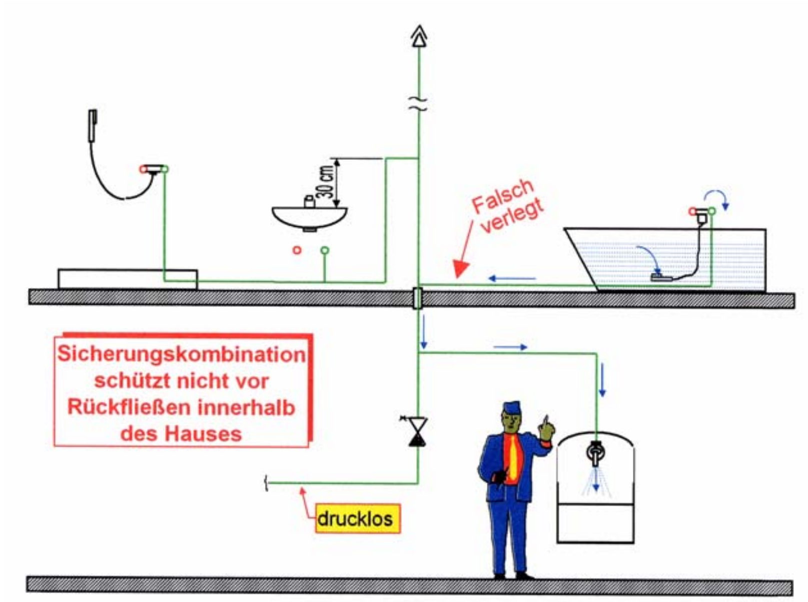
Vulnerable points of supply are, for example, points where the drinking water outlet can be below the level of the non-drinking water

Points of supply where non-drinking water cannot flow back into the pipe are safe points of supply. Such points of supply are, for example, wash basin tabs with a fixed outlet, or the flushing cistern of a toilet. In both systems, the water supply is above the level of the non-drinking water.

This point of supply is not vulnerable - as long as it is not misused (by placing a bucket underneath, for example)

Vulnerable points of supply must be protected with a safety fitting. There are two different possible implentation variants to DIN 1988-4. Protection is possible as an individual protection or as a collective protection. In an installation with individual protection, each vulnerable point of supply is allocated to its safety device. In an installation with collective protection, several or even all vulnerable points of supply of a system are protected by a safety fitting.

A widely used example of a collective protection is the utilization of a backflow preventer at the bottom of a rising pipe in conjunction with a pipe aerator at the end of the rising pipe. This tpye of protection has always been a problem since flowing or sucking back within the system in flow direction after the backflow preventer can never be excluded. This is why the term "drinking water system" already defines that this system ends at the free outlet or at the safety fitting. In the case decribed here, the drinking water system thus does not lead up to the points of supply - it ends at the backflow preventer at the foot of a rising pipe. If, for example, a pipe separator is installed immediately after the water meter in order to protect the entire building, the drinking water system according to the standard ends there. With respect to the Drinking Water Regulations, you quickly have a lot of explaining to do. These Regulations request that the drinking water system goes up to the point of supply.



A collective protection is not able to prevent flowing, sucking or pressing back in flow direction after the safety fitting (Figure: J. Scheele)

Collective protection is frequently the cause of problems concerning the water hygiene. Flowless feeders to pipe areators in the hot water system represent an ideal breeding ground for bacteria, such as legionellae. The DVGW working sheet W 551 [10] therefore requests the removal of pipe aerators when hygiene problems arise. Items that are to be removed from old systems should logically not be used at all for new systems.

Even more explicit is DIN EN 1717. It defines that safety devices must always be used as individual protection devices. The possibility of using a safety fitting in the domestic area as a collective protection is restricted to exceptions. This requirement is already implemented in practice: The manufactuers of branded fittings already offer the majority of their outlet fittings with integrated safety devices.

Increased safety standard when selecting safety fittings

The individual safety fittings feature different safety standards. It is thus possible that a backflow preventer, for example, does not close tightly and is not able to perform its task correctly. This is why it is only allowed to be used for protecting non-drinking water where a backflow is annoying, but not dangerous. Safety fittings of a very low failure probability must be installed if the drinking water is to be protected against hazardous non-drinking water. DIN 1988-4 specifies five different water classes to assess the non-drinking water that must be separated. Instead, DIN EN 1717 describes five different liquid categories. When we compare these definitions, we can see: Merely the name of the game was changed. The facts remained virtually unchanged: (*see Table 1, page 19)*

DIN EN 1717 merely tightens the liquid categories: The term "detrimental effect" cannot be found here.

DIN 1988-4, in contrast, differentiates class-2 water with respect to "detrimental effect" and "hazard". There is a hazard when the health of the water user can be affected detrimentally. A detrimental effect of the water means that the water has changed (odour, taste, colour), but does not have any effect on the health of the consumer. If you look exactly, you can see that a risk cannot be excluded with any detrimenal effect. It depends on the consumer whether or not a change in the water has a detrimental effect or is hazardous. While a glass of beer (class-2 water), for example, is harmless for an adult, it can be lethal for a baby.

The situation-related selection of the safety fittings is made according to the water class and/or liquid category of the non-drinking water against which protection is required. The water class is the sole selection criteria in DIN 1988-4.

In DIN EN 1717, there is another weighing factor in addition to the liquid category: The selection of the safety fitting also takes into account whether the non-drinking water can flow back, be sucked back or be pressed back. Under this aspect, some safety devices that may protect against flowing or sucking back up to liquid category five are not suitable if pressing back is to be expected. Example:

A pipe interruptor is a "length of pipe with holes". The negative pressure is reliably relieved through the holes if there is a suck-back effect in the drinking water pipe. Sucking in non-drinking water via the pipe interruptor is not possible. If, however, the non-drinking water is pressurized - due to faulty operation - and presses towards the drinking water pipe, part of it squirts out of the pipe through the holes of the pipe interruptor, but the non-drinking water cannot be prevented from entering the drinking water pipe.

Compared with DIN 1988-4, the second selection criterion to DIN EN 1717 thus provides a higher degree of protection. This degree of protection is further emphasized by the fact that there is no "temporary connection" in DIN EN 1717. It can only be found in DIN 1988-4. Here, safety fittings with a degree of protection can be used that is lower that the one required for a permanent connection, provided that the connection only exists for one working day and is continuously monitored during this time. The question is, why poisonous water, for example, is expected to be less hazardous when it is connected to the drinking water system for a maximum of one working day. The consideration of this fact already shows that it is a very good thing that DIN EN 1717 no longer contains the "temporary connection variant".

Notation system for international comprehensibility

The skilled DIN-1988 user is used to calling the individual safety fittings quasi "by their names". He knows backflow preventers, pipe separators, system separators, pipe interruptors etc. There are no problems with this in a national standard. It is more complicated on the international scene. Here, the initial standard (i.e. EN 1717) must finally be translated into the language of the respective member state. In this context, we find out that there is no English word for "Systemtrenner" [system separator]. We employ a notation system in order to preclude translation-related misunderstandings in such a situation.

This system allocated the safety devices to groups. Within the group, we differentiate according to types. The group and/or the type of the safety device has a letter allocated. The free outlet, for example, is allocated to group A. Depending on the version of the outlet, we distinguish between the types A - G. If, for example, you want to name the outlet found in a flushing cistern, you merely specify "safety device AA" and you know unambiguously what is meant. The following allocations are possible when you restrict yourself to the safety equipment that is common in Germany: (*see Table 2, page 20)*

Classification to DIN 1988 Part 4		Liquid categories to DIN EN 1717	
Class 1:	Without hazardous effect on the health and without detrimental effect (on taste, odour, or colour, for example).	**Category 1:**	Water for human use that is taken directly from a drinking water installation.
Class 2:	Without hazardous effect on the health, and with detrimental effect (noticeable by a change in taste, odour, or colour, for example).	**Category 2:**	Liquid that does not represent a hazard to human health. Liquids that are suitable for human use, including water from a drinking water installation, which may show a change in taste, odour, colour or temperature (heated or cooled).
Class 3:	With a health hazard from little poisonous substances. These are substances that are not to be allocated to Class 4.	**Category 3:**	Liquid that represents a hazard to human health by the presence of one or more less poisonous substances.
Class 4:	Hazard to human health due to poisonous, very poisonous, carcinogenous or radioactive substances (danger to life).	**Category 4:**	Liquid that represents a hazard to the human health due to the presence of one or several poisonous or very poisonous substances and one or several radioactive, mutagenic or carcinogenous substances.
Class 5:	With a health hazard due to pathogens of infectous diseases (epidemic, danger to life).	**Category 5:**	Liquid that represents a hazard to human health by the presence of microbial or viral pathogenic agents causing infectious diseases.

Table 1: Classification vs liquid categories

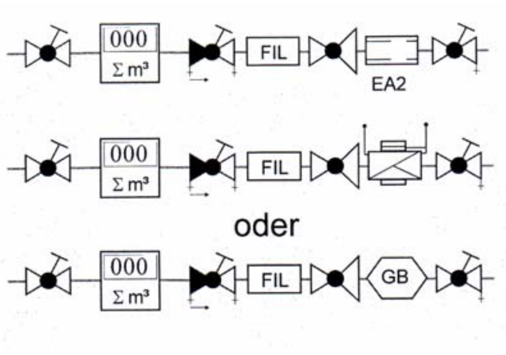
DIN EN 1717		DIN 1988-4
Name	**Safety device**	**Safety device**
AA	Unobstructed free outlet	Free outlet
AB	Free outlet with a non-circular overflow (unrestricted)	Free outlet (only at the manufacturer side in intrinsically safe washing machines and dishwashers)
BA	Pipe separator with controllable medium pressure zone	System separator with measurable medium pressure zone[1)] *1) Not included in DIN 1988-4; installation is common practice in Germany.*
CA	Pipe separator with different not measurable pressure zones	System separator with different not measurable pressure zones
DB	Pipe interruptor with moveable parts	Pipe interruptor A2
DC	Pipe interruptor with permanent connection to the atmosphere	Pipe interruptor A1
EA	Measurable backflow preventer	Backflow preventer
GA	Pipe separator, not flow-controlled	Pipe separator EA1
GB	Pipe separator, flow-controlled	Pipe separator EA2
HA	Hose connection with backflow preventer	Backflow preventer
HB	Pipe aerator for hose connections	Pipe aerator style C
HC	Automatic changeover element	Changeover element and backflow preventer on outlet fittings with hose connection and free outlet
HD	Pipe aerator for hose connections, combined with backflow preventer	Safety combination

Table 2: Nomenclature of the safety devices to DIN EN1717 and DIN 1988-4

The pipe separator EA3 cannot be found in the Table on the previous page. There is no equivalent to this fitting in DIN EN 1717. Likewise, the pipe aerators for rising pipes are not listed.

Originally, the notation system adopted in DIN EN 1717 comes from France. However, the logic of the system could not be maintained due to the allocation of all safety fittings that are common in Europe. The allocation of the letter combinations was thus arbitrary. Don't try to find any background.

To specify in a drawing the safety fitting that is to be installed in a system, you may use drawing symbols according to DIN 1988-4 and according to DIN EN 1717. However, the European drawing symbols are frequently more complicated than the national representations. To simplify matters, DIN EN 1717 permits a hexagon to be drawn at the required location in the drawing, in which you can enter the letter combination of the required safety device.



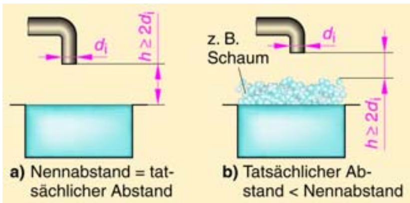
Compared with the drawing symbols of DIN 1988-4 (top), the symbols to DIN EN 1717 are more complicated (centre), but may also be represented by letter combinations (bottom) (Figure: J. Scheele)

6. THE FUNCTION OF THE SAFETY FITTINGS

The safety fittings commonly used in Germany were already mentioned in Chapter 5, and compared with the European names. We now want to explain the functions of the individual fittings and - if there are any - describe installation specifications. This is done - following the European notation system - from "A" to "H". This does not necessarily lead to an assessment of the safety of the individual fittings. This safety aspect is dealt with in Chapter 7.

Unobstructed free outlet - AA (DIN EN 1717)
Free outlet (DIN 1988-4)

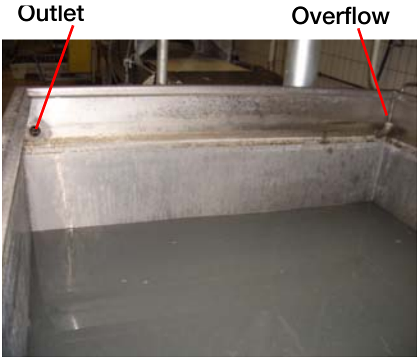
"Keep your distance" could be the description of the principle of a free outlet. The name indicates that the drinking water outlet is at some distance to the highest possible non-drinking water level. To DIN 1988-4 [7], this must invariably be twice the inside diameter of the outlet pipe, but at least 20 mm. DIN EN 1717 [8] requests a distance to the non-drinking water level that must correspond to three times the inside diameter of the outlet pipe. However, it does not specify a minimum distance. Since the drinking water outlet is above the non-drinking water level, the non-drinking water can neither flow or press back nor be sucked back in the domestic application.



When a free outlet is used, the highest possible non-drinking water outlet may also be above the upper edge of the container (Figure: A. Gaßner)

The catch of using this way of protection is in the definition of the highest possible non-drinking water level. It is frequently assumed that this is the overflow of the sanitary object. But an overflow can be obstructed. Even the upper edge of the object can not always be considered as the highest possible non-drinking water level. For example, there is frequently foam on a bath tub. An outlet that is inside the foam is everything else but "free". These operating conditions must also be taken into account when the necessary distance between the outlet and the non-drinking water level is determined.

At washstands with a so-called mouth-flushing tab you must also check critically whether there is always a free outlet. The outlet of these fittings are usually significantly above the surface of the washstand. But exactly this makes is possible to put a bucket underneath. The outlet is then inside the bucket. Each system builder must decide whether or not there shall be a protection against this non-intentional use.



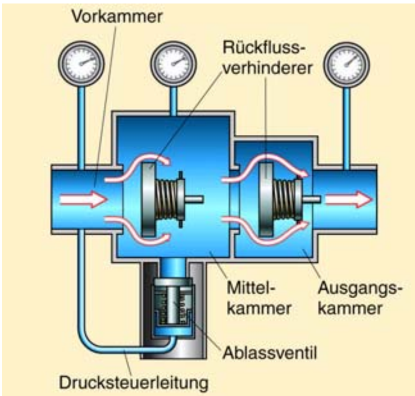
This should not be: The overflow (right) is higher than the supposedly free outlet (left)

Prior to using a free outlet you must determine whether harmful vapours can get into the outlet. This can be the case in commercial or industrial systems. There is little use if the water outlet to a basin with poisonous chemicals uses a free outlet, although the poison find a way as a gas into the water pipe.

In addition to the described free outlet AA, only version AB (free outlet with non-circular overflow) is used in Germany. However, it is not used in domestic drinking water installations, but as a safety device in intrinsically safet washing machines and dishwashers.

Pipe separator with controllable medium pressure zone - BA (DIN EN 1717)
System separatur with controllable medium pressure zone

The system separator is a safety fitting that is not listed in DIN 1988-4. Still, this fitting established itself in Germany in the 1990s. It is somewhat confusing that the European term is "pipe separator". This was born of necessity since there is no English word for "system separator".



The drain valve remains closed as long as the pressure in the feeder pipe is 0.14 bars higher than the pressure in the middle chamber

A system separator consists of three chambers. Between the chambers there are backflow preventers. The water first flows into the prechamber. Here, the water pressure is higher than in the middle chamber, where in turn it is higher than in the outlet chamber. The pressure drop the water experiences when it flows through is defined exactly. If the water pressure before the system separator drops, thus reducing the volume flow and producing a risk of sucking or pressing back, the backflow preventer between the prechamber and the middle chamber closes. This happens, at the latest, when a pressure difference of 0.14 bars is reached. The drain valve in the middle chamber opens at the same time. The middle chamber is thus emptied. This requires a draining connection for this fitting. Thanks to the (technically seen) pressureless middle chamber, the water that is still standing in the system forces, together with the spring force, the backflow preventer of the outlet chamber closed. The empty middle chamber represents an atmospheric split of the system. As soon as the pressure at the feeder side returns to normal, the drain valve closes and the backflow preventer between pre-chamber and middle chamber is forced open. The middle chamber fills up. The backflow preventer between middle chamber and outlet chamber opens when water is required. A test socket is connected to each of the three chambers. This permits the function of the installed safety fitting to be checked with a test instrument.

A system separator with controllable medium pressure zone works automatically and does not require any additional control elements. The middle chamber normally remains filled with water, and the system separator is thus operational. The middle chamber is only drained - and thus the system separated - when the water pressure drops and a potential risk arises. The sensitivity of the system separator has a detrimental effect in practice. A pressure reducer should be installed before the system separator in order to prevent that is responds already at a minor pressure fluctuation.

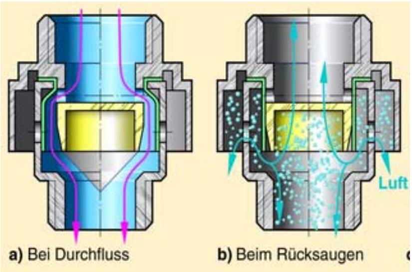
Pipe separator with different not measurable pressure zones - CA (DIN EN 1717)
System separator with different not measurable pressure zones

The operation of a system separator with not measurable pressure zones corresponds to the operation of the system separator BA described above. The difference between the two fittings is that the system separator CA does not have a test socket. The function of the installed unit can thus not be checked.

Pipe separator with moveable parts - DB (DIN EN 1717)
Pipe separator A2 (DIN 1988-4)

The pipe separator with moveable parts is a mechanically rather simple component. However, this statement should not have a negative meaning. The simple design provides a high functional safety. The pipe separator A2 is basically a length of pipe with holes. A rubber membrane was inserted as the moveable part. In the pressureless state, this membrane hangs at a certain distance from the holes. Flowing water presses the membrane onto the holes. This prevents that splashing water emerges here.

The membrane, however, makes the component unsuitable for pressure. If a stagnation pressure (due to the length of the pipe or the connection of a shower head, for example) built up in the pipe after the component, the holes in the fitting would be noticed immediately as such. This fitting can consequently only be used before a short pipe with an open outlet.

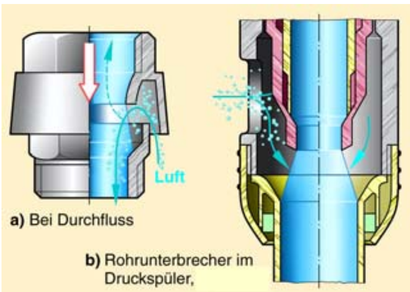


The vent openings of a pipe interruptor with moveable parts are covered by a membrane as long as water flows (Figure: A. Gaßner)

The protective effect is based on the fact that the rubber membrane releases the holes immediately after the water flow stops, and allows air to stream into the pipe. The pipe can thus drain completely without producing a vacuum. The holes of the pipe interruptor prevent the suction effect to be transferred to the subsequent pipe if there is a back suction in the upstream drinking water pipe. Sucking in non-drinking water is thus prevented. This safety fitting does not help against pressed-back non-drinking water.

In order to permit the pipe after the pipe interruptor A2 to drain, the fitting must be installed at a point that is at least 150 mm (to DIN 1988-4) or more than 150 mm (to DIN EN 1717) above the highest possible non-drinking water level.

Pipe interruptor with permanent connection to the atmosphere - DC (DIN EN 1717)
Pipe interruptor A1 (DIN 1988-4)



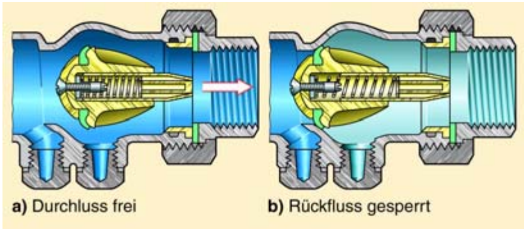
The vent openings of a pipe interruptor with permanent connection to the atmosphere are always open (Figure: A. Gaßner)

The design of the pipe interruptor with permanent connection to the atmosphere is almost identical to the design of the pipe interruptor A2 described above. The sole difference is that the pipe interruptor A1 does not have a rubber membrane. The vent openings of this safety fitting are thus always open.

A vacuum in the drinking water pipe can thus not have a sucking effect on the pipe that follows the pipe interruptor. However, this pipe must not be under pressure. It must be open at the end and may not be very long.

The pipe interruptor must be installed at a point that is at least 150 mm (to DIN 1988-4) or more than 150 mm (to DIN EN 1717) above the highest possible non-drinking water level. If a pipe interruptor A1 is used for protecting a toilet cistern (the pipe interruptors A1 precede the flushing pipes of flushing valves), DIN 1988-4 requests that the pipe interruptor is at least 400 mm above the upper edge of the toilet cistern. The elevated installation position protects against flowing back non-drinking water. The holes prevent sucking back. Neither the pipe interruptor A1 nor the A2 version can protect against non-drinking water that presses back.

Measurable backflow preventer - EA (DIN EN 1717)
Backflow preventer (DIN 1988-4)

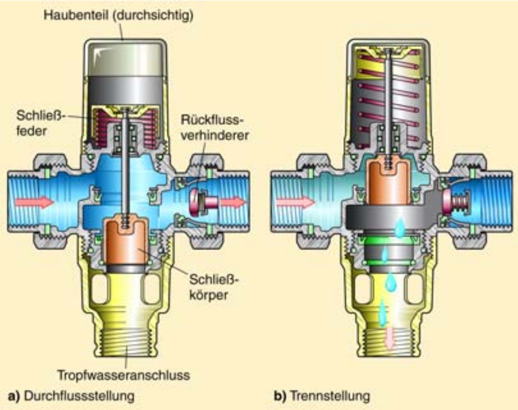


A backfow preventer is only open when water is taken. It is closed at idle pressure

Eradicating a term in practice is very difficult: Flap valve. There should be nothing "flapping" let alone "beating" in a drinking water installation. The term "backflow preventer" is adequate here. In contrast to a flap valve, this fitting is equipped with a spring. Consequently, it closes not only when the flow direction is reversed. The fitting closes already when there is no water flowing. In other words: The backblow preventer is pressed open by the flowing water.

This means that closing the fitting in the event of a flow reversal is not necessary. However, this is only ensured when the installation position is correct. Horizontal installation or vertical installation in flow direction does not represent any problem. A vertical installation with a flow from top to bottom, however, may cause the backflow preventer to close only when the flow direction is reversed. The spring cannot close the fitting against the water pressure if more than one meter water column presses on the closing element and thus on the spring. The degree of protection deteriorates. This also applies if the spring is worn out or if there are deposits on the closing element. The backflow preventer features an inspection opening that enables the operator to check whether this is the case, and the reason of inadequate closing. To check, the water supply to the backflow preventer is closed and the feeder pipe is drained. Next, the inspection opening is opened. If no water emerges here, the pipe after the fitting does not drain and the backflow preventer is consequently OK.

Pipe separator, not flow-controlled - GA (DIN EN 1717)
Pipe separator EA1 (DIN 1988-4)



The not flow-controlled pipe separator switches only to separating position when the water pressure reaches the separation pressure or falls below it.

Both, in the European and in the national standard version, the name of this fitting already describes its function: When the water pressure at the input drops below a given value, the fitting separates the protected part of the pipe from the feeding drinking water pipe. The separation is visible. Like in a system separator, the water flows out of the separation area. A pipe separator thus needs a draining connection, too. An integrated backflow preventer at the outlet side of the fitting prevents that the subsequent pipe system is drained when the safety device is in separating position.

Normally, a not flow-controlled pipe separator (pipe separator EA1) is in flow position. It only changes to separating position when the water pressure drops below a certain value.

In order to safely prevent non-drinking water from flowing back, pressing back and being sucked back, this separation process must take place before there is any risk - i.e. as long as the water pressure at the inlet side is still higher than the highest pressure that can build up at the outlet side. Here, we add a safety margin of 0.5 bars.

Example:

A pipe separator is followed by a drinking water pipe of a height of 10 m. A water column of 10 m high produces a pressure of 1 bar at its base. It is a draw, when the water pressure at the inlet drops to 1 bar. Water is pressed back when the pressure drops below 1 bar. Consequently, we add the 0.5 bars safety to this "critical" value. The pipe separator that is to be used for protection in this example must consequently transition to separating position when the water pressure at the inlet reaches or falls below a value of 1.5 bars.

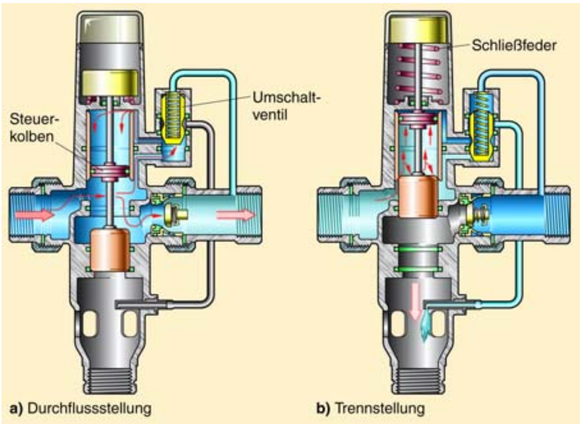
The pressure at which a pipe separator transitions to the separating position is referred to as "separation pressure". Generally - a higher separation pressure never does any harm. If only one pipe separator with a separation pressure of 1.0 bar and one pipe separator with a separation pressure of 2.5 bars were available in the example above, the safety fitting with a separation pressure of 2.5 bars would be the right choice.

The separation pressure is determined by the tension of a spring. The spring permanently "tries" to pull the closing element into the seat and thus in separating position. This is prevented by the water pressure that acts against the spring force. If the applied water pressure drops to or below the value of the separating pressure, the spring can pull the closing element upwards and thus in separating position. When the water pressure rises, it presses the closing element back down. The flow position is attained. This is called a „force comparison principle".

The disadvantage of a pipe separator EA1 is the fact that they are only in separating position when the water pressure at the inlet is low. Since this occurs very rarely, the fitting is in flow position for most of the time. If the yearly inspection is dropped (which is frequently the case in practice), the unit may not be able to switch to separating position when it comes to it. It is stuck - due to deposits, calcification, etc..

Pipe separator, flow-controlled - GA (DIN EN 1717)
Pipe separator EA2 (DIN 1988-4)

The flow-controlled pipe separators basically work in the same way as the not flow-controlled versions: They change to separating position when the inlet water pressure reaches or falls below the determined separation pressure. The procedure of determining the separation pressure is the same as the one for the EA1 pipe separators. The major difference is in the fact that the EA2 pipe separator does not only transition to the separating position when the water pressure reaches critical values. It separates also when no water is taken from the pipe system after the fitting. This fitting is thus always in separating position - with the exception of the moments when water is taken from the system.



The flow-controlled pipe separator is only in flow position when water is taken from the downstream pipe

Flow-related control is achieved by sensing the water pressure at the outlet. A back-pressure chamber is emptied when the water pressure at the outlet is identical with the water pressure at the inlet (which is the case if no water is taken). The spring can thus move the closing element of the pipe separator to the separating position. When the water pressure at the outlet side drops (i.e. when water is taken), the back-pressure chamber is filled with water and the closing element is thus pressed back to the flow position. If the total water pressure is low (less than or equal to the separation pressure), even a full back-pressure chamber cannot prevent the spring from pulling the closing element up (and thus in separating position). With critical pressure conditions, taking water is thus interrupted or not possible. Like in the not flow-controlled pipe separator, a backflow preventer prevents the downstream pipe from running empty.

In Germany, however, flow-controlled pipe separators are used that do not feature a backflow preventer at their outlet side. With these so-called EA3 pipe separators, the downstream pipe is emptied deliberately after each separation process of the fitting. In order to make this happen, an EA3 pipe separator must be at least 300 mm above the highest non-drinking water level possible.

Hose connection with backflow preventer - HA (DIN EN 1717)
Backflow preventer (DIN 1988-4)

We already discussed the backflow preventer in this Chapter. This was a measurable backflow preventer. There is no measuring possibility in a backflow preventer with hose connection. This backflow preventer is installed in an outlet fitting. Its function corresponds to the function of a measurable backflow preventer - but it does not have the inspection opening. This fitting should - according to the definitions of DIN EN 1717 - be installed at more than 200 mm above the highest non-drinking water level possible.

Pipe aerator for hose connections - HB (DIN EN 1717)
Pipe aerator of style C (DIN 1988-4)

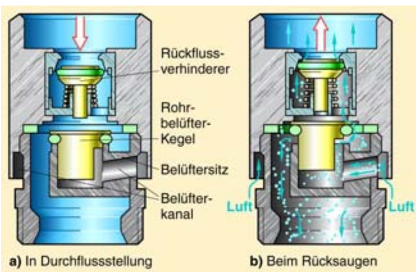
The reason may be in the translation of the EN 1717 from French - but the name "pipe aerator for hose connections" is a contradiction in terms. This aearator do not aerate the feeding pipe, but the hose wich is connected to that pipe. Consequently, the name "hose aerator" would be more appropriate. In favour of the makers of the EN 1717 we should see that the term "pipe aerator of style C" can also be found in our national standard. When we take DIN EN 1717 as a basis, we can adapt ourselves in Germany to the term "hose aerator". The pipe aerators proper that have previously been installed at the end of a rising pipe, can no longer be found in DIN EN 1717. Although there are still pipe arators (group L) according to this standard, they cannot be compared with the aerators used in Germany.

Thus, DIN EN 1717 for Germany merely leaves the aerator that vents a hose. Basically, the events in the downstream hose are the same as the ones in a pipe that follows a pipe interruptor in flow direction: The connected hose is vented and drained when the water supply is interrupted. For this, the vent openings of the fitting must be at least 150 mm (to DIN 1988-4) or more than 250 mm (to DIN EN 1717) above the highest non-drinking water level possible. The difference between a pipe interruptor and a hose aerator is in the fact that the hose connected to a hose aerator may be pressurized. A gate actuator is a part of the hose aerator. It closes the connection to the air openings as soon as a little pressure builds up. If a suction builds up in the supplying water pipe (when the pipe is drained, for example), the gate actuator lifts off and allows air to flow in through the aerator. A dangerous vacuum in the connected hose is thus relieved - there can be no sucking-back effect. The air route is blocked, too, if the non-drinking water is - against its intended flow direction - pressed into the hose and the water pipe does not "suck in" the non-drinking water. The aerator remains without an effect. According to the definitions of DIN EN 1717, the hose aerator is thus no protection against backpressing water.

Automatic changeover element - HC (DIN EN 1717)
Changeover element and backflow preventer on outlet fittings (DIN 1988-4)

An automatic changeover element is installed at outlet fittings with hose connection - frequently with tub filling and shower head fittings. This element is used for changing the water flow manually from the free tub inlet to the hose of the shower head. If the water pressure drops below 0.5 bars while the shower head is being used, the changeover element switches the water route back to the free tub inlet. In the event of a failure of the water supply, water could not be sucked via the shower head hose into the pipe, because the tub inlet is open and allows air to come in, thus compensating for any dangerous vacuum right from the beginning. However, the water inlet must be more than 250 mm above the highest possible non-drinking water level. The backflow preventer at the cold and warm water connections of the fitting contribute to preventing a backflow of the water.

Pipe aerator for hose connections, combined with backflow preventer - HD (DIN EN 1717) safety combination (DIN 1988-4)



Backflow preventer and hose aerator work together in a safety combination

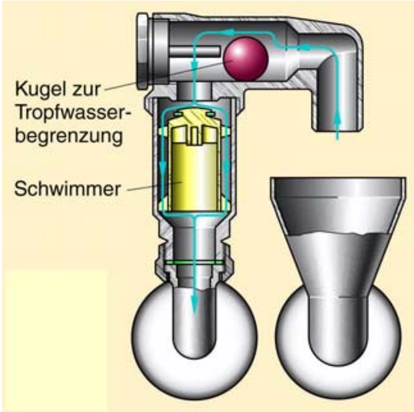
The safety combination, too, counts on the backflow preventer. It is used together with a hose aerator (HB). In flow direction, the water first passes the backflow preventer, then the aerator. In the event of a suck-back effect in the drinking water pipe, the backflow preventer prevents non-drinking water from entering into the pipe system. If the backflow preventer is leaking - due to deposits, for example, the aeroator prevents vacuum from building up in the connected hose, thus preventing water to be sucked back. This requires the vent openings of the fitting to be at least 150 mm (to DIN 1988-4) or more than 250 mm (to DIN EN 1717) above the highest possible non-drinking water level. The hose aerator cannot prevent non-drinking water from pressing back. This can only be done by the backflow preventer. As mentioned above, the backflow preventer may be leaking. The degree of protection of the safety combination is thus lower when protection against backpressing water is required.

Pipe aerators of styles D and E (DIN 1988-4)

As mentioned above in Chapter 5, DIN EN 1717 does not list the pipe aerators that have been used in Germany up to now. DIN EN 1717 requires the utilization of safety fittings as individual protection devices; pipe aerators however are usually employed as collective protection devices. It is thus comprehensible, that the pipe aerators dropped out of the running in European applications. However, this does not mean that they disappeared. They are quite numerous in existing building installations. DIN 1988-4 also permits their utilization - although newer national Technical Rules do not support it. This is why the functional description of this safety fitting should not be omitted here.

Due to its shape, a pipe aerator of style D is also known as mushroom aerator. Inside the aerator there is a float. When the pipe is used, the water presses the float into its seat. When the rise pipe is drained, the float drops off the seat and air flows into the pipe. This prevents a vacuum and thus a suction effect. The aerator of style D does not have a dripping water drainage.
Water squirts out if the float does not close properly. They should therefore be used only at places where this emerging water cannot do any harm (such as in a closed shower cubicle).

The pipe aerators of style E work like pipe areators of style D, but are equipped with a dripping water drainage. Since the funnel of the pipe aerator is hardly able to drain the emerging water completely when the float is not tight, many pipe aerators of style E are equipped with a dripping water limiter. This is a porous ball that is pressed against the outlet by the water pressure. It closes the cross section of the outlet and lets only small water quantities emerge through its pores. In the event of venting, the vacuum pulls it off the outlet into a larger fitting area. Here it is too small to fill the cross section and allows air to enter the pipe freely.



In a pipe aerator of style E, a float provides for the closing. Water presses the float into the seat - a porous ball limits the emerging water volume in the event of a failure

The floor pipes must branch off at a height of 300 mm above the highest possible non-drinking water level, and the floor pipe must also be installed at that height when a pipe aerator of style D or E is used. When a rising pipe with a pipe aerator is offset, a second pipe aerator must be installed below the offset if the rectangular offset is greater than 0.5 m. An offset of less than 45° requires a second aerator when the projection exceeds 1 m.

Comparison of the installation dimensions of the safety fittings

Name of the safety fitting		Installation dimensions to be observed	
to DIN EN 1717	to DIN 1988-4	to DIN EN 1717	to DIN 1988-4
Unobstructed free outlet - AA	Free outlet	The distance between the inlet and the highest possible non-drinking water level must be the **3-fold inside diameter** of the inlet pipe	The distance between the inlet and the highest possible non-drinking water level must be the **2-fold inside diameter** of the inlet pipe, **but at least 20 mm**
Pipe separator with measurable medium pressure zone - BA	System separator with measurable medium pressure zone[1)]	The safe function does not require any installation dimensions to be observed.	
Pipe interruptor with moveable parts - DB	Pipe interruptor A2	The distance between the vent openings and the highest possible non-drinking water level must be **greater than 150** mm.	The distance between the vent openings and the highest possible non-drinking water level must be **greater than 150** mm.
Pipe interruptor with permanent connection to the atmosphere - DC	Pipe interruptor A1	The distance between the vent openings and the highest possible non-drinking water level must be **greater than 150** mm.	The distance between the vent openings and the highest possible non-drinking water level must be **greater than 150** mm. The distance between the vent openings and the upper edge of a sanitary basin (e. g. toilet) must be **at least 400** mm.
Measurable backflow preventer - EA	Measurable backflow preventer	The safe function does not require any installation dimensions to be observed. Up to a **diameter of 50 mm**, the fitting must work in any installation position.	There should be no more than **1 m water column** on the spring when the fitting is installed in flow direction "from top to bottom".

1) Not included in DIN 1988-4, installation in Germany is common practice

Name of the safety fitting		Installation dimensions to be observed	
to DIN EN 1717	to DIN 1988-4	to DIN EN 1717	to DIN 1988-4
Pipe separator, not flow-controlled - GA	Pipe separator EA1	The safe function does not require any installation dimensions to be observed.	
Pipe separator, flow-controlled - GB	Pipe separator EA2	The safe function does not require any installation dimensions to be observed.	
-	Pipe separator EA3	-	The pipe separator must be **at least 300 mm** above the highest possible non-drinking water level.
Hose connection with backflow preventer - HA	Not-controllable backflow preventer	The backflow preventer must be **at least 200 mm** above the highest possible non-drinking water level.	The safe function does not require any installation dimensions to be observed.
Pipe aerator for hose connections - HB	Pipe aerator style C	The pipe aerator must be **at least 250 mm** above the highest possible non-drinking water level.	The pipe aerator must be **at least 150 mm** above the highest possible non-drinking water level.
Automatic changeover element - HC	Changeover element and backflow preventer on outlet points with hose connection and free outlet	The outlet must be at least **250 mm** higher than the highest possible non-drinking water level.	The safe function does not require any installation dimensions to be observed.
Pipe aerator for hose connections, combined with flowback preventer - HD	Safety combination	The pipe aerator must be **at least 250 mm** above the highest possible non-drinking water level.	The pipe aerator must be **at least 150 mm** above the highest non-drinking water level.

7. EMPLOYING SAFETY FITTINGS

The reliability of functioning of the individual safety fittings and protective measures should be judged differently. As mentioned above in Chapter 5, the selection of the suitable protective measure depends on the class (or liquid category) of the non-drinking water the drinking water must be protected from. If the drinking water shall be shielded against a relatively harmless non-drinking water (e. g. coffee from a coffee machine), using safety fittings with a high failure probability is permitted. If water penetrates the drinking water pipe, the requirements of the Drinking Water Regulations [2] will no longer be satisfied, but taking water with addedd coffee from the pipe is disagreeable at most.

It is completely different when the treatment chairs of a dentist are to be connected to the water supply of a house. In this case we must assume that germs can be involved. This water of class (or liquid category) 5 must never find its way back to the drinking water pipe system. Consequently, a protection of a very low failure probability is required.

Degree of protection depends on the non-drinking water

To select the protection that is sufficient for the water supply you must therefore specify the potential hazard of the non-drinking water against which the drinking water is to be protected. Unfortunately, this assessment was not frequently made in the past. When looking at old systems, we often get the impression that a backflow preventer or a pipe aerator was understood as a kind of panacea. The battle cry of the fitting industry that the outlet fitting is "intrinsically safe" gives you the feeling to provide sufficient protection in any conceivable case. However, this is not the case. Below, we want to examine more closely the protective aspect of those water outlet situations, water supply companies, planners and fitters are confronted with in practice.

Temporary points of supply

The necessity of a protection is not necessarily restricted to the area of the customer system. Water may as well be taken before a customer system. This is the case, for example, when it is needed at a construction site. Using a standpipe makes it possible. But where does the pipe lead that is connected to the standpipe? Frequently, it ends in the water trough of the bricklayer. The question about the whereabouts of the hose end is not only relevant in this water supply situation. It is always relevant when a standpipe is used.

When the snack stand on a fair is supplied with water, the outlet fittings connected in this stand require a protection. Checking the existence of an adequate protection is very difficult for the water supply company.

There should be no compromise with respect to drinking water when standpipes are used (Figure: Paguag)

Standpipes with integrated safety fitting are used in order to protect the drinking water in the supply mains. A backflow preventer (HA) in this context has rather the function to ease the conscience - its degree of protection is not particularly high. Even minor deposits in its seat would have the effect that it merley slows down sucked or pressed back water, but does not prevent it from flocking back. Furthermore, DIN EN 1717 [8] requires this fitting to be at least 200 mm above the highest non-drinking water level possible. This is just not possible with a hose connection. The same applies to the hose aerator (HB) which can also be found here. Its vent openings must be at least 250 mm (DIN 1988-4 [7] requires 150 mm) above the non-drinking water level.

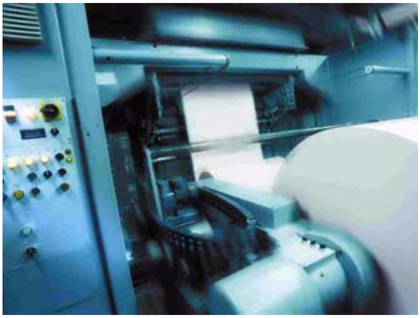
Using standpipes with integrated system separator (BA) provides a solution of the problem. This safety fitting does not require any heigths to be observed to ensure proper functioning. In addition, there is a protection against non-drinking water up to class (or liquid category) 4. A backflow preventer or an aerator provide only a moderate protection against class-2 non-drinking water.

Points of supply in industrial and commercial areas

The supply situations in the industrial and commercial areas are of an even greater variety than the possible connections to a standpipe. Here, we can therefore only discuss some examples of protection situations in this area.

Industrial water which is used in the field of galvanic applications must be classified in liquid category 4. To protect the filling fitting, a free outlet (AA), a system separator (BA), a flow-controlled pipe separator (GB) and - since backpressing industrial water is not to be expected - pipe interruptors (DB und DC) may be used here. Shut-off fittings are required when these safety devices are installed. A pipe separator of style 3 (EA3) can take on the function of the shut-off device.

We also deal with water of liquid category 4 when printing presses or film development machines without DVGW mark of conformity are to be connected to the drinking water system. In contrast to a galvanic basin, these units need the water pressure from the pipe. Protection with a pipe interruptor is thus not possible. The correct choice of the safety device is a free outlet (AA) with downstream booster system, system separator (BA) or flow-controlled pipe separator (GB).



The drinking water connection of printing presses must be protected against class-4 non-drinking water

The hazard from a meat-processing machine is frequently misjudged. Since meat is food, a flowback preventer was frequently used as a protective measure - - which fulfils the normative requirements not even marginally. We should be allowed to assume that meat is food from which does not come any harm. But what can happen when a sucking-back effect takes meat particles back into the drinking water pipe, where they remain? The meat would rot quickly in the drinking water, which is rich in oxygen. An infestation of the drinking water with bacteria could not be excluded. A backflow preventer can leak. Consequently, it is not very reliable in preventing a suck-back effect. The water connection on such a machine must therefore be established in the same way as the connection to a device that contains non-drinking water of liquid category 5.
If the water in the machine is not pressurized, a pipe interruptor without moving parts (DC) or a free outlet (AA) can be used. If the water must be supplied to the machine under pressure, there is no way to avoid a booster system with atmospheric prevessel (including a free outlet).

The water of a fishpond (e. g. trout farm), too, must be considered as water of liquid category 5. Refilling is only permitted via a pipe interruptor without moveable parts (DC) or a free outlet (AA). ince it can easily be implemented, the latter is common practice with fishponds.

The bottom rinsing pipe of a glass washing facility may only be supplied with drinking water via a free outlet

At the place where the trout is served - in the restaurant - there is also a frequently unexpected protection requirement. The glass washing facility on the bar has a water inlet underneath the water level, the bottom rinsing pipe.

Like the water in a dishwasher, the water in the basin is assigned to liquid category 5. This shows the necessity of a protection via a free outlet (AA), combined with a booster system. Compact systems that are ready to be installed are available.

Points of supply in the medical area

Besides industrial and commercial facilities, drinking water pipes in the medical areas require particular attention. Frequently, they have to be installed in the "normal" installation of a building when a medical practice is installed in a house with several dwellings, or when a shop is converted into a pharmacy.

Hose connections in chemical laboratories must be protected with a hose or system separator

Some apparatuses in a pharmacy laboratory must be connected to the drinking water pipe. The points of supply that are used for the connection are to be considered as a vulnerable point of supply, and must be protected. Since the pharmacy laboratory is to be classified as a chemical laboratory, we deal with non-drinking water of liquid category 4. The system must therefore be protected via a flow-controlled pipe separator (GB) or a system separator (BA).

Where vulnerable points of supply in a bacteriological laboratory are concerned (e. g. in a medical practice or a hospital), we deal with liquid category 5. This means: Free outlet (AA) and downstream booster system must be used. This type of protection can also be necessary in the consulting rooms. This is the case in a dental surgery, for example. If the treatment units do not have the "intrinsically safe rating" - i.e. a DVGW mark of conformity - they may only indirectly be in contact with the drinking water installation. Connecting units that are ready to be installed can be used for this purpose. These units take the drinking water via a free outlet into a container and feed the treatment unit via a pump. Such a unit can be installed directly next to the chair or in a separate equipment room of the surgery.

The water pipe installed after that safety unit (which may only feed one or more treatment chairs, but no further points of supply) must be as small as possible, and short. The treatment chairs need only very little water (drill cooling requires approximately 75 ml/min, each chair needs per treatment day approximately 15 liters). With unnecessary large or long feeder pipes we have again the problem of stagnation.

Dental treatment chairs must be intrinsically safe or be supplied with water via a separate booster system

Care must also be taken at bath tubs and shower trays in hospitals or nursing homes. The supply fittings that are installed here are not "intrinsically safe", even if the manufacturer states exactly this property in his documents. Intrinsically safe fittings can protect against non-drinking water up to liquid category 3. Since we must assume that there are ill people who take a shower or bath in a hospital or a nursing home, the non-drinking water must here be assigned to liquid category 5. Consequently, the degree of protection of the "intrinsically safe" fitting proves insufficient. Connecting the shower head (which may as well lie in the tub) via a pipe interruptor with movable parts (DB) would therefore be necessary. However, the fitting does not make any sense here, since the downstream hose is - through the shower head - under flow pressure. As a result, the water would squirt out of the pipe interruptor, rather than out of the shower. Since there are currently no intrinsically safe "hospital fittings", there is only one possibility: The inlets and hose connections must be arranged such that they cannot get under the non-drinking water level. A hose connecting angle installed at a high level and an approriately short hose do not allow the shower head to land in the tub or shower tray.

Points of supply in the domestic area

There are also different protection requirements for the points of supply in a residential building. Below we look at the facilities that are usual in a residential building.

The fittings on washstands do not usually represent vulnerable points of supply. The outlet of the supply fitting is fixed above the highest possible non-drinking water level, thus fulfilling the requirements for a free outlet (AA). If this is not the case - like with a washstand fitting with extractable shower head - it cannot be excluded that the shower head dives into the non-drinking water. In the domestic area, this non-drinking water can be assigned to liquid category 3. Using a safety combination (HD) is the minimum protection in this case. The same applies to a kitchen fitting with extractable hose shower head.

The water in a toilet cistern corresponds to liquid category 5. Where flushing valves are used, protection is achieved by a pipe interruptor without moveable parts (DC). Since this pipe interruptor is integrated in the flushing valve, additional safety equipment need not be installed. If the toilet is flushed through a flushing box, the water supply is provided as a filling valve with free outlet (AA).

Tub filling fittings and shower fittings are equipped with a free outlet to fill the bath tub. The shower head could lie in the bath water (Figure: Villeroy und Boch)

Tub filling fittings and shower fittings are equipped with a free outlet to fill the bath tub. The shower head could lie in the bath water and must therefore be protected. Like with the washstand, the water of a bath tub must be assigned to liquid category 3. It must be protected at least with a safety combination (HD). This type of protection is also the minimum requirement for shower fittings in the domestic area. Outlet fittings that are "intrinsically safe" according to the manufacturer specifications are equipped with integrated protective elements.

For bath tubs with a water inlet below the tub brim, a protection to DIN 1988-4 must be implemented with a pipe interruptor with moveable parts (DB). The necessity of such a high protection is questionable, since the domestic bath tub still contains water of liquid category 3, even when it is equipped with a water inlet below the tub brim. Basically, the shower head lying in the bath water is also an "inlet below the tub brim". DIN EN 1717 confirms the suspicion that things were a little exaggerated here. It requires merely the use of a safety combination (HD) to protect a water inlet under the tub brim.

In most cases, there is a point of supply for filling the heating in the installation room of the heat generating unit. Since the heating is not operated at atmospheric pressure, the connection betweeen drinking water system and heating system must be established to DIN EN 1717 via at least a pipe separator (GA) or a system separator (CA). To DIN 1988-4, a backflow preventer would do for protection in the case of heating filling. This element is only sufficient when the hose connection between drinking water system and heating is removed immediately after the heating

has been filled. From practical use we know that the user never removes the hose after filling.
This is why a safety combination (HD) is installed. According to DIN 1988-4, a permanent connection between drinking water system and heating system is permitted when a safety combination is employed. But: The highest possible non-drinking water level (i.e. the heating water level) must be at least 150 mm (to DIN EN 1717 even 250 mm) below the openings of the aerator of the safety combination. This installation requirement is not fulfilled when the safety combination is installed in the basement.

Points of supply with safety combination (HD) are frequently used to connect washing machines or dishwashers. Looking at the machine connection, the protection is either insufficient or exaggerated. When selecting the protection it is assumed that the machine can contain water that must be assigned to liquid category 5. This requires a pipe interruptor without moveable parts (DC) or the water supply via a free outlet (AA).

European washing machine connection? Washing machines or dishwashers that are not intrinsically safe must actually be connected via a free outlet (Figure: J. Scheele)

Machines with the DVGW mark of conformity are intrinsically safe. An additional safety fitting is not necessary. However, protecting a machine connection with a safety combination cannot do any harm. This permits a hose to be connected for other purposes.

Using a small high-pressure cleaner for cleaning requires a pipe separator for the water connection - only a few house owners know about it (Figure: J. Scheele)

A safety combination (HD) provides sufficient protection for the point of supply in the garden, too. However, this applies exclusively to the connection of pressureless devices. Connecting a high-pressure cleaner without its own water tank, for example, to this fitting is not permitted. A high-pressure cleaner permits cleaning agents to be mixed in the water, using the venturi principle. The machine thus works with water of liquid category 4. The high-pressure cleaner must therefore be connected to the drinking water pipe via a flow-controlled pipe separator (GB). The house owner (who most likely is in possession of a high-pressure cleaner) must thus be notified that a high-pressure cleaner must not be connected to the "outdoor water plug". This is also mentioned in the Operating Instructions of the high-pressure cleaners - but who is going to read them?

Utilization of the safety fittings vs water class / liquid category of the non-drinking water

Safety device			to DIN EN 1717 usable for protecting liquid category					To DIN 1988-4 usable for protecting class				
Group	Type	Description	1	2	2	4	5	1	2	3	4	5
A[1]	A	Free outlet	X	X	X	X	X	X	X	X	X	X
	B	Free outlet with overflow	X	X	X	X	X					
	C	Free outlet with vented immersion tube and overflow	X	X	X	-	-					
	D	Free outlet with injector	X	X	X	X	X					
B	A	Separator with reduced medium pressure zone	X	X	X	X	-	X[2]	X[2]	X[2]	X[2]	-
C	A	Separator with different not measurable pressure zones	X	X	X	-	-					
D	A	Pipe aerator in flow form	o	o	o	-	-	X	X	-	-	-
	B	Pipe interruptor with moveable parts	o	o	o	o	-	X	X	X	X	K
	C	Pipe interruptor with permanent connection to the atmosphere	o	o	o	o	o	X	X	X	X	X
E	A	Measurable backflow preventer	X	X	-	-	-	X	X	K	-	-
	B	Not-controllable backflow preventer	For specific domestic use only									
	C	Measurable double backflow preventer	X	X	-	-	-					
	D	Not measurable double backflow preventer	For specific domestic use only									
G	A	Pipe separator, not flow-controlled	X	X	X	-	-	X	X	X	-	-
	B	Pipe separator, flow-controlled	X	X	X	X	-	X	X	X	X	-

Safety device			to DIN EN 1717 usable for protecting liquid category					To DIN 1988-4 usable for protecting class				
Group	Type	Description	1	2	2	4	5	1	2	3	4	5
H	A	Hose connection with backflow preventer	X	X	o	-	-					
	B	Pipe aerator for hose connections	o	o	-	-	-	X	X	-	-	-
	C	Automatic changeover element	For specific domestic use only					X	X	X	-	-
	D	Pipe aerator for hose connections, combined with backflow preventer (fitting combination)	X	X	o	-	-	X	X	X	-	-
L	A	Pressurized aerator	o	o	-	-	-					
	B	Pressurized aerator, combined with downstream backflow preventer	X	X	o	-	-					

1) Selection

2) In DIN 1988-4 not taken into account, but as a „technical rule" also employed within the scope of application of this standard

X = Protection against sucking and pressing back

o = Protection against sucking back, but no sufficient protection against pressing back

K = Connection must permanently be supervised and be limited to one working day

- = not suitable

8. APPLICABLE DOCUMENTS

[1] DIN 2000: Zentrale Trinkwasserversorgung - Leitsätze für Anforderungen an Trinkwasser, Planung, Bau, Betrieb und Instandhaltung der Versorgungsanlagen - Technische Regel des DVGW

[2] TrinkwV: Verordnung über die Qualität von Wasser für den menschlichen Gebrauch - Trinkwasserverordnung

[3] DIN 50930-6: Korrosion der Metalle - Korrosion metallischer Werkstoffe im Innern von Rohrleitungen, Behältern und Apparaten bei Korrosionsbelastung durch Wässer - Teil 6: Beeinflussung der Trinkwasserbeschaffenheit

[4] DIN 1988-6: Technische Regeln für Trinkwasser-Installationen (TRWI) - Teil 6: Feuerlösch- und Brandschutzanlagen (Dezember 1988)

[5] DIN 1988-6: Technische Regeln für Trinkwasser-Installationen (TRWI) - Teil 6: Feuerlösch- und Brandschutzanlagen (Dezember 2002)

[6] DIN 1988-2: Technische Regeln für Trinkwasser-Installationen (TRWI) - Teil 6:

[7] DIN 1988-4: Technische Regeln für Trinkwasser-Installationen (TRWI) - Teil 6:

[8] DIN EN 1717: Schutz des Trinkwassers vor Verunreinigungen in Trinkwasser-Installationen und allgemeine Anforderungen an Sicherheitseinrichtungen zur Verhütung von Trinkwasserverunreinigungen durch Rückfließen

[9] DIN 18381: VOB Vergabe- und Vertragsordnung für Bauleistungen - Teil C: Allgemeine Technische Vertragsbedingungen für Bauleistungen (ATV); Gas-, Wasser- und Entwässerungsanlagen innerhalb von Gebäuden

[10] DVGW W 551: Trinkwassererwärmungs- und Trinkwasserleitungsanlagen - Technische Maßnahmen zur Verminderung des Legionellenwachstums - Planung, Errichtung, Betrieb und Sanierung von Trinkwasser-Installationen

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