Viega Engineering Guide

Industrial Applications

viega

The term „Viega“ used in the Viega Engineering Guide document refers to a company of the Viega group or to the Viega brand, depending on the context. The individual companies of the Viega group are legally separate, independent units and, as such, act autonomously. Accordingly, the term „Viega“ is not necessarily to be understood as referring to a certain company of the Viega group.

The Viega Engineering Guide document contains references and links to third-party websites. Viega does not assume any responsibility for the content of such sites.

The Viega Engineering Guide document refers to European standards and regulations (e.g. DIN / DVGW / EN). These are not binding for other countries and are regarded there as recommendations. National laws, standards and regulations take precedence.

INHALT

FOREWORD

Dear expert,

When planning, maintaining or operating an industrial system, your demands on the availability, safety and economic efficiency of your production facility are high. This is where piping technology plays a key and indeed a connecting role, because it guarantees the smooth interaction of all system components.

When it comes to the media being conveyed, you expect a constant quality under specified operating parameters, as well as compliance with legal requirements and due consideration for technical regulations. This is not only about potable water quality. The purity of compressed air and technical gases, as well as process water specifications, are also often crucial to production quality. Once the quality standards have been met, you strive to achieve economic production coupled with high system availability.

This is where the "cold" press connecting technology comes in, because it meets these objectives to perfection. As a leading system provider, Viega had revolutionised installation technology by the mid-1990s. Press connecting technology is now the recognised standard in building services engineering. And numerous other industrial processes are already benefiting from the use of this technology too.

In piping installation, both when installing new systems and maintaining existing ones – which calls for short system shutdowns – fast, reliable and durable execution without a major need for skilled labour is the ideal. This manual will show you how you can use the advantages of "cold" press connecting technology for these very tasks and which typical applications can be realised with the wide ranging materials of the press connectors.

Join us in installing the lifelines for the buildings of tomorrow. Everything that industrial units and buildings need flows through our piping systems: process water, compressed air, technical gases, oil – and not forgetting potable water.

We would like to take this opportunity to wish you every success, both at your desk and on the construction site!

Attendorn, July 2021
The Viega team

PLANNING PRINCIPLES

General principles

bar	mbar	Pa	kPa	hPa	MPA
1	1 000	100 000	100	1 000	0.1
0.001	1	100	0.1	1	0.0001
0.01	10	1 000	1	10	0.001
0.1	100	10 000	10	100	0.01

Tab. 1: Conversion Bar / Pascal

Press connector systems

Viega press connecting technology

The Viega press connecting technology is a clean, efficient and reliable method of connecting piping to one another. With a large choice of materials and sealing elements, the Viega product range offers win-win solutions for a host of applications in the industrial sector.

Fig. 1: Viega press connectors

No matter whether compressed air, process water, technical gases, firefighting water or oils, the cold press connecting technology from Viega offers numerous advantages.

Advantages of Viega press connecting technology	
Time savings	Press connecting technology in a matter of seconds, no welding needed
Manpower requirements	Easy assembly without the need for qualified welders
Safety	No fire risk, no fire watch, no danger to personnel or to the environment
Costs	Short assembly times, minimum system downtimes, no X-ray costs
Mounting material	Handy press tools, no welding equipment required
Diversity	Broad range of systems and materials for the most diverse processes
Reliability	Tried and proven, certified technology

Tab. 2: Advantages of Viega press connecting technology

SC-Contur and double pressing

All Viega press connectors are fitted with the SC-Contur. This allows any inadvertently unpressed connections to be detected and pressed in good time. During "dry" leakage tests using air or inert gas, Viega guarantees the detection of unpressed connections in the pressure range of 22 hPa to 0.3 MPa, and during "wet" leakage tests with water, from 0.1 to 0.65 MPa.

Fig. 2: SC-Contur of a Profipress press connector

Viega press connectors also offer double pressing, which is made in front of and behind the sealing element in each press connection.

The quality tests for Viega press connectors are geared to meeting the requirements of DVGW-W 534, and easily surpass these requirements in some cases. Tab. 3 shows the test values for the Profipress, Sanpress and Sanpress Inox systems as examples.

Testing criteria	Requirements according to DVGW-W 534	Viega test values
Compression strength	At least 2.5 MPa	5.0–20 MPa
Pressure surge	10,000 loads between 0.1 and 1.5 MPa, at room temperature	100,000 loads between 0.1 and 1.5 MPa, at room temperature and 95°C
Resistance to temperature fluctuations	10,000 loads, 15 minutes alternating between 20°C and 95°C, at a pressure of 1.0 MPa and a pipe prestress of 2 N/mm^2	
Vacuum	-0.08 MPa; P_{abs} = 200 hPa	
Sealing elements	Special tests	

Tab. 3: Viega quality tests for Profipress / Sanpress / Sanpress Inox

Materials for piping systems

NOTE!
Be sure to refer to the information on the intended use of the selected piping system. Always agree any use of the system going beyond the applications specified in 'Intended Use' with the Viega Service Center.

The individual Viega piping systems differ in terms of the materials of the press connectors, the suitable pipes and the factory-fitted sealing elements. The most suitable piping system for a particular application case depends largely on the medium being conveyed and the operating and ambient conditions. The flow rule explained below and the information on material compatibility should be observed at all times.

Flow rule

A connected potable water system in which dissimilar materials are used is referred to as a mixed installation. Although considered cutting edge technology, such a system can lead to contact corrosion if installed incorrectly. The less noble of two metals can disintegrate and even become completely destroyed. Less noble metals used for potable water installations are galvanised ferrous materials.

If, for instance, oxygen-rich potable water on its way through the system flows first through components made of more noble materials and then comes into contact with the less noble materials, copper ions, for example, deposit on iron or zinc surfaces and the less noble zinc or iron disintegrates. This is referred to as copper-induced pitting. If the opposite situation occurs, such corrosion is far less likely to occur.

This is the basis of the so-called flow rule:

Flow rule
In potable water installations with two or more metals, the base metal must be used first and then the noble material, viewed in the flow direction.

Mixed installation
In most cases, installing a non-ferrous metal fitting or a component made of gunmetal or silicon bronze along the length of the pipe cross-section is sufficient to prevent contact corrosion. In mixed installations of metal Viega press connector systems with galvanised iron materials, Viega recommends the arrangement according to Tab. 4.

System	Installation in the flow direction	
	Upstream of galvanised ferrous materials	Downstream of galvanised ferrous materials
Sanpress Inox	✓	✓
Sanpress	✓	✓
Profipress	✗	✓

Tab. 4: Viega press connector systems in combination with galvanised ferrous materials

Copper
Components made of copper must not be installed upstream of galvanised ferrous materials. Observe the flow rule at all times.

Stainless steel
Stainless steel system components must be protected against high concentrations of chloride produced by both the medium and by external factors.

Mixed installations of stainless steel system components and other materials are permitted, irrespective of the flow direction.

Steel (non-alloyed/galvanised)
Steel system components are intended for use in industrial applications and heating systems. Steel system components are not suitable for use in potable water installations or in other open systems because the constant oxygen enrichment would cause the system to corrode. For this reason, pipes and press connectors are labelled with a red or black symbol "Not for potable water installations".

Components made of galvanised ferrous materials must not be installed downstream of copper components. Observe the flow rule at all times.

Steel components may be used only with those components belonging to the system.

Brass
Brass system components must be protected against high concentrations of chloride produced by both the medium and by external factors (risk of dezincification).

Gunmetal/silicon bronze

Gunmetal and silicon bronze can be used as "isolators" between two dissimilar metals to prevent contact corrosion. Observe the flow rule at all times.

Technical data for installation materials

Material	Density ρ [kg/dm³]	Breaking strength δ_z [N/mm²]	E-modulus E [N/mm²]	Heat expansion α [mm/(m·K)]	Heat conductivity λ [W/(m·K)]
Stainless steel 1.4401	8.0	520	210 000	0.0165	15
Stainless steel 1.4521	7.7	420	220 000	0.0108	26
Stainless steel 1.4520	7.7	380	220 000	0.0108	26
Copper	8.89	250–340	120 000	0.0166	372
Steel (non-alloyed/ galvanised)	7.85	420	210 000	0.0120	50
Brass	8.44	360	97 000	0.0200	123
Gunmetal	8.74	220	84 000	0.0180	72
Plastic	0.91–1.55	-	350–3 500	0.08–0.20	0.15–0.40
Composite material	-	-	70 000	0.025–0.030	0.45

Tab. 5: Technical data – Installation materials

Sealing elements

Seals play a key role in all technical systems or equipment in which media are kept enclosed. They are designed to prevent the enclosed medium from escaping into the environment unchecked at the connection points of the individual system components. This requires the seals to fulfil a number of crucial requirements:

- They are in perfect mechanical condition and clean when installed.
- They are chemically resistant to the enclosed medium.
- They withstand the operating conditions of the installation (pressure, temperature, etc.).

Seals can be made from numerous dissimilar materials. The most suitable material for the special application case concerned must be selected.
Its composition influences the mechanical and chemical properties and hence its compatibility with certain media. As a rule, the seal material to be selected for a particular application is already specified in the regulations pertaining to this application. A range of sealing materials, along with their general characteristics, is shown in the next section „Sealing materials".
Viega uses different sealing elements to meet the various media and system requirements, paired with the ideal pipe and connecting material in each case. Consequently, the selected system (pipe connector sealing element) guarantees the optimum solution for the intended purpose concerned, including special applications such as PWIS-free systems for the automotive industry or paint shops. The properties of the sealing elements used at Viega are described in section „Viega solutions" on page 19.

Sealing materials

Of the multitude of sealing materials available, the following are described here:

- EPDM
- FKM
- HNBR
- NBR

Each of these designations is a generic term for a number of subtypes. Each individual type can have various forms of a particular property. For example, there are different types of EPDM that can produce different results in material tests due to their composition (see Fig. 10 on page 18).
Therefore, before any sealing material is used, it is necessary to verify with the manufacturer whether the chemical composition of the seal it offers is actually suitable for the application case concerned.

EPDM

EPDM is the standard international abbreviation for **e**thylene-**p**ropylene-**d**iene rubber of the **M** group according to DIN ISO 1629. This is a rubbery-elastic synthetic rubber based on ethylene and propylene, as well as a diene with no further specification.
The expression "ethylene-propylene-diene-monomer-rubber" has also spuriously become common currency for EPDM. However, this is misleading because it is a polymer rather than a monomer.

The backbone and side groups of EPDM consist mainly of saturated compounds and a relatively small number of double carbon-carbon ones (Fig. 3). These unsaturated double bonds make EPDM a highly efficient reactant for certain substances. This limits the possible use of EPDM in systems and may need to be considered if selected as a sealing material.

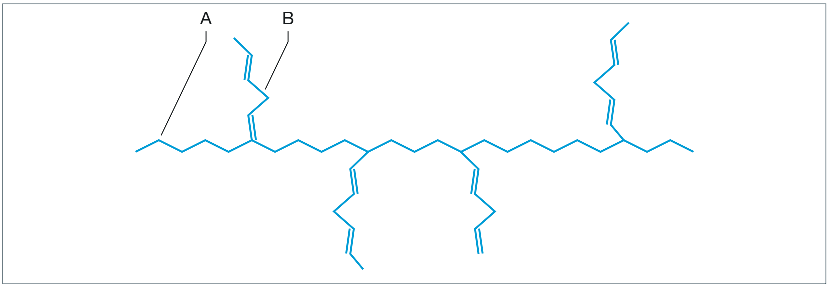


Fig. 3: Schematic representation of EPDM

A Backbone

B Unsaturated side groups

Consequently, EPDM is an ideal sealing material for polar media such as water (Fig. 4) or alcohols, especially for potable water according to DIN EN 806 in combination with the "Evaluation basis for plastics and other organic materials in contact with potable water"[1] (KTW evaluation basis) of the German Environment Agency (UBA). It can also be used effectively for cooling liquids and acids or bases within certain limits.

However, it is not suitable for non-polar substances such as hydrocarbon solvents, chlorinated hydrocarbons, turpentine or benzene. EPDM is also resistant to oils to a very limited extent.

[1] Since 21 March 2021, this evaluation basis has replaced the established KTW Guideline ("Guideline on the hygienic evaluation of organic materials in contact with potable water" (KTW) of the German Environment Agency)

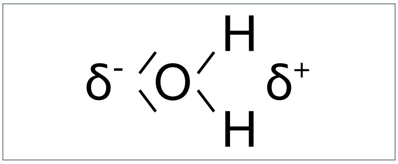


Fig. 4: Schematic representation of polar water

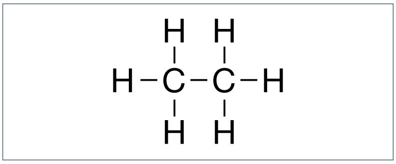


Fig. 5: Schematic representation of non-polar ethane

The lines in the diagram represent the electron pairs that connect the atoms carbon (C), hydrogen (H) and oxygen (O) with one another. Since there are more electrons on the left side of the water, this side is charged a "little more negatively" (-) than the right side (+). This polarisation does not occur with symmetrical ethane.

FKM

FKM is the abbreviation for **f**luorocarbon rubber of the **M** group according to DIN ISO 1629 as well as ASTM D1418 and refers to a whole group of elastic rubbers that have vinylidene (di)fluoride (VDF) as a common characterising monomer.
The "K" is derived from the German for carbon (**K**arbon). The expression fluoropolymer rubber (FPM), now superseded, was also used in the past.
FKM can be used in the temperature range from -40°C to +200°C, depending on the composition, and is characterised by an increased resistance to numerous chemicals as well as a good compression set („Compression set“ on page 16). This chemical resistance is due, among other things, to the saturated side groups, which lack the chemically highly reactive double bonds (Fig. 6). This makes FKM particularly suitable for:

- Oxygen and ozone
- Greases and oils
- Non-polar media
- Non-polar solvents

The typical properties of a special FKM of a group are determined by the other monomers used and the fluorine content. Consequently, the resistance to certain chemicals, to the effects of heat and to mechanical deformation, for example, can be adjusted over a wide range.

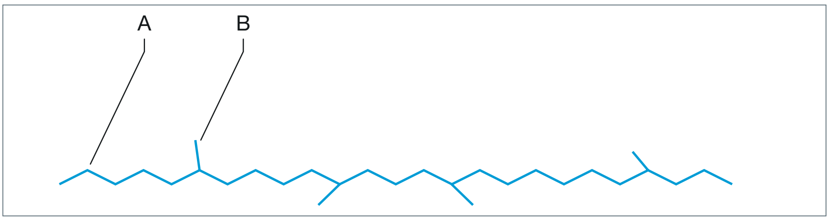


Fig. 6: Schematic representation of FKM

A Backbone

B Short saturated side groups

HNBR
The abbreviation HNBR stands for **h**ydroge**n**ated acrylonitrile **b**utadiene **r**ubber. The essential components of this plastic are the eponymous monomers acrylonitrile and 1,3-butadiene, the proportions of which determine its material properties:
- Elasticity
- Compression set (Page 16)
- Flexibility when cold
- Resistance to swelling
- Gas permeability

Generally speaking, products made of HNBR have a high resistance to oils, greases and hydrocarbons. They also exhibit low abrasion and favourable ageing behaviour.
Their temperature resistance allows them to be used in the range between -55°C and +150°C, depending on the proportion of the monomers used and with any necessary addition of plasticisers. Low temperature resistance and resistance to fuel are in competition here:
The lower the acrylonitrile content, the lower the minimum usage temperature, though the poorer the fuel resistance.

Since HNBR contains hardly any unsaturated double bonds, products made from it are also resistant to oxidation, ozone and UV light. Their resistance to swelling depends largely on the medium with which they come into contact:
- Good resistance to swelling in
  - aliphatic hydrocarbons (e.g. propane, butane, certain mineral oils),
  - animal and vegetable oils and fats and
  - light heating oil and diesel fuel.
- Limited resistance to swelling in
  - media with a high content of aromatic hydrocarbons (e.g. premium fuel).
- Little to no resistance to swelling in
  - aromatic hydrocarbons (e.g. benzene),
  - chlorinated hydrocarbons (e.g. methylene chloride, trichloroethylene),
  - esters, as well as
  - polar solvents.

NBR
NBR stands for acrylo**n**itrile **b**utadiene **ru**bber. Its chemical properties are comparable to those of the HNBR derived from it.
However, due to the double bonds still present in NBR, its resistance to oxygen, ozone and UV light, as well as its temperature resistance of only approx. 100°C are significantly lower.

Material testing

Sealing materials are subjected to various material tests for the purpose of comparability and to ensure their suitability for a particular application (cf. e.g. DIN ISO 1817: Elastomers or thermoplastic elastomers - Determination of behaviour towards liquids).
Two tests are cited here as examples. The first test examines a material property and the second the suitability for a specific application.

Compression set

When used with press connectors, these are usually sealing elements which, when pressing connectors are gently pressed with the pipe and hence deformed by approx. 25% in order to seal the connection. In order to maintain this function for a prolonged period, the material of the sealing element has to remain elastic for a long time without permanently deforming. This behaviour is described with the compression set, which is determined using the test procedure according to DIN EN 681-1, Annex B.
The sealing elements to be tested are clamped in a fixture according to ISO 815 and compressed for a defined time at a specific elevated (ISO 815-1) or low (ISO 815-2) temperature (Fig. 7).

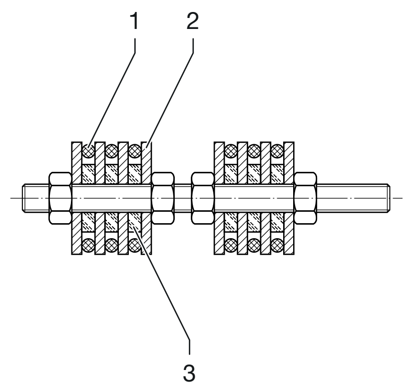


Fig. 7: Setup of the fixture for determining the compression set according to ISO 815

1 Sealing element
2 Stainless steel pressure plate
3 Compression limiter

At the end of the test time, the tested sealing element is measured after being relieved (Fig. 8) and the value of the compression set is calculated.

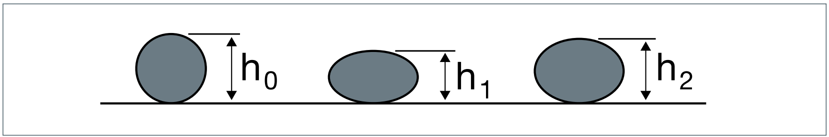


Fig. 8: Measurement of the sealing element before, during and after the test

h_0 original height of the sealing element
h_1 height of the spacer between the test plates = compressed height
h_2 height of the sealing element after relieving

The following formula according to ISO 815 is used to calculate the compression set in percent:

$$DVR = \frac{h_0 - h_2}{h_0 - h_1} \cdot 100$$

The formula shows that a perfectly elastic material would have a compression set of 0%, i.e. return to its original shape completely. This represents the ideal case for a sealing material.
The reverse of this is a plastic material with a compression set of 100%, which does not return to its original shape after being relieved and remains deformed.

For illustration purposes, Fig. 9 shows the profile of the compression set plotted over time at different temperatures.

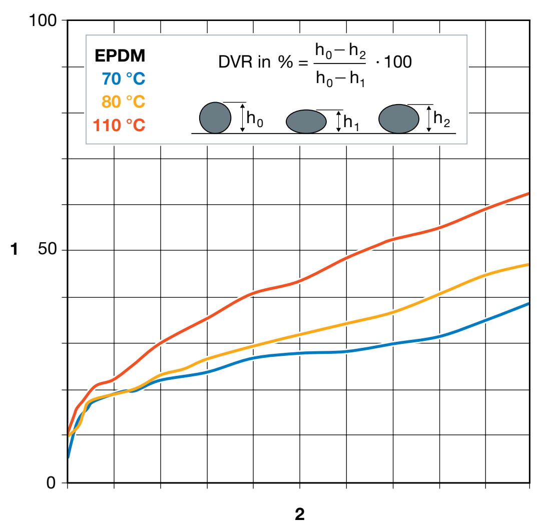


Fig. 9: Compression set for a selected EPDM at different temperatures

1 Compression set [%]
2 Time

Due to the different compositions of various EPDM types, the same test may produce different results (Fig. 10). In simple terms: the smaller the compression set, the better the long-term behaviour of a pipe connection.

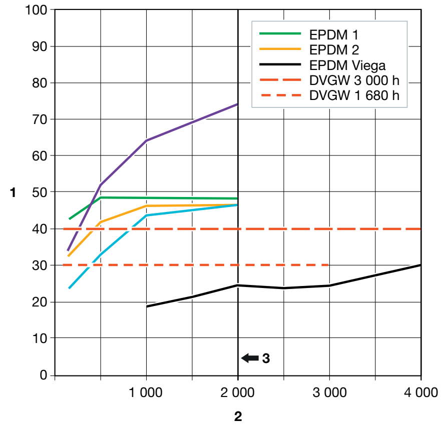


Fig. 10: Compression set for various EPDM types at the same temperature during the test procedure according to DIN EN 681-1

1 Compression set [%]
2 Time [h]
3 End of the DIN test time (2000 h)

Higher thermal resistance (HTR)

The criterion for higher thermal resistance (HTR) is based on the ignition temperature of natural gas in air (approx. 640°C). To prevent the formation of an explosive mixture, in case of fire, no dangerous quantity of gas must escape at any point in the building that is below the ignition temperature.

For gas installations in the domestic sector, only components labelled as "higher thermal resistance (HTR)" may be used. Components that are not HTR-resistant must be separately secured by a thermal shut-off system (TSS). According to DIN 3537-1, the HTB criteria are fulfilled if products resist a fire and remain functional for at least 30 minutes at an operating temperature of 0.1 MPa (1 bar) and an ambient temperature of 650°C. Leak tightness even at extreme ambient temperatures prevents the spread of fire due to gas escaping unchecked and buys time for closing the shut-off systems.

Products that meet the criteria in accordance with DIN 3537-1 at a required max. operating pressure of 0.1 MPa (1.0 bar) are provided with the "GT 1" marking.
Products that achieve the increased thermal capacity even at a higher maximum operating pressure are marked accordingly, e.g. with "GT 5" for the maximum operating pressure of 0.5 MPa (5.0 bar).

Viega solutions

Viega uses the following sealing materials for press connectors, the properties and special features of which are described in detail:

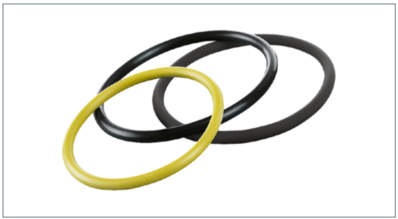


Fig. 11: Sealing elements for Viega press connector

- EPDM
- FKM
- HNBR
- NBR

Viega sealing elements

Viega uses sealing elements made of the materials itemised in Tab. 6 with the properties indicated. They are inserted in the factory into the connectors of the listed Viega press connector systems. Some typical applications of the various sealing materials are shown in Tab. 7.

Acronyms	EPDM[1)]	HNBR	FKM
Material	Ethylene propylene diene rubber	Acrylonitrile butadiene rubber	Fluorine carbon rubber
Colour	Black, polished	Yellow	Black, matt
Max. operating temperature [°C][2)]	110	70	140
Max. operating pressure [MPa (bar)][2)]	1.6 (16)	0.5 (5)	1.6 (16)
Higher thermal resistance (HTR)[3)]	No	Yes	No
Potable water (KTW approval)[4)]	Yes	No	No
Viega press connector system	■ Profipress ■ Sanpress ■ Sanpress LF[5)] ■ Sanpress Inox ■ Sanpress Inox LF[5)] ■ Prestabo ■ Prestabo LF[5)] ■ Megapress ■ Seapress	■ Profipress G[6)] ■ Sanpress Inox G[7)] ■ Megapress G[7)]	■ Profipress S ■ Megapress S

1) Max. oil content in compressed air < 25 mg/m^3, not resistant to hydrocarbon solvents, chlorinated hydrocarbons, turpentine, benzene

2) The values may vary depending on the medium flowing through and other operating conditions or area of application. Send your detailed enquiries to the Viega Service Center using the "Enquiry for material durability" form. You can find the form for this on the Viega website *viega.com* by entering "material durability" as the search term.

3) According to DIN 3537-1

4) Evaluation basis for plastics and other organic materials in contact with potable water (KTW)

5) LF = free of paint-wetting impairment substances (PWIS-free)

6) GT 1 according to DIN 3537-1

7) GT 5 according to DIN 3537-1

Tab. 6: Viega sealing elements – Technical data

Use	Regulations	Operating temperature	Operating pressure [MPa]	Pipe material	Elastomers[6]
Gas house service connections	DVGW Worksheet G459-1/G472	-20°C to 20°C[1]	≤ 1.0	PE/PE-X	NBR
Potable water house service connections	DVGW Worksheet 400 1-3	≤ 20°C	≤ 1.6	PE/PE-X	EPDM
Gas installations	DVGW Worksheet G 600 (TRGI 2018)	-20 °C up to 70 °C	≤ 0.5 – HTB/GT 5 ≤ 0.5 – HTB/GT 1	Stainless steel/steel[8]/ copper	HNBR
Liquid gas installations	DVFG - TRF 2021[2]	-20 °C up to 70 °C	≤ 0.5 – HTB/ GT 5[7] ≤ 0.5 – HTB/ GT 1[7]	Stainless steel/steel[8]/ copper	HNBR
Heating oil installations	TRbF 50[3]	≤ 40°C	-0.05 to 0.5	Stainless steel/steel[8]/ copper	HNBR
Radiant heating and cooling	DIN EN 1264	≤ 50°C	≤ 0.6	Polybutene/PE-X	EPDM
Potable water systems	DIN 1988; DIN EN 806; VDI/ DVGW 6023	60°C to 85°C	≤ 1.0 DEA ≤ 1.6	Stainless steel/copper Multi-layer pipe	EPDM
Potable water heating systems (therm. disinfection)	DIN 1988-200 DVGW-ABW291/ W551/W553	≤ 60°C > 70°C	1.0 0.6 (closed PWH)	Stainless steel/copper Multi-layer pipe	EPDM
Potable water heating systems (heating side)	DIN 1988-200 DIN 4753-1	≤ 95°C (PWH closed) > 95°C (PWH indirect)	1.0 0.6 (closed PWH)	Stainless steel/copper	EPDM
Heating systems (INT-PHWHS)	DIN EN 12 828	≤ 70 °C	≤ 0.6	Copper/steel Multi-layer pipe	EPDM
Local heat supply systems (ground)	AGFW	≤ 95 °C	≤ 1.0	Multi-layer pipe	EPDM
Heating systems (industrial), heat recovery	DIN EN 12 828	≤ 110°C	≤ 0.6	Copper/steel	EPDM
Solar installations, flat collectors	DIN EN ISO 9806/DIN EN 12 976	According to manufacturer's information[4]	≤ 0.6	Stainless steel/copper	EPDM
District heat supply systems	Technical connection conditions, district heat supplier[5]	≤ 140°C	≤ 1.6	Stainless steel/copper/ steel	FKM
Solar installation, vacuum tube collectors	DIN EN ISO 9806/DIN EN 12 976	According to manufacturer's information[4]	≤ 0.6	Stainless steel/copper/ steel	FKM

1) -20°C test criterion for use in gas supply lines
2) Based on DVGW Worksheet G 600 TRGI 2018
3) In conjunction with the approvals from the building authorities
4) Product specific
5) The technical connection conditions of the individual supply companies may differ
6) Short designation for application-specific compounds with the required approvals
7) Maximum pressure – equates to the response pressure of the safety shut-off valve
8) Exclusively in combination with Megapress G

Tab. 7: Areas of application of Viega sealing elements

Replacement of sealing elements in press connectors

The press connectors of Viega piping systems without a letter at the end of their name are generally equipped with EPDM seals in the factory (Tab. 6). The press connectors of Viega piping systems with a "G" in the name (e.g. "Profipress G") are delivered with HNBR sealing elements. The press connectors of Viega piping systems with an "S" in the name (e.g. "Profipress S") are delivered with FKM sealing elements.
It may also be possible, unless the installation is for potable water, to manually replace the factory-fitted EPDM sealing elements with Viega sealing elements made of FKM on site if necessary. As a result, the Sanpress, Sanpress Inox, Prestabo and Seapress Viega piping systems can be used even at higher temperatures or with other media if necessary.

When selecting materials for fittings, pipes and sealing elements, the special operating and installation conditions, as well as other system requirements, must be considered on a case-by-case basis.

Send your detailed enquiries to the Viega Service Center using the "Enquiry for material durability" form. You can find the form for this on the Viega website *viega.com* by entering "material durability" as the search term.

Replacement of sealing elements in press connectors 12–54 mm

> **NOTE!**
> Do not use pointed or sharp-edged objects to remove the sealing element. They may damage the sealing element or the bead.

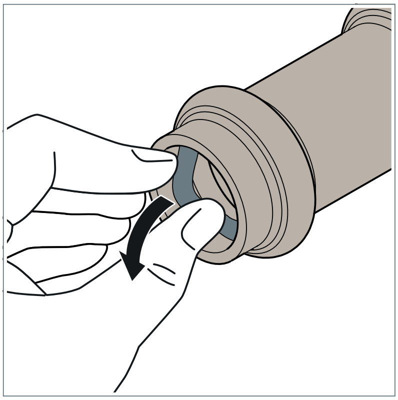


Fig. 12: Removal of sealing element from press connectors – 12–54 mm

- Remove the sealing element.

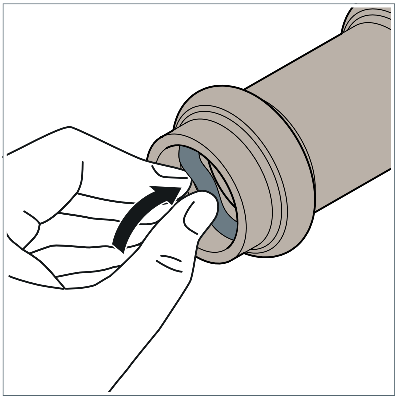


Fig. 13: Insertion of sealing element into press connectors – 12–54 mm

- Insert a new, undamaged sealing element into the bead.
- Ensure that the sealing element is completely in the bead.

Replacement of sealing elements XL press connectors 64.0 – 108.0 mm

CAUTION!
Risk of injury due to sharp edges
There is a separator ring and a sharp-edged cutting ring above the sealing element. There is a risk of injury (cutting) when replacing the sealing element.
- Do not reach into the press connector with your bare hands.

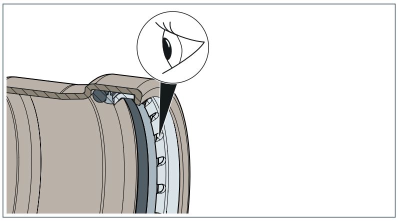


Fig. 14: Cutting ring of an XL press connector – 64.0 – 108.0 mm

NOTE!
Do not use pointed or sharp-edged objects to remove the sealing element. They may damage the sealing element or the bead.

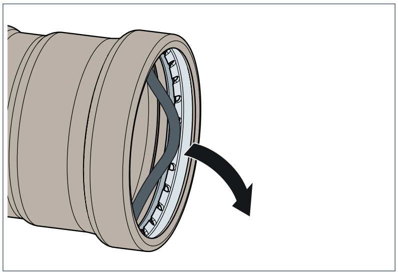


Fig. 15: Removal of the sealing element from XL press connectors – 64.0 – 108.0 mm

- Remove the sealing element from the bead, leaving the separator ring in the press connector.
- Proceed carefully to avoid damaging the separator ring and sealing element seat.

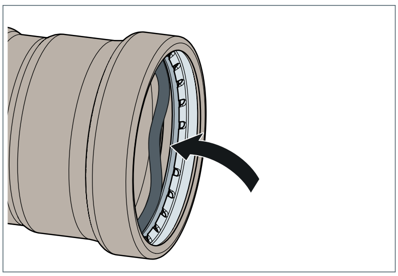


Fig. 16: Insertion of the sealing element into XL press connectors – 64.0 – 108.0 mm

- Insert a new, undamaged sealing element into the bead. Make sure that the sealing element is not damaged by the cutting ring.
- Ensure that the sealing element is completely in the bead.

Replacement of the sealing element in Megapress press connectors ⅜–4 inch

The Megapress systems were developed specifically for the intended areas of application concerned. The components (cutting ring, separating ring and sealing element) installed in the press connector in the factory are precisely matched to one another to suit the different requirements of the areas of application. For all Megapress systems, therefore, the factory-fitted sealing element has to be replaced 1:1 (e.g. FKM for FKM).

Megapress and Megapress G press connectors

Megapress and Megapress G press connectors up to 2 inches are equipped with specifically designed EPDM or HNBR profile sealing elements. Integrally moulded sealing lips with several sealing levels reliably seal pipe surfaces, even those with slightly uneven surfaces or grooves.

Fig. 17: Megapress profile sealing element up to 2 inches

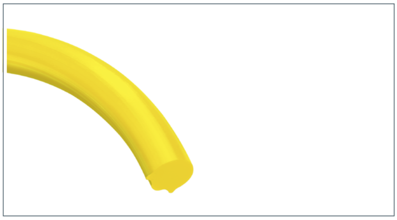


Fig. 18: Megapress G profile sealing element up to 2 inches

Megapress S press connectors

All Megapress S press connectors are fitted with FKM sealing elements.
In the dimensions of ⅜ to 2 inches, the press connectors include a round sealing element and a reinforced separator ring.
The XL press connectors in the dimensions 2½, 3 and 4 inches are equipped with round sealing elements with an increased cord thickness.
Given their design, the Megapress S press connectors have the same sealing properties as the Megapress press connectors and therefore do not require a profile.

Fig. 19: Megapress S round sealing element up to 2 inches

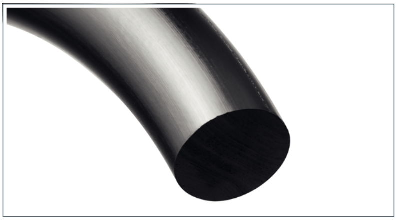


Fig. 20: Megapress S XL round sealing element from 2½ inches

Replacement of sealing elements up to 2 inches

CAUTION!
Risk of injury due to sharp edges
There is a separator ring and a sharp-edged cutting ring above the sealing element. There is a risk of injury (cutting) when replacing the sealing element.
- Do not reach into the press connector with your bare hands.

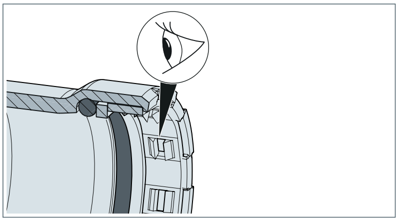


Fig. 21: Cutting ring

NOTE!
Do not use pointed or sharp-edged objects to remove the sealing element. They may damage the sealing element or the bead.

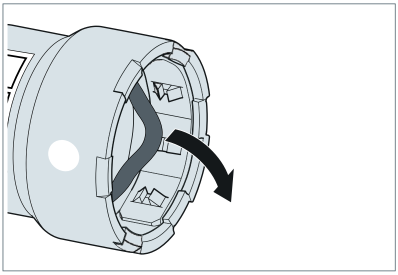


Fig. 22: Removal of the sealing element from press connectors – up to 2 inches

- Remove the sealing element from the bead, leaving the separator ring in the press connector.
- Proceed carefully to avoid damaging the separator ring and sealing element seat.

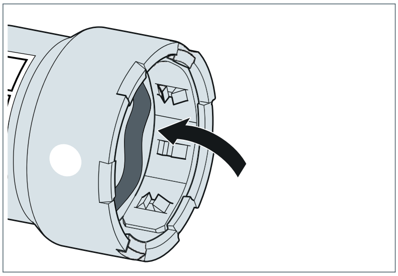


Fig. 23: Insertion of the sealing element into press connectors – up to 2 inches

- Insert a new, undamaged sealing element into the bead. Make sure that the sealing element is not damaged by the cutting ring.
- Ensure that the sealing element is completely in the bead.

Replacement of sealing elements from 2½ inches

> **CAUTION!**
> **Risk of injury due to sharp edges**
> There is a separator ring and a sharp-edged cutting ring above the sealing element. There is a risk of injury (cutting) when replacing the sealing element.
> - Do not reach into the press connector with your bare hands.

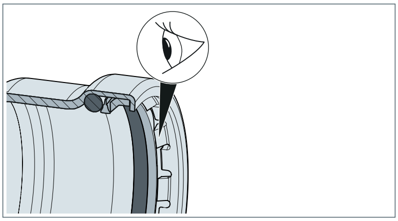


Fig. 24: Cutting ring

> **NOTE!**
> Do not use pointed or sharp-edged objects to remove the sealing element. They may damage the sealing element or the bead.

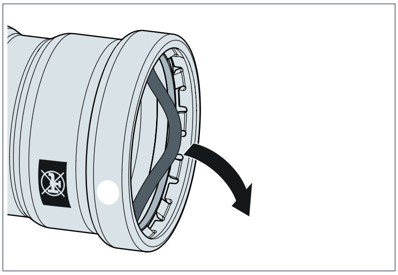


Fig. 25: Removal of the sealing element from press connectors – from 2½ inches

- Remove the sealing element from the bead, leaving the separator ring in the press connector.
- Proceed carefully to avoid damaging the separator ring and sealing element seat.

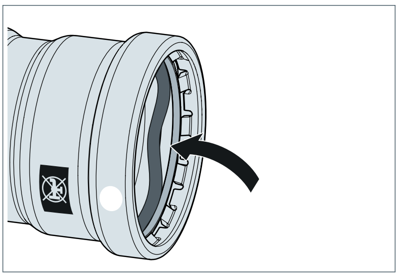


Fig. 26: Insertion of the sealing element into press connectors – from 2½ inches

- Insert a new, undamaged sealing element into the bead. Make sure that the sealing element is not damaged by the cutting ring.
- Ensure that the sealing element is completely in the bead.

Sealing elements for flange connections

With the Viega press connector systems, a direct transition to flange connections is possible with press connections.
Seals for flange connections must be selected according to the requirements from AFM 34/2 (asbestos-free) and are likewise available from Viega.

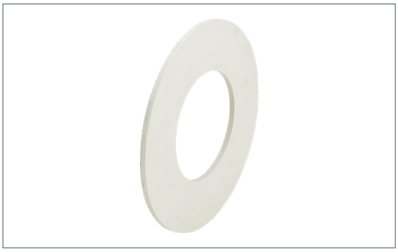


Fig. 27: AFM 34/2 sealing elements for flange connections

Electrically-insulating sealing elements for threaded connections

In an installation with dissimilar metallic pipe materials and a transition from a galvanised steel pipe to e.g. stainless steel or copper, Sanpress insulating unions should be installed for potable water hardness levels > 15°dH in order to prevent contact corrosion and scaling.

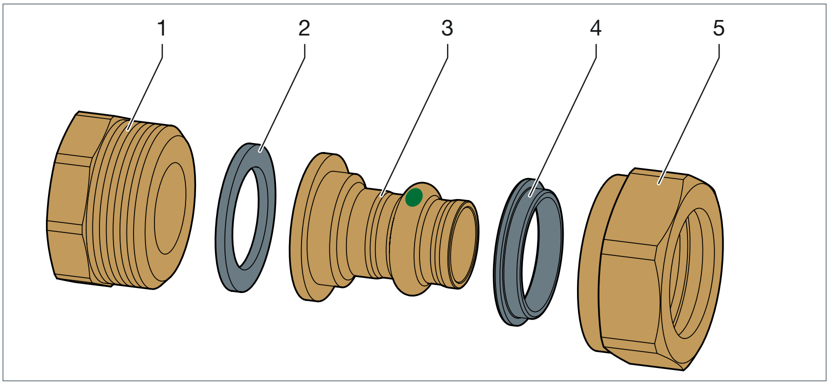


Fig. 28: Insulating union with EPDM flat seal

1 Threaded sockets made of gunmetal or silicon bronze with RP internal thread according to DIN EN 10226
2 EPDM flat seal, not electrically conductive
3 Sanpress press connection for connection screw fittings made of gunmetal or silicon bronze with SC-Contur
4 Insulating ring for electrical isolation
5 Union nut

PWIS-free sealing elements

In certain applications, all components of an installation have to be free of paint-wetting impairment substances (PWIS) (see „PWIS conformity“ on page 169).

PWIS-free press connectors from Viega are specially cleaned after the production process and fitted with sealing elements with PWIS-free lubricants. They are then marked with a blue dot and packed.

Fig. 29: Sanpress Inox LF with PWIS-free sealing element

General mounting instructions

Producing a press connection

Bending of pipes

Stainless steel and copper pipes must be bent with suitable machines.
The minimum bending radius for Sanpress pipes is R ≥ 3.5 d. Generally speaking:

- The expansion bends must be straight and at least 50 mm in order to create a correct press connection.
- Avoid bending stresses between elbows and press connectors.
- Check compatibility with pipe materials before using bending sprays.
- Stainless steel pipes may only be bent when cold. Heat treatment changes the material properties and thus must be avoided.

Flange connections

With metal press connector systems, a direct transition to flange connections is possible with press connections in sizes 28 to 108 mm.
For Sanpress Inox, flanges made of stainless steel with press connections in sizes 22 to 108 mm are available.
Select seals for flange connections according to the requirements from AFM 34/2 or asbestos-free sealing material.

Sanpress Inox

Fig. 30: Sanpress Inox fixed flange

Sanpress Inox

- Material: 1.4401 stainless steel
- Model: 2359
- Press connection size: 22–54 mm

Fig. 31: Sanpress Inox XL fixed flange

Sanpress Inox XL

- Material: 1.4401 stainless steel
- Model: 2359XL
- Press connection size: 64–108 mm

Sanpress

Fig. 32: Sanpress loose flange

Sanpress
- Material: steel, black powder-coated
- Press connection material: Gunmetal/silicon bronze
- Model: 2259.5
- Press connection size: 28–54 mm

Fig. 33: Sanpress XL loose flange

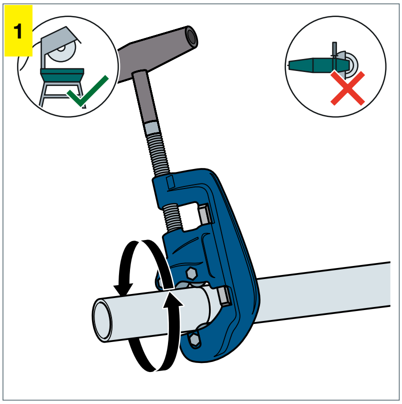
Sanpress XL
- Material: steel, black powder-coated
- Press connection material: Gunmetal/silicon bronze
- Model: 2259.5XL
- Press connection size: 76.1–108 mm

Press connections

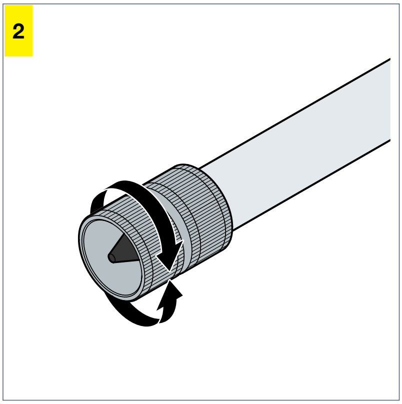
> **NOTE!**
> **Risk of property damage!**
> For stainless steel, the use of angle grinders for cutting pipes to length is not permitted.

Sanpress, **Sanpress Inox**, **Profipress**, **Prestabo 12 to 54 mm**
Stainless steel, copper and steel pipes are connected simply and safely with Viega press connections.
Required tools:
- Pipe cutter or fine-toothed steel saw – the use of angle grinders is not permitted for stainless steel
- Deburrer and coloured pen for marking the insertion depth
- Suitable press machine with press jaw

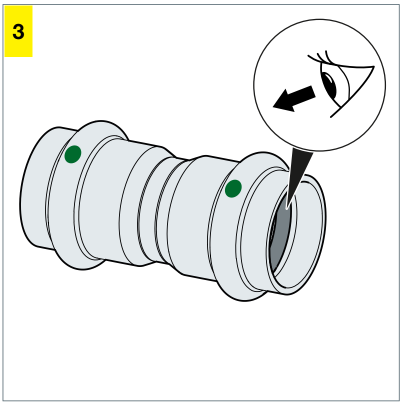
The figures below show the processing of a Sanpress Inox article as an example.



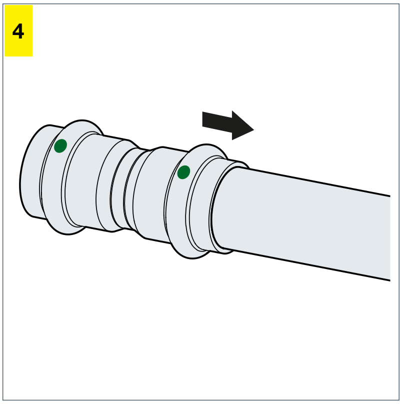
- Cut pipe to length.



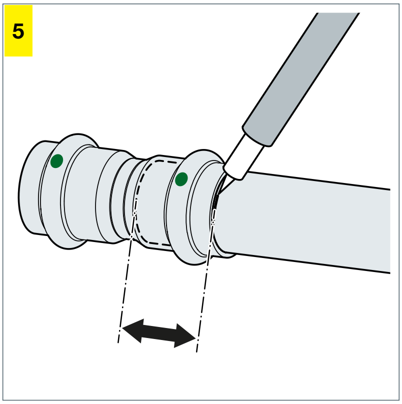
- Deburr the inside and outside of the pipe.



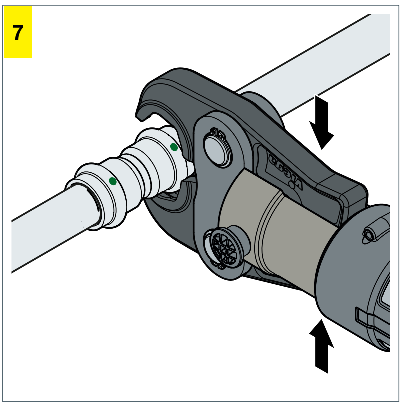
- Ensure that the sealing element is properly positioned



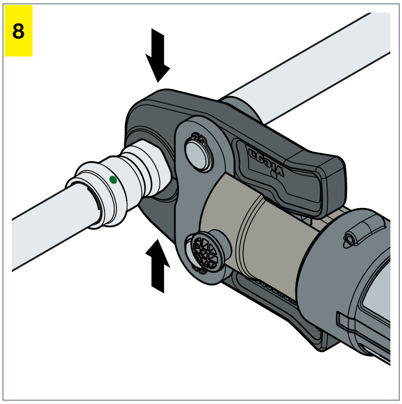
- Push the press connector onto the pipe as far as it will go.



- Mark the insertion depth.



- Open the press jaw and place it at a right-angle onto the press connector.
- Check insertion depth.
- Start pressing.

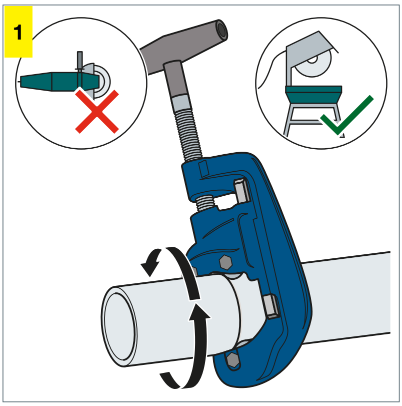


- Once pressing is complete, open the press jaw.

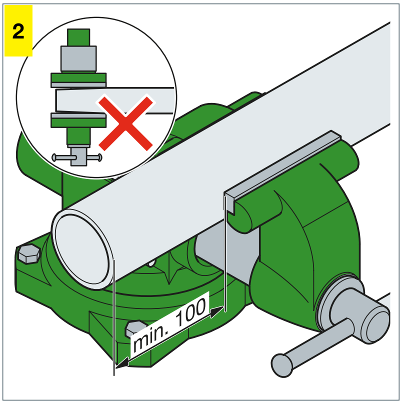
Sanpress XL 76.1 to 108.0 mm
Stainless steel and copper pipes are connected simply and safely with Viega press connections.
Required tools:

- Pipe cutter or fine-toothed steel saw – the use of angle grinders is not permitted for stainless steel
- Deburrer and coloured pen for marking the insertion depth
- Suitable press machine
- Suitable sized press chain and hinged adapter jaw for press chain (press rings are not suitable)

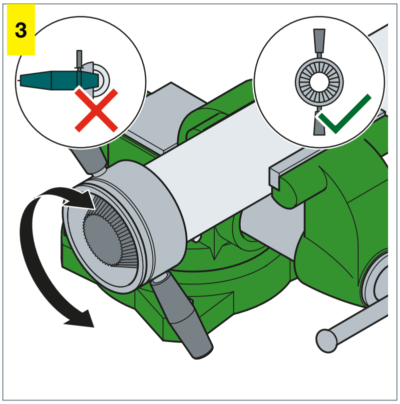
The figures below show only the processing of the Sanpress XL article.



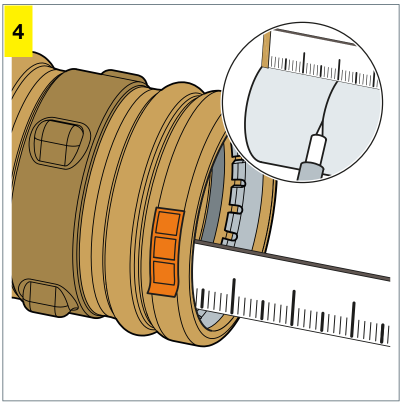
- Cut pipe to length.



- Caution when clamping! The pipe ends must be absolutely round.

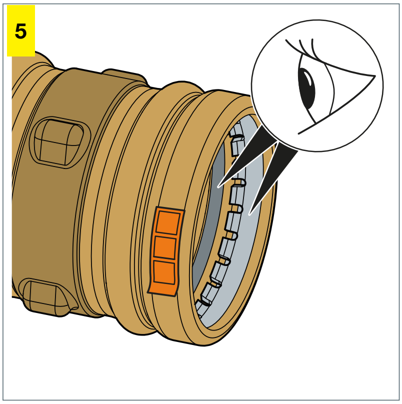


- Deburr the inside and outside of the pipe.

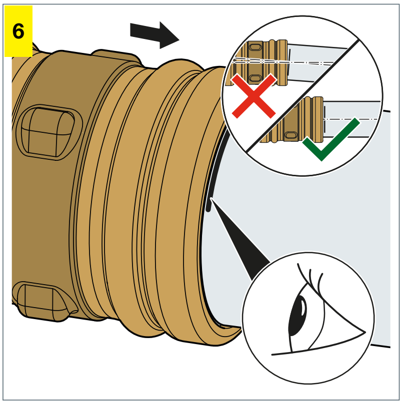


- Mark the insertion depth on the pipe.

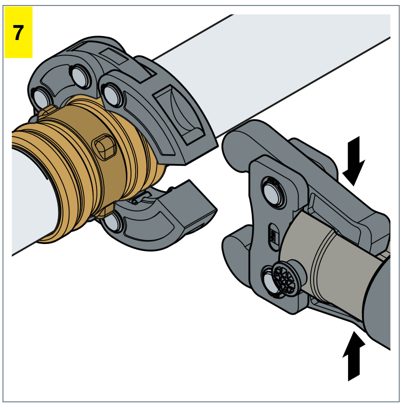
ø	Insertion depth
76.1 mm	55 mm
88.9 mm	55 mm
108.0 mm	65 mm



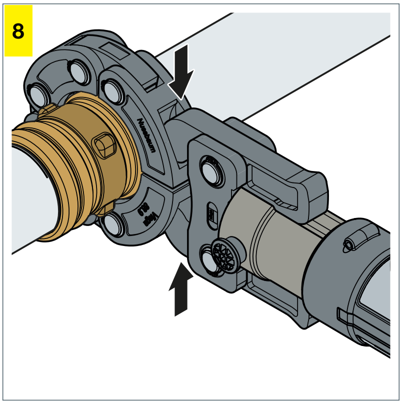
- Ensure the sealing element and cutting ring are properly seated.



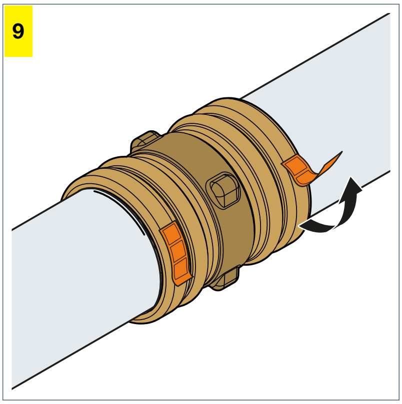
- Push the press connector up to the marked insertion depth on the pipe.



- Place the hinged adapter jaw for the press chain onto the press machine and push in the retaining bolt until it clicks into place.
- Position the press chain on the connector.
- Open the press hinged adapter jaw and engage in the seat of the press chain.



Attach the press machine and perform pressing.



Remove the control label to mark the connection as "pressed"

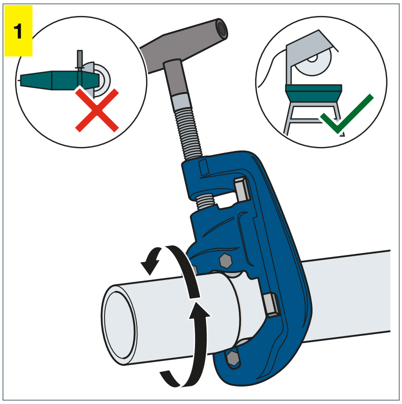
Sanpress Inox XL, Profipress XL, Prestabo XL 64.0 to 108.0 mm
Stainless steel, copper and steel pipes are connected simply and safely with Viega press connections.
Required tools:

- Pipe cutter or fine-toothed steel saw – the use of angle grinders is not permitted for stainless steel
- Deburrer and coloured pen for marking the insertion depth
- Suitable press machine
- Suitable sized press rings and hinged adapter jaw

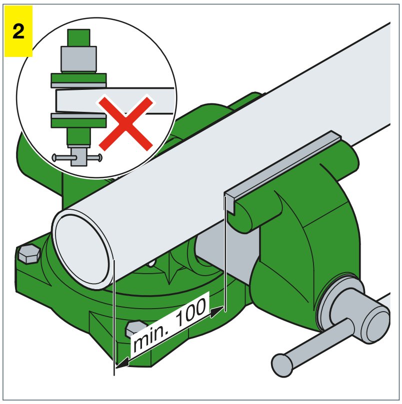
Differences to using Sanpress XL press connectors:

- Different insertion depths (step „4“)
- Use of press rings instead of press chains (step „7“)
- Use of hinged adapter jaws instead of adapter jaws (step „7“)

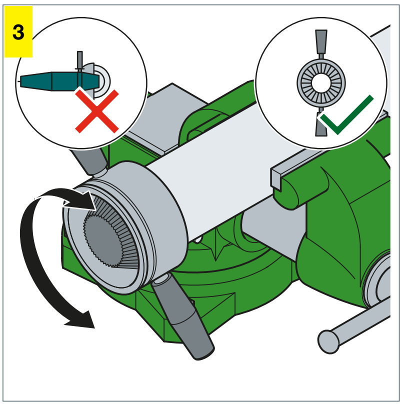
The figures below show the processing of a Sanpress Inox XL article as an example.



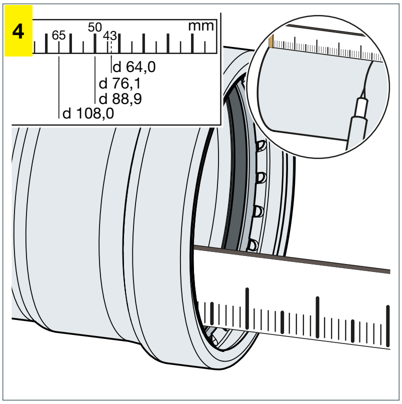
Cut pipe to length.



Caution when clamping! The pipe ends must be absolutely round.

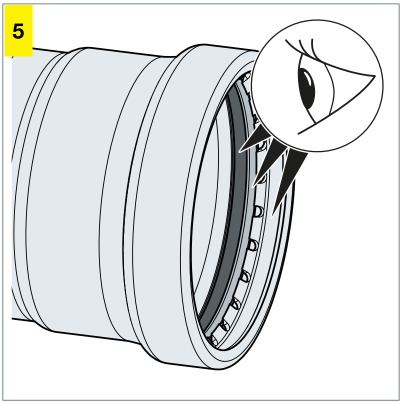


Deburr the inside and outside of the pipe.

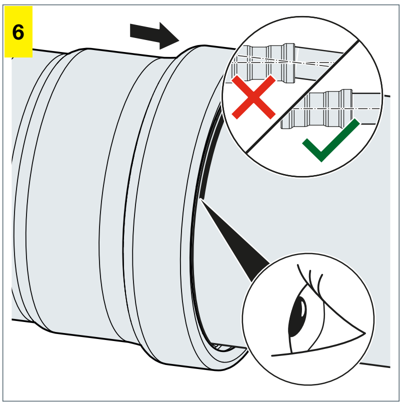


- Mark the insertion depth on the pipe.

ø	Insertion depth
64.0 mm	43 mm
76.1 mm	50 mm
88.9 mm	50 mm
108.0 mm	65 mm

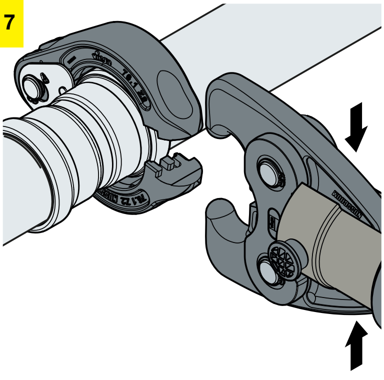


- Ensure sealing element, separator ring and cutting ring are properly seated.



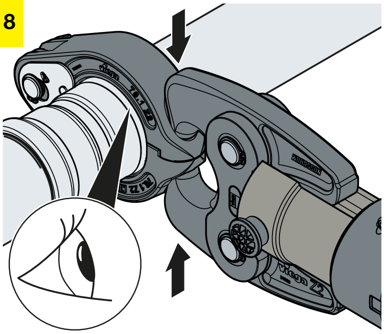
- Push the press connector up to the marked insertion depth on the pipe.

7



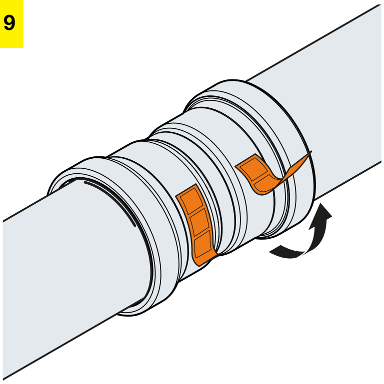
- Place the hinged adapter jaw for the press ring onto the press machine and push in the retaining bolt until it clicks into place.
- Place the press ring on the connector – open the hinged adapter jaw and engage in the recesses of the press ring.

8



- Attach the press machine and perform pressing.

9

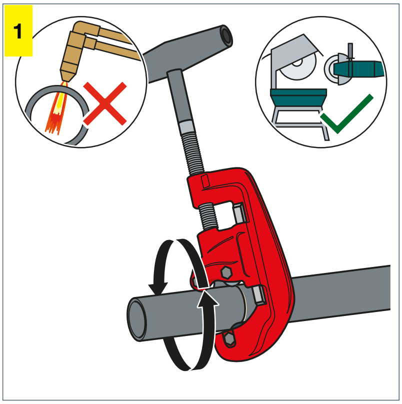


- Remove the control label to mark the connection as "pressed".

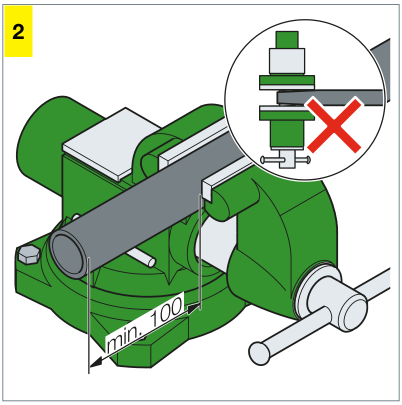
Megapress - Creation of the press connection up to 2 inches
Steel pipes are connected simply and safely using Viega press connections.
Required tools:

- Pipe cutter, angle grinder or fine-toothed steel saw
- Deburrer and coloured pen for marking the insertion depth
- Suitable press machine
- Suitable sized press jaws or suitable sized press rings with hinged adapter jaw

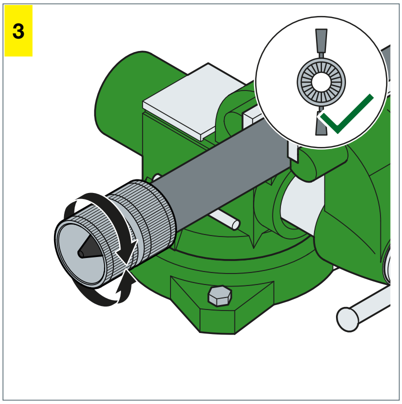
The figures below show the processing of a Megapress S article as an example.



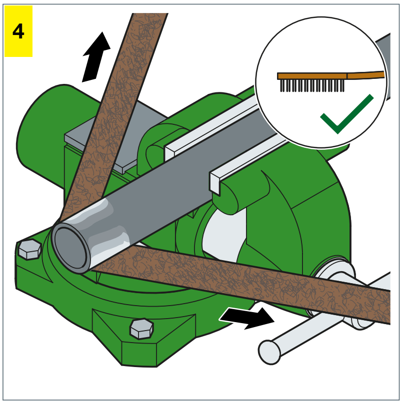
- Cut the steel pipe properly and at a right angle using a pipe cutter, angle grinder or fine-toothed hacksaw. Do not use a flame cutter.



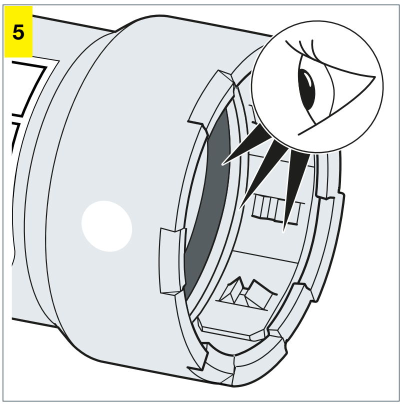
- Proceed with caution when clamping the pipe – avoid deformation of the pipe end.



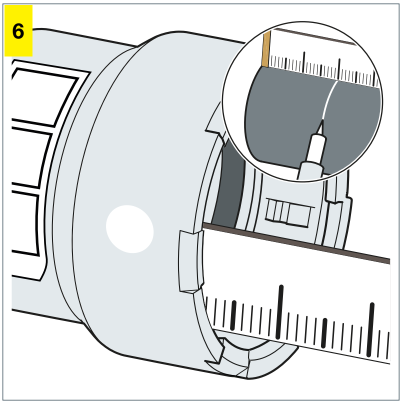
- Use a deburrer to deburr the inside and outside of the pipe – up to DN40 use model 2292.2, DN50 use model 2292.4XLXL



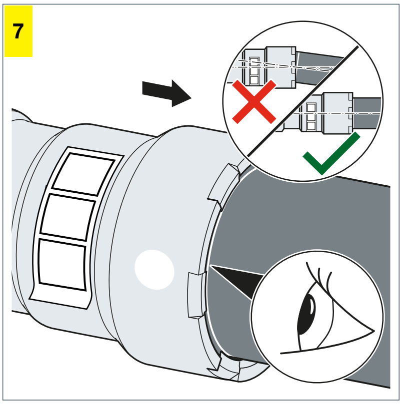
- With the help of a wire brush, sanding paper or an angle grinder with a fan washer, remove loose dirt and rust particles from the pressing area.



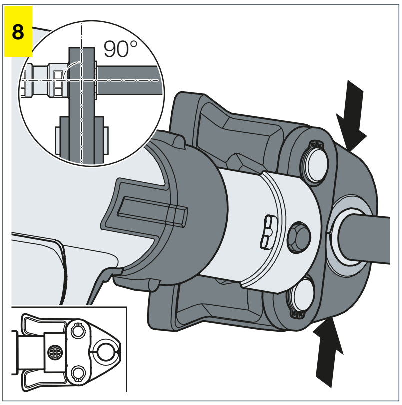
- Ensure sealing element, separator ring and cutting ring are properly seated.



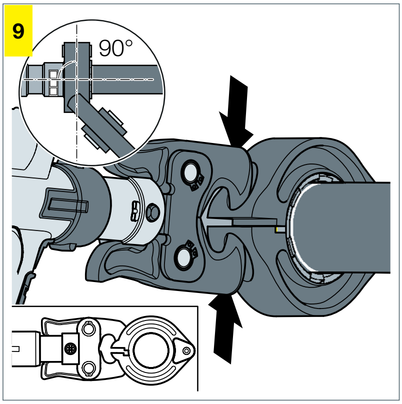
- Measure the insertion depth and mark it on the pipe.



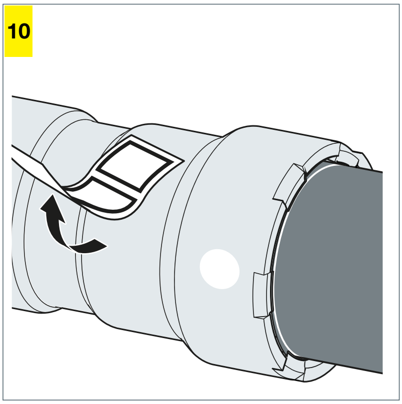
- Push the press connector onto the pipe as far as it will go. Do not tilt the press connector. Check insertion depth.



- Place the Megapress press jaw (≤ DN25) around the press connector. Ensure it is properly seated. Carry out the pressing until the press jaw is completely closed.



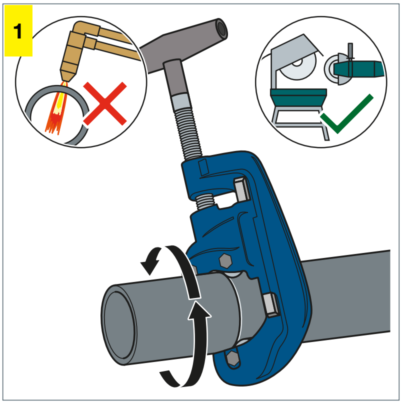
Place the Megapress press ring around the press connector. Ensure that it is properly fitted. Carry out the pressing using the hinged adapter jaw until the press ring is completely closed.



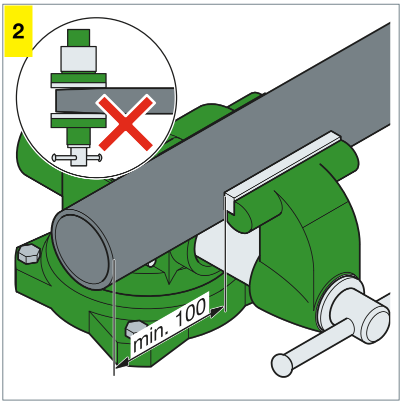
Remove the control label to mark the connection as "pressed".

Megapress XL – Creation of the press connection from 2½ to 4 inches
Steel pipes are connected simply and safely using Viega press connections.
Required tools:
- Pipe cutter, angle grinder or fine-toothed steel saw
- Deburrer and coloured pen for marking the insertion depth
- Suitable press machine
- Pressgun Press Booster
- Suitable sized press rings

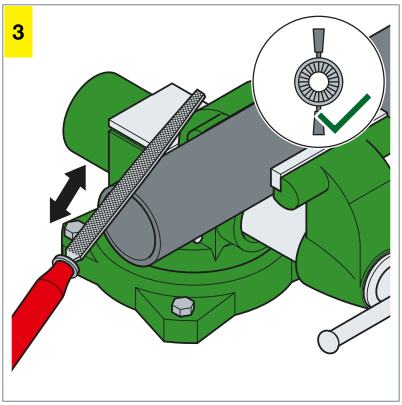
The figures below show the processing of a Megapress S XL article as an example.



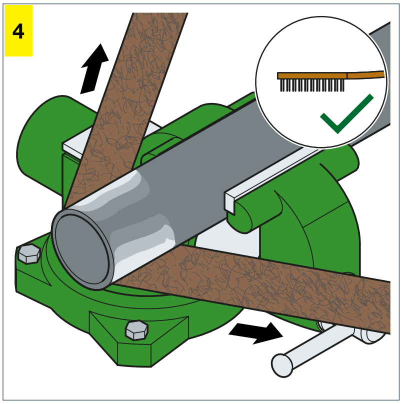
- Cut the steel pipe properly and at a right angle using a pipe cutter, angle grinder or fine-toothed hacksaw. Do not use a flame cutter.



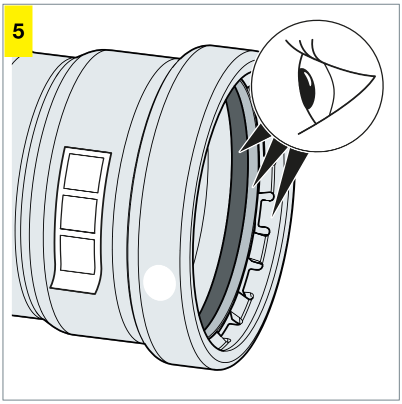
- Proceed with caution when clamping the pipe – avoid deformation of the pipe end.



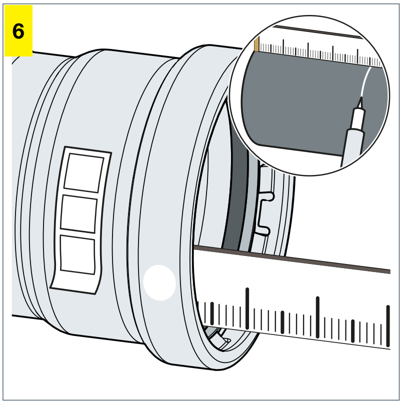
- Properly deburr the inside and outside of the pipe.



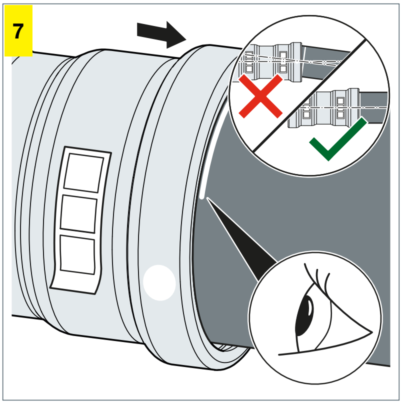
- With the help of a wire brush, sanding paper or an angle grinder with a fan washer, remove loose dirt and rust particles from the pressing area.



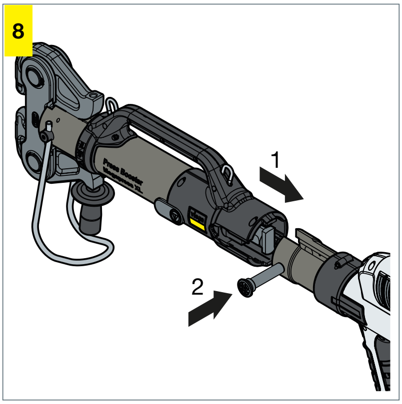
- Ensure sealing element, separator ring and cutting ring are properly seated.



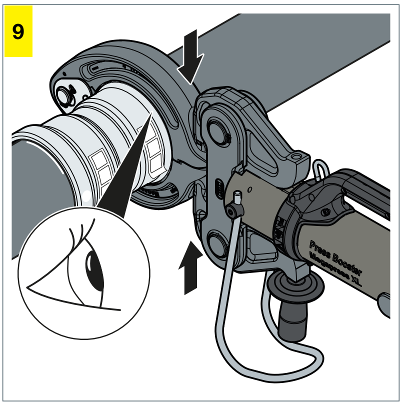
- Measure the insertion depth and mark it on the pipe.



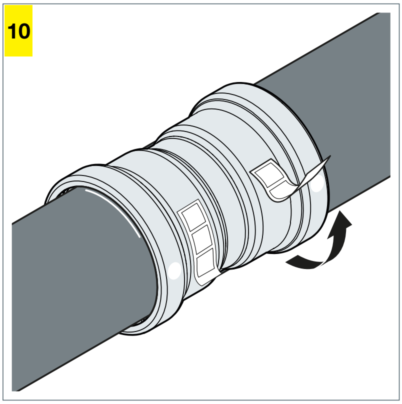
- Push the press connector onto the pipe as far as it will go. Do not tilt the press connector. Check insertion depth.



- Place the Press Booster in the press machine and lock in place using the retaining bolt.



- Place the Megapress XL press ring around the press connector. Observe the proper fit of the press ring.
- Trigger pressing twice, carry out a reset stroke if necessary.



- Remove the control label to mark the connection as "pressed".

Insertion depths

Observe the following insertion depths for the Megapress systems:

Dimension		Minimum insertion depth
inch	[mm]	[mm]
⅜	17.2	24
½	21.3	27
¾	26.9	29
1	33.7	34
–	38.0	42
1¼	42.4	46
–	44.5	48
–	48.3	48
1½	57.0	48
2	60.3	50
2½	76.1	46
3	88.9	59
4	114.3	80

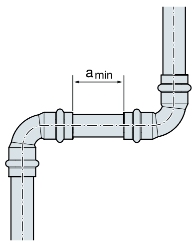
Tab. 8: Minimum insertion depths for Megapress press connector

Space requirement when pressing

For technically fault-free pressing, some space is required for placing the press machine. See the following tables for information on the minimum space required between the pressings.

Minimum distance between the pressings

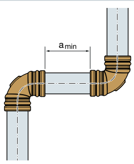
Pipe sizes 12 to 54 mm
For Sanpress, Sanpress Inox, Profipress and Prestabo



d [mm]	Minimum distance a [mm]
12	0
15	
18	
22	
28	
35	10
42	15
54	25

Tab. 9: Interval between the pressings

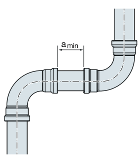
Pipe sizes 76.1 to 108.0 mm – with press chain
Exclusively for Sanpress XL



d [mm]	Minimum interval a [mm]
76.1	0
88.9	
108.0	

Tab. 10: Interval between the pressings

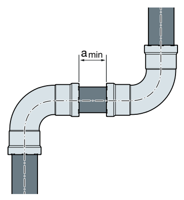
Pipe sizes 64.0 to 108.0 mm – with press ring
For Sanpress Inox XL, Profipress XL (64.0 mm) and Prestabo XL



d [mm]	Minimum interval a [mm]
64.0	0
67.1	
88.9	
108.0	

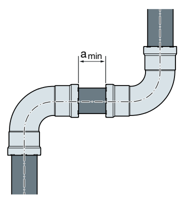
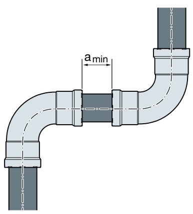
Tab. 11: Interval between the pressings

Megapress press jaws to DN25

	d [mm]	Minimum interval a [mm]
	⅜	5
	½	
	¾	
	1	

Tab. 12: Minimum space required between the pressings – press jaws up to DN25

Megapress press rings DN 15 – DN100

	d [mm]	Minimum interval a [mm]
	½	15
	¾	
	1¼	
	1½	
	2	
	2½	
	3	
	4	

Tab. 13: Minimum space required between the pressings – press rings DN15–DN100

Length expansion

Heat-induced linear expansion in installation systems causes severe stress in piping and device connections. Therefore, compensators or expansion compensators must be installed in very long pipe sections.
Expansion compensators are pipe routes with U- or Z-shaped expansion bends which, given their length and fixation type, are able to absorb movements.

Pipe material	Heat expansion coefficient [mm/m·K]	Linear expansion with pipe length = 20 m and ΔT = 50 K [mm]
Stainless steel (1.4401)	0.0165	16.5
Stainless steel (1.4521/1.4520)	0.0108	10.8
Steel (non-alloyed/ galvanised)	0.0120	12.0
Copper	0.0166	16.6
Plastic	0.08–0.18	80.0–180.0

Tab. 14: Linear expansion of pipe materials

Expansion compensation

If the installation situation allows U-shaped and Z-shaped expansion compensators, their expansion bend lengths can be calculated as follows:

- Determine the largest possible temperature difference Δϑ.
- Determine the pipe length l_0.
- Use these values to calculate the total length by which the pipeline section is extended.
- Then read off the necessary pipe bend length L_{BZ} or L_{BU} for the respective pipe sizes using the diagrams on the following pages.

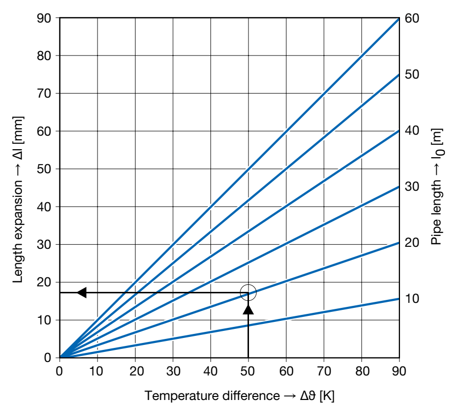


Fig. 34: Linear expansion of pipes made of copper and 1.4401 stainless steel

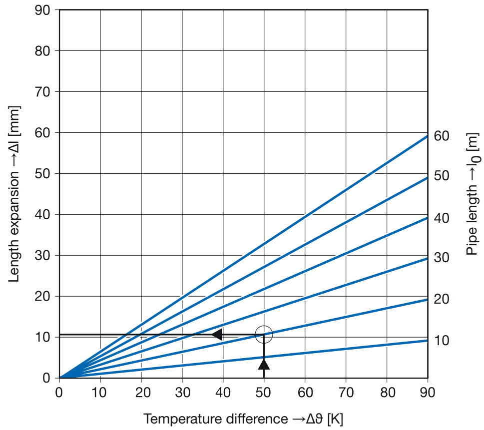


Fig. 35: Linear expansion of 1.4521/1.4520 stainless steel pipes

Example

- The operating temperature is between 10 and 60°C.
  Hence, $\Delta\vartheta = 50\,K$.
- The pipeline section has a length of $l_0 = 20\,m$.
- The coefficient of linear expansion for copper pipe is
  $\alpha = 0.0165$ [mm/mK].
- Insert values into the formula $\Delta l = \alpha[mm/mK] \cdot L[m] \cdot \Delta\vartheta[K]$
  Consequently:
  Linear expansion $\Delta l = 0.0165\,[mm/m \cdot K] \cdot 20\,[m] \cdot 50\,[K] = 16.5\,mm$
- Selection of the U or Z shape depending on the available space.
- Reading off of the necessary expansion bend length L_B from the U or Z diagram. In this example for a Z-shaped expansion bend: On the vertical axis at 16.5 mm, trace horizontally to the line of the pipe size used and read off the necessary expansion bend length below on the horizontal axis.

When the nominal pipe diameter is d 28 mm, the expansion bend length is $L_{BZ} = 1.3\,m$.

Determination of the expansion bend length for stainless steel and copper pipes with d ≤ 54 mm

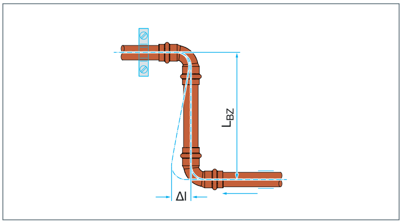


Fig. 36: For the Z shape with expansion bend L_{BZ}

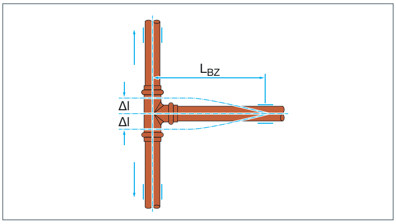


Fig. 37: For the T shape with expansion bend L_{BZ}

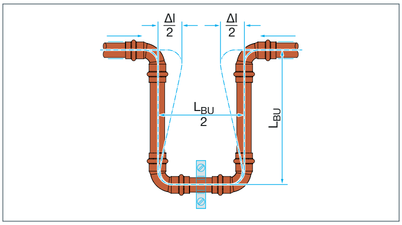


Fig. 38: For the U shape with expansion bend L_{BU}

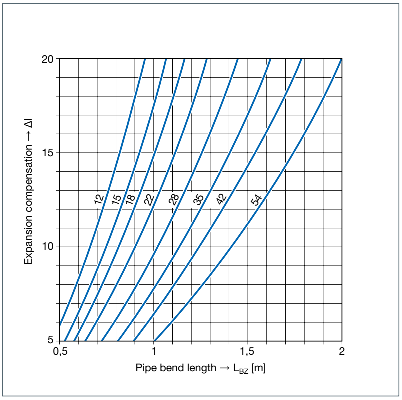


Fig. 39: Length determination for Z-shaped and T-shaped expansion bend

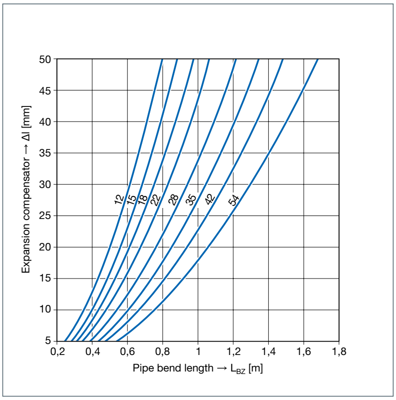


Fig. 40: Length determination for U-shaped expansion bend

Determination of the expansion bend length for stainless steel and copper pipes with d ≥ 64 mm

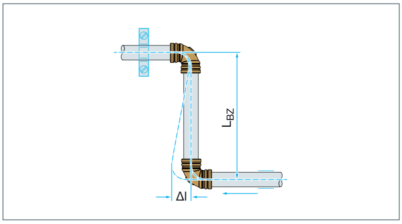


Fig. 41: For the Z shape with expansion bend L_{BZ}

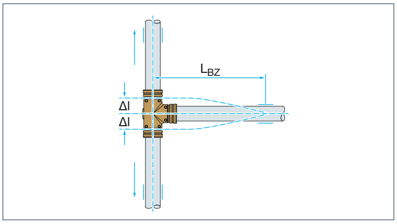


Fig. 42: For the T shape with expansion bend L_{BZ}

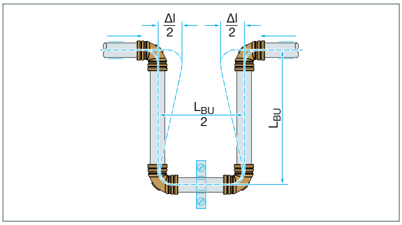


Fig. 43: U shape with expansion bend L_{BU}

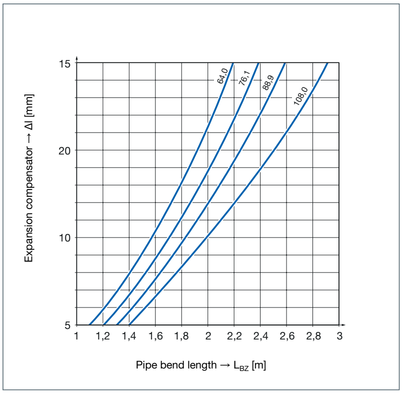


Fig. 44: Length determination for Z-shaped and T-shaped expansion bend

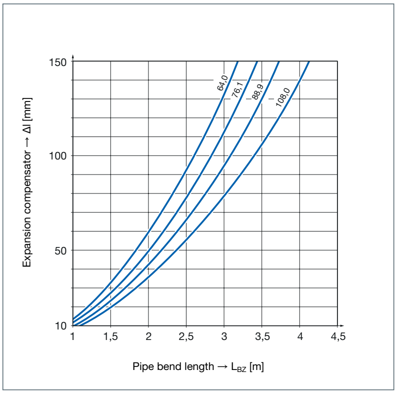


Fig. 45: Length determination for U-shaped expansion bend

Determination of the expansion bend length for steel piping from ⅜ up to 4 inches

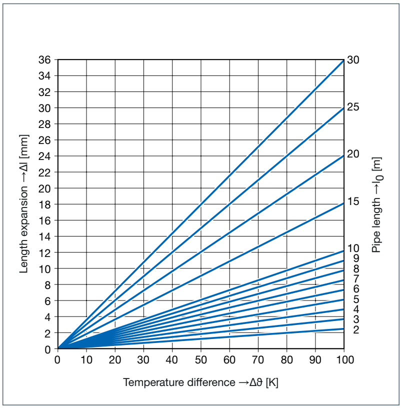


Fig. 46: Linear expansion steel pipes

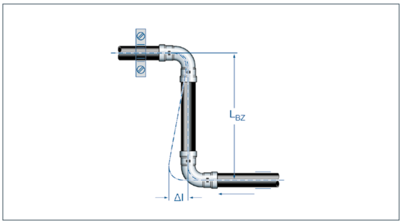


Fig. 47: For the Z shape with expansion bend L_{BZ}

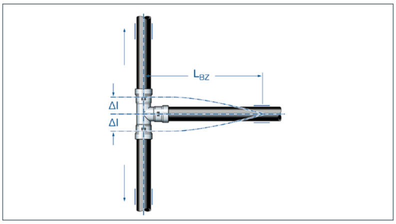


Fig. 48: For the T shape with expansion bend L_{BZ}

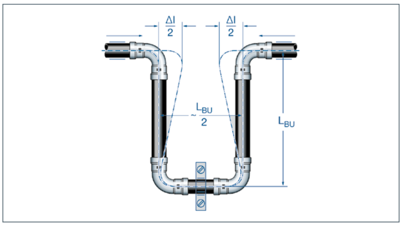


Fig. 49: U shape with expansion bend L_{BU}

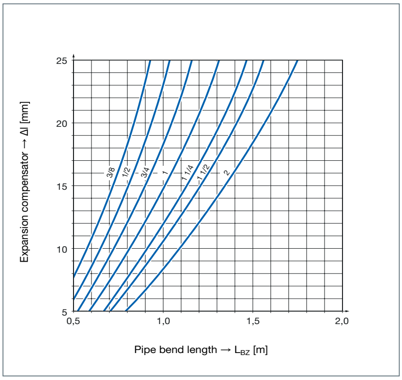


Fig. 50: Z-shaped and T-shaped expansion bends for Megapress/ Megapress S ⅜–2 inches

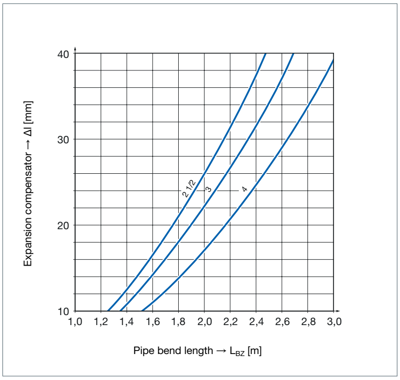


Fig. 51: Z-shaped and T-shaped expansion bends for Megapress S XL 2½–4 inches

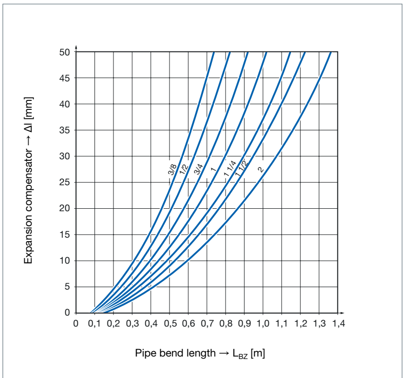


Fig. 52: U-shaped expansion bend for Megapress/Megapress S ⅜–2 inches

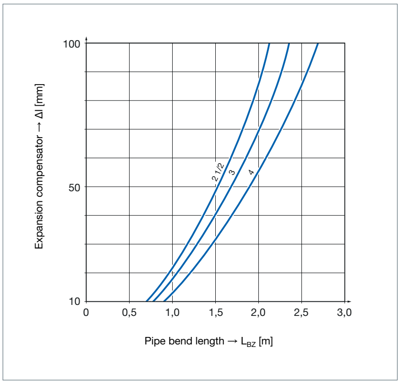


Fig. 53: U-shaped expansion bend for Megapress S XL 2½–4 inches

Compensators

The alternative to expansion compensators are compensators. They are ideal for absorbing axial movements in pipeline installations at operating temperatures between 20 and 110°C.

Features

- Space-saving alternatives to expansion compensators
- No preloading required
- Sound-absorbing
- Long-lasting and corrosion-resistant
- Suitable for mixed installations

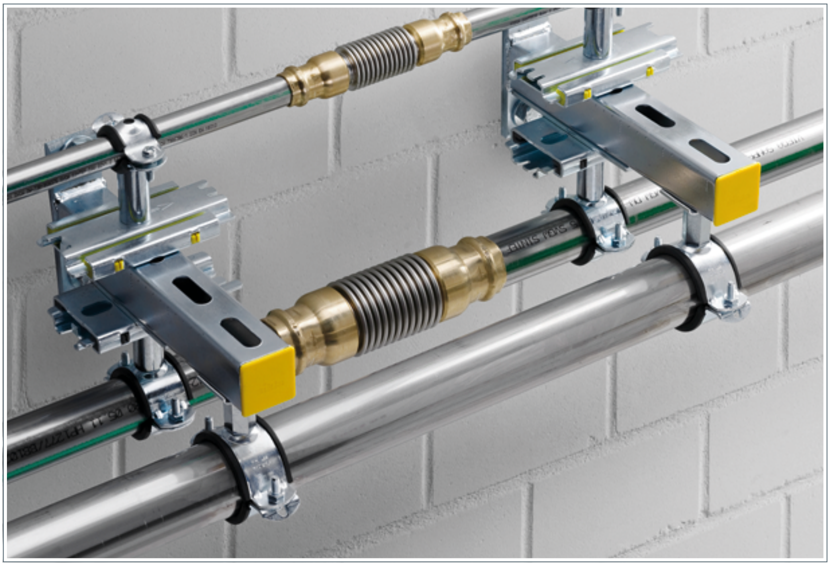


Fig. 54: Axial compensators

Mounting instructions

Piping is to be fixed in such a way that non-permitted radial and torsion loads are avoided. The fixing points must be dimensioned in such a way that they can absorb the considerable forces caused by temperature-related changes in length.

It is important that the fixing points and sliding pipe connections are arranged correctly.

- Always lay piping in a straight line.
- Prevent radial and torsion loads.
- Only one compensator is allowed to be placed between two fixing points.
- Do not use compensators to change direction.
- Protect the stainless steel bellows from mechanical damage.

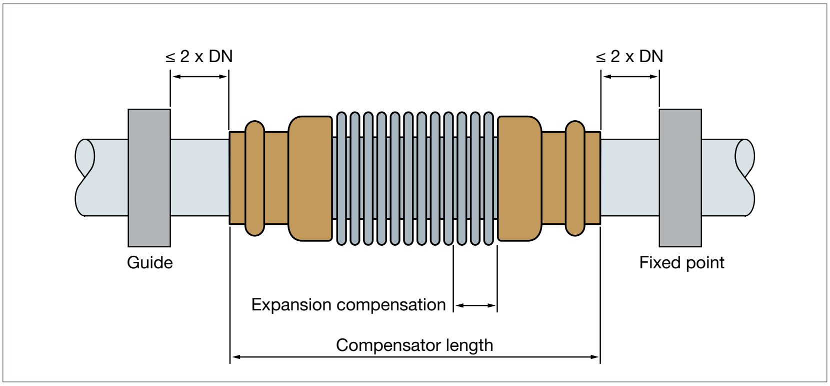


Fig. 55: Dimensions of axial compensators

Compensator d_i/DN	Pressure [MPa]	Effective bellows cross-section A [cm²]	Maximum fixed point load F_{max} [N]	Expansion compensation [1)] [mm]
15/12	1.0	3.10	620	-7
18/15	1.0	3.97	794	-9
22/20	1.0	6.15	1230	-11.5
28/25	1.0	9.02	1814	-14
35/32	1.0	13.85	2770	-13
42/40	1.0	20.42	4048	-15.5
54/50	1.0	30.90	6180	-16

[1)] Dimensioning: 10,000 full movement cycles at nominal pressure, design temperature 85 °C

Tab. 15: Characteristic properties of compensators

Function of fixed points and gliding points

Fixed points connect the pipeline firmly to the supporting installation body and direct the expansion movement in the desired direction. Piping that is not interrupted by a change in direction or which does not have an expansion compensator may have only one fixed point. With long sections of piping, it is advisable to have the fixed points in the middle of the section in order to allow linear expansion in both directions.

Fig. 56: Fixing as a fixed point

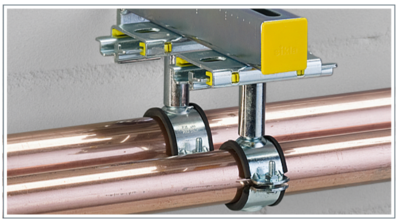


Fig. 57: Fixing as a gliding point

Pressure test

The pressure test is normally done with water or another approved testing medium at the test pressure specified for the respective application in the corresponding regulations. Directive 2014/68/EU (Pressure Equipment Directive) specifies that the hydrostatic test pressure for pressure vessels must not fall below the higher of the following two values:

- 1.25 times the value of the maximum load on the pressure equipment in operation, taking into account the maximum allowable pressure and temperature
- 1.43 times the value of the maximum allowable pressure

This requirement is also laid down in the AD 2000 data sheets HP 30 and HP 512 R and is also stated in DIN EN 13480-5. Deviating from this, for domestic potable water installations in accordance with DIN EN 806-4, the test pressure is set to 1.1 times the maximum permissible operating pressure. This has also been incorporated into BTGA[1] Rule 5.001 and in BG RCI[2] data sheet T039 / BGI[3] 619.

Alternatively, in accordance with the Pressure Equipment Directive an inert gas – mostly air or nitrogen – at 1.1x the operating pressure can be used. Here too, a limitation of the test pressure to a maximum of 0.3 MPa applies under the building services engineering rules based on DVGW-TRGI 2018.

Special precautions are prescribed for the use of liquid testing media at testing pressures above 10 MPa. Details on this and the procedure as a whole can be found in AD data sheet HP 30. With underground piping, the pressure test must be performed before closing the trench. If this is not possible, the pressure test can be performed using other suitable methods, e.g. VdTÜV instructions 1051, water pressure tests of underground pipelines according to pressure-temperature measurement procedures.
In special cases, e.g. particular laying methods, the presence of components/fittings in the piping, the function of which would be impaired by the pressure test, the pressure test can be replaced by other suitable procedures, e.g. non-destructive testing in connection with leakage tests. These procedures must be agreed between the operator, expert and manufacturer. The test results must be documented in such a manner that they serve as a basis for recurrent tests.

[1] BTGA: Federal Industrial Association for Building Services Engineering
[2] BG RCI: Employer's Liability Insurance Association for Raw Materials and the Chemical Industry
[3] BGI: Employer's Liability Insurance Association Information

Documentation – manufacturer certificate

With the so-called "manufacturer certificate" the manufacturer confirms that the system complies with the requirements of the pressure vessel regulations and the technical rules for pipelines, e.g. TRR 100. In particular the manufacturer confirms that all official requirements are satisfied and the work has been performed properly. Special importance is attached to:

- The manufacturer's qualifications
- The materials used
- Calculations for the design and dimensions
- Professional production/laying
- The components used
- Marking of the pipelines and components
- Insulation and corrosion protection

Furthermore, the manufacturer confirms that when subjected to the test pressure of the pressure test the pipeline was tight and there were no deformations of relevance to safety.
If alternative procedures are used instead of the pressure test, both these and the results must be documented.
The subcontracting of work to other manufacturers must be documented.
The proper production of the system is only fully confirmed once certifications stating that this work has been executed properly have been submitted. The documents required to identify/mark the piping must be included with the manufacturer certificate.
During the acceptance test, the expert must be provided with the documents that served as the basis for the manufacturer certificate upon request. These documents must correspond to the actual state of the pipeline.
Any information from the manufacturer that has to be noted in the acceptance test or the recurring tests must be stated in the manufacturer certificate.

Marking of piping

Piping in buildings are mostly laid in bundles. The pipes which lay alongside each other must be marked according to the media they transport in order to rule out the risk of mix-ups and accidents when performing repairs. The size, appearance and spacing of the media markings and their arrangement on manifolds and outlets are regulated in DIN 2403.

Medium	Group	Colour	RAL
Water	1	Green	6023
Vapour	2	Red	3001
Compressed air	3	Grey	7004
Gas flammable	4	Yellow / red	1003/3001
Gas non-combustible	5	Yellow / black	1003/9004
Acid	6	Orange	2010
Lyes	7	Violet	4008
Oxygen	0	Blue	5005

Tab. 16: Marking of pipes according to DIN 2403 (excerpt)

Press tools

Intended use

The functional safety of Viega press connector systems is primarily dependent on the perfect condition of the press machines, press jaw, rings, chains and (hinged) adapter jaws used.
The detailed instructions for use included when purchasing press tools are to be noted.
All the product information is to be provided when lending press machines.
The operating temperature of the machines must be between -5 and +50°C. This is based on the temperature of the hydraulic oil in the machine.
If the temperature is well below 0 °C, the hydraulic oil will become viscous and the machines have to be warmed up to room temperature before use. If this is not done, the functionality will be impaired and the mechanisms may be damaged.
If a press machine happens to be completely immersed in water, it must be sent to an authorised service station for testing before further use.
Irrespective of the statutory regulations, Viega guarantees the leak tightness of the connection according to the liability agreement with the Association for Sanitation, Heating and Air Conditioning (ZVSHK) and the Federal Industrial Association for Heating, Air Conditioning and Sanitary Engineering/Technical Buildings Systems (BHKS).
As such, the warranty period demanded by law is extended when using Viega press machines and Viega press tools.

Fig. 58: Viega Pressgun 6 Plus and Pressgun Picco 6 Plus

System press tools
Safe, low-maintenance press tools are an important part of the Viega system. They have been optimised for the materials and dimensions of Viega press connectors and thus guarantee safety and function when used on site. Also because they can be used everywhere – with and without a mains connection.

Viega recommends the use of the following system press tools:

Viega system press machine	**Viega press connector systems**		
	All metallic systems (excluding Megapress)	**Megapress**	**All plastic systems**
Pressgun 6 Plus with mains adapter or rechargeable battery	12–108 mm	D⅜–D2 D2½–D4[1]	12–63 mm
Pressgun Picco 6 Plus with rechargeable battery	12–35 mm	D⅜–D¾	12–40 mm
Pressgun 6 with mains adapter or rechargeable battery	12–108 mm	D⅜–D2	12–63 mm
Pressgun Picco 6 with mains adapter or rechargeable battery	12–35 mm	D⅜–D¾	12–40 mm
Pressgun 5 with mains adapter or rechargeable battery	12–108 mm	D⅜–D2 D2½–D4[1]	12–63 mm
Pressgun Picco	12–35 mm	D⅜–D¾	12–40 mm
Pressgun 4 E	12–108 mm	D⅜–D2 D2½–D4[1]	12–63 mm
Pressgun 4 B	12–108 mm	D⅜–D2 D2½–D4[1]	12–63 mm
PT3-H/EH	12–108 mm	D⅜–D2 D2½–D4[1]	12–63 mm
PT3-AH	12–108 mm	D⅜–D2	12–63 mm
PT2	12–108 mm	D⅜–D2 D2½–D4[1]	12–63 mm

[1] for Megapress XL dimensions (D2½–D4/DN 65–DN100), use of the Pressgun Press Booster is required in addition

Tab. 17: Overview of the area of application for Viega system press machines

> **Compatibility with third-party products**
> One of the prerequisites for certification of Viega piping systems is successful testing of the connection technology according to DVGW Worksheet W 534 by an approved testing institute. To this end, the press connections are only produced using Viega press machines and Viega press jaws, chains and rings. If the trade professional uses press tools from other manufacturers, in the interests of liability security it is recommended to get proof of suitability from the other press tool manufacturers (press machines, press jaws, rings and chains). If, in the event of a complaint, it can be shown that the damage was caused through the use of press tools from other manufacturers, Viega shall refuse to accept claims for damages.

System press jaws, chains and rings

Press jaws for press machines of the "Picco" series for

- Metal press connector systems 12–35 mm
- Press connector system Megapress D⅜–D¾
- Plastic piping system Raxofix 16–40 mm

Fig. 59: Picco press jaws for all metal press connector systems

Fig. 60: Picco press jaw for Megapress

Fig. 61: Picco press jaws for Raxofix

Press jaws with snap action for press machines of the "Picco" series

These press jaws are opened manually in the usual manner and, thanks to the spring force, remain open until the press machine is actuated. However, the position of the press jaw can still be corrected even faster and easier before the actual pressing. This offers numerous advantages when working overhead and with just one hand.

Fig. 62: Picco press jaw with snap action for metal press connector systems: 12–35 mm

Press jaws for all other press machines for

- Metal press connector systems 12–54 mm
- Press connector system Megapress D⅜–D1
- Plastic piping system Raxofix 10–63 mm

Fig. 63: Press jaws for metal press connector systems

Fig. 64: Press jaws for Megapress

Fig. 65: Press jaws for Raxofix

Press chain with hinged adapter jaw

The combination of press chain and hinged adapter jaw is for use exclusively for Sanpress XL connectors. Press chains are available for nominal widths 76.1 to 108.0 mm.

Fig. 66: Press chain/hinged adapter jaw for Sanpress XL press connector made of gunmetal or silicon bronze

Press rings and hinged adapter jaws

Thanks to the smooth pivoting, the patented Viega press rings and hinged adapter jaws can be used for pressing in the most challenging of conditions, e.g. in installation shafts and pre-wall installations. They are compatible with all Viega press machines.
Press rings and hinged adapter jaws are available for the following nominal widths:

- Metal press connector systems 12–108 mm (excluding Sanpress XL – see press chain with adapter jaw)
- Press connector system Megapress D½–D2 (see Pressgun Press Booster for Megapress XL dimensions D2½–D4)
- Plastic piping system Raxofix 16–63 mm
- Plastic piping system Geopress K 25–63 mm

Fig. 67: Press ring and hinged adapter jaw for metal press connector systems

Fig. 68: Press ring and hinged adapter jaw for Megapress ≤ D2

Fig. 69: Press ring for Raxofix

Fig. 70: Press ring for Geopress K

Pressgun Press Booster for Megapress XL dimensions D21/2–D4

- Innovative force amplifier with integrated hinged adapter jaw for Megapress XL dimensions of 2½, 3 and 4 inches.
- Optimally dimensioned pressing force for maximum safety.
- Pressing of Megapress XL press connectors in less than 16 seconds.
- A weight of just 9 kg and a handy carrying strap ensure ideal ergonomics and simple handling.
- Can be used for all Viega press machines from type 2 to Pressgun 5 and Pressgun 6 Plus (not compatible with Picco types and Pressgun 6).
- The specific ball heads of the hinged adapter jaw prevent confusion with other Viega press rings.
- Long service intervals.

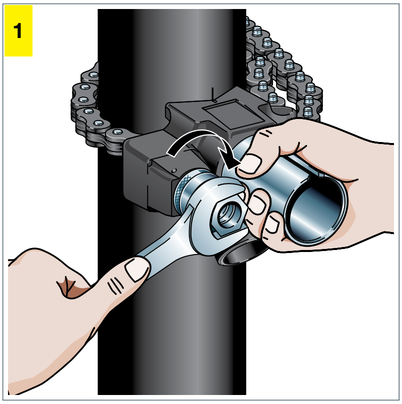
Fig. 71: Pressgun Press Booster with press ring for Megapress XL dimensions

Megapress/Megapress S press-in branch connectors

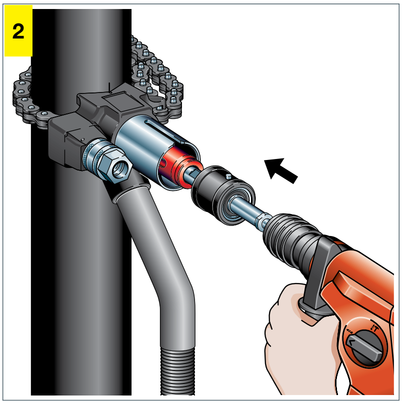
The Megapress press-in branch connectors (available with EPDM or FKM sealing elements) can be used to make connections retrospectively in existing steel pipe installations (1½, 2, 2½, 3, 4, 5 and 6 inches).
The corresponding tool set is used to drill a hole in the steel piping (not pressurised), and the Megapress press-in branch connector is then pressed in. This makes it possible, for example, to quickly mount a thermometer to an existing steel pipe installation and without labour-intensive preparations. The system is then ready for use immediately afterwards.

Mounting steps

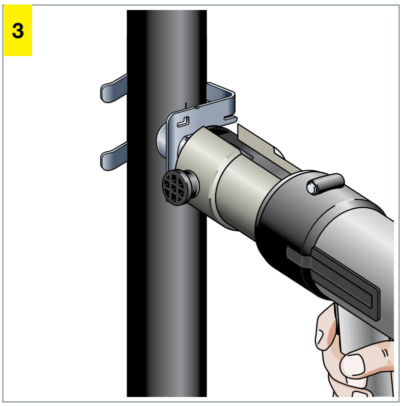
Making a threaded connection in just four steps:



- Fasten the special drilling device for guiding the drilling shaft to the steel pipe (1½-6 inches) using a ring or fork spanner.

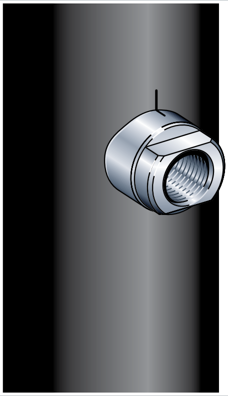


- The hole is drilled by means of a commercially available drilling machine. The steel chips can be extracted by means of the vacuum cleaner nozzle. Afterwards, remove the drilling device again.



- Press the press-in branch connector to the steel pipe by means of the press machine and the positioning aid. This is a fast and clean way of making the connection to the pipeline.

4



- The steel pipe connection Rp ¾ for thermometers, temperature sensors, manometers, drains or line connections is completed.

Maintenance and service

Maintenance instructions

System press tools

Functional safety and permanent leak tightness of the Viega press connector systems primarily depends on the functional and operational safety of the Viega system press tools – i.e. on Viega press machine plus suitable Viega press jaw, ring, chain and (hinged) adapter jaw. These Viega press tools were developed and adapted specifically for use with Viega press connector systems. If systems from other manufacturers are used, Viega cannot provide any warranties.

System press machines

Viega system press machines generate a specified pressure for the pressing process. To guarantee operational safety, a leak-free hydraulic system is required; however, natural wear and tear on such heavily used components is unavoidable. To ensure the continuous operational safety and reliability of the system press machines, they must be maintained regularly. Usually, tools are sent for maintenance to the service partners named by Viega, or maintained at local maintenance events by the service partners at the specialist wholesalers, see „Press tool service“ on page 69.

Store the press jaw fixtures with the press rolls in a clean and dry place. Clean the press tools with a cloth after each use. If necessary, oil moving parts such as bolts and press rolls. Regularly polish and oil the contours of the press jaws, rings, chains and inserts with fine steel wool or a cleaning fleece.

Type	Maintenance intervals
Pressgun 6 Plus Pressgun Picco 6 Plus	After 40,000 pressings, service information is shown as a LED display. Safety shutdown will take place after a further 2,000 pressings. Maintenance after 4 years at the latest.
Pressgun 6 Pressgun Picco 6	After 30,000 presses, service information is shown as a LED display. Safety shutdown will take place after a further 2,000 pressings. Maintenance after 4 years at the latest.
Pressgun 5	After 40,000 pressings, service information is shown as a LED display. Safety shutdown will take place after a further 2,000 pressings. Maintenance after 4 years at the latest.
Pressgun Picco Pressgun 4E Pressgun 4B	After 30,000 presses, service information is shown as a LED display. Safety shutdown will take place after a further 2,000 pressings. Maintenance after 4 years at the latest.
Type PT3-H/EH Type PT3-AH Picco	After 20,000 presses, service information is shown as a LED display. Safety shutdown will take place after a further 2,000 pressings. Maintenance after 4 years at the latest.
Type 2	Every 2 years
Model 2478	At least once a year
Model 2475	After 20,000 presses, an LED display is shown. Maintenance after 4 years at the latest.

Tab. 18: Viega press machines – maintenance intervals

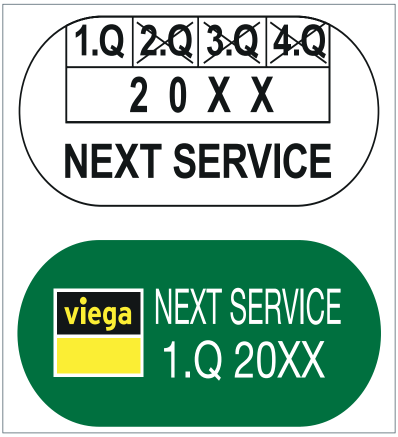


Fig. 72: Maintenance label

Viega highly recommends that the system press jaws, press chains and press rings are also inspected while the system press machines are undergoing maintenance.
During the procedure, consumables are replaced, press jaw contours are revised and the press jaws, chains and rings are reset.
Since 2012, Viega press jaws, chains and rings have been provided with maintenance stickers, which show the next recommended inspection date.

Press tool service

Germany

Hans-Joachim Voigt & Sohn
Nordlichtstraße 48/50
13405 Berlin

Phone +49 (0)30 413 4041
Fax +49 (0)30 413 3057
info@voigt-und-sohn.de
www.voigt-und-sohn.de

Hamburger-Hochdruck-Hydraulik GmbH
Billwerder Billdeich 601c
21033 Hamburg

Phone +49 (0)40 7511 900
Fax +49 (0)40 7511 9039
service@hhhydraulik.com
www.hhhydraulik.com

Hamburger-Hochdruck-Hydraulik GmbH – Süd
Neue Gautinger Str. 2
82110 Germering

Tel. +49 (89) 130 111 03
service@hhhydraulik.com
www.hhhydraulik.com

Austria

König & Landl GmbH
Döblinger Hauptstrasse 15
1190 Vienna

Phone (+43) 1 4797484 13
office@koenig-landl.at
www.koenig-landl.at

König & Landl GmbH
Gewerbering 2
2020 Hollabrunn

Phone (+43) 1 4797484 50
hollabrunn@koenig-landl.at
www.koenig-landl.at

Planning information for selected media

Potable water

During the Capnetz Study in 2008, scientists found that in Germany, 15,000 to 30,000 clinical cases per year are caused by legionella. The mortality rate was estimated to be between 1500 and 2000. It is not possible to determine with absolute certainty how many of these cases are caused by infection from contaminated potable water installations. A status analysis commissioned by the Potable Water Analysis Working Group of the Association of Companies for Gas and Water Technologies (figawa) [German association of gas and water firms] for the second time now, however, has attracted attention. For the first status analysis in 2015, more than a million data records on sampling procedures for all building types, made available by five German potable water control service providers, were evaluated by the Institute for Hygiene and Public Health (IHPH) at the University of Bonn.[1] An overrun of the technical intervention value was detected in around one in six buildings. Another status analysis based on better data quality, which the IHPH presented in 2018, revealed as similar picture. In addition to hot potable water, cold potable water is also a risk factor because the critical value of 20°C is being exceeded more and more often. The evaluations of 30,000 water samples from German health authorities, taken from 2003 to 2009 in 4,400 public buildings, showed, for example: In about 13% of the samples, the technical intervention value for legionella of 100 colony-forming units (CFU) per 100 ml was exceeded. This predominantly affected potable water hot. However, 5% of the samples of potable water cold also showed breaches of the technical intervention value. Maintaining potable water quality in the potable water cold on its way from the entry to the building up to the last draw-off point is jeopardised by external heating, verifiably promoting microbial growth. The evaluation of the samples, therefore, reliably confirms that maintaining potable water quality presents a serious challenge.

[1] Accordingly, during the period under review from 2012 to 2015, legionella was found in one in three buildings at least once.

Hygiene
Hygiene is the sum total of all efforts and measures for preventing indirect or indirect impairments of individual users' health. The aim is to maintain potable water quality in the potable water installation. The potential impairments can be caused not only by microbiological, chemical and/or physical-chemical changes to the potable water in potable water installations, but may also ensue retrospectively due to changes to the operating conditions. The regional water supply company is initially responsible for the proper potable water quality up to the transfer point at the house service connection, and inside the operator is responsible for the potable water installation. The operator must ensure that potable water is drawn off regularly in accordance with the AVBWasserV. To ensure that the regularly tapped water quantity is sufficient to guarantee the complete water exchange in the installation, the expert planner and/or the installer has to meet the necessary preconditions. They use certified components and systems to ensure that the nominal pipe diameters are dimensioned according to requirements and that the piping is routed in a hygiene-conscious manner – also for draw-off points where usage interruptions are to be expected (e.g. garden valves). The responsibility for compliance with the quality requirements for potable water in domestic installations lies with the owner and operator concerned. They must ensure perfect potable water quality.

Generally recognised rules of engineering
The hygienically safe operation of the potable water installation plays the most crucial role here. In order to achieve this goal at all, operators are advised to align themselves with the generally recognised rules of engineering, see Tab. 19. In May 2012 the European series of standards DIN EN 806-1 to 5 in conjunction with DIN EN 1717 and the national collateral standards became authoritative.

European basic standards	National collateral standards	Additional directives and rules
DIN EN 1717 "Protection against pollution of potable water installations..."	DIN 1988-100 "Protection of drinking water, drinking water quality control"	FEA recommendation BTGA rules DVGW Worksheets VDI Directives
EN 806 Part 1 "General"	–	
EN 806 Part 2 "Design"	DIN 1988-200 "Installation Type A, planning, components, devices, materials"	
EN 806 Part 3 "Pipe sizing, simplified method"	DIN 1988-300 "Pipe sizing"	
EN 806 Part 4 "Installation"	–	
EN 806 Part 5 "Operation and maintenance"	–	
–	DIN 1988-500 "Pressure boosting stations with RPM-regulated pumps	
–	DIN 1988-600 "Drinking water installations in connection with fire fighting and fire protection installations"	

Tab. 19: Standards and regulations

This means that users, for planning and installation purposes, should take into account the requirements of DIN EN 806-2, DIN 1988-200, DIN EN 806-3, DIN 1988-300, DIN EN 806-4 and, additionally, the directives and worksheets of the VDI, DVGW and ZVSHK. For this reason, professional associations and organisations, e.g. the ZVSHK, have developed commentaries to facilitate an understanding of the correlation between the European and national standards.

Appealing bathrooms and eat-in kitchens are an essential feelgood factor in our homes – but clean potable water is the basis for meal preparation and cleaning. It adds to the quality of life and serves to protect health. To achieve this, compliance with the generally recognised rules of engineering for planning, construction, commissioning and operation as intended, including regular maintenance, is indispensable.

Analysis parameters in potable water installations

Microbiological parameters

The regulators reacted to the dangers posed by contaminated potable water, with an amendment to the Potable Water Ordinance, by defining various limit values for microbiological parameters, see „Tab. 21: Limit values for microbiological parameters“ on page 75, as well as a technical intervention value in accordance with Section 3 of the Potable Water Ordinance for legionella, see „Tab. 20: Technical intervention value for legionella“. This technical intervention value is 100 "colony-forming units" in 100 ml of water (100 CFU/100 ml). This is an empirically derived value that will not be exceeded if the generally recognised rules of engineering are observed and the contractor and other owners (UsI) of a potable water installation apply the required diligence. According to a recommendation by the German Environment Agency of 2005, a target value for legionella contamination of 0 CFU/100 ml applies to hospitals, and also to other medical and care facilities. The hazard value is set at ≥ 1 CFU/100 ml.

If the technical intervention value is exceeded, avoidable circumstances will occur that can raise concerns over a health hazard or in fact cause a health hazard. The technical intervention value is determined by means of a laboratory analysis of water samples taken.

Microbiological parameters	Technical intervention value
Legionella	100 CFU/100 ml

Tab. 20: Technical intervention value for legionella

To define the expression 'concerns over a health hazard', the regulatory authority used an auxiliary quantity described as a technical intervention value. The technical intervention value is defined in Annex 3, Part II of the Potable Water Ordinance at 100 CFU/100 ml (legionella spec./potable water). Annex 3, Part II of the Potable Water Ordinance sets out the expression "Special indicator parameters for potable water installation systems". In accordance with the Potable Water Ordinance, legionella is generally only an indicator parameter for the failure to implement the technical procedures required to achieve the protection objective stated under Section 1 of the Potable Water Ordinance.

Specifically, Section 4, para. 1 and Section 17, para. 1 of the Potable Water Ordinance require at least compliance with the generally recognised rules of engineering for water treatment and water distribution. If, therefore, the generally recognised rules of engineering are observed during the planning, construction and operation of water supply systems in domestic installations (potable water installations), compliance with the limit values and requirements for Potable Water Ordinance parameters, which can change for the worse within the domestic installation, can be expected.

Despite the precautions taken by the legislators, however, overruns of the technical intervention value of the Potable Water Ordinance are repeatedly identified during routine examinations in accordance with Section 14b, para. 1, or people fall ill due to using water from potable water installations.

The auxiliary variable "Legionella" used in the Potable Water Ordinance continues to be named as a pathogen in Section 7 of the Protection Against Infection Act. This means that legionella is not only a technical auxiliary variable, but also a pathogen. There is a circular reference, then, between the technical auxiliary variable and the pathogen:
If technical deficiencies occur, the presence of pathogens must be suspected.
If pathogens are identified, a technical deficiency must be assumed.

If legionella are considered in their function as a technical auxiliary variable, technical measures for protecting the users of potable water installations and for restoring technically avoidable deficiencies must be taken in accordance with Section 16, para. 7. In accordance with Section 16, para. 7, the measures taken to protect users must conform at least to the generally recognised rules of engineering.

However, if legionella, which can be transmitted by water, are now considered to act like pathogens in accordance with Section 7 of the Protection Against Infection Act, the state of medical and epidemiological science and technology for protecting users of potable water installations ought to be applied according to Section 1, para. 2 of the Protection Against Infection Act.

However, since the majority of users are not necessarily aware of the state of medical and epidemiological science, the regulatory authority has decided on the protection level of the generally recognised rules of engineering in Section 16, para. 7 of the Potable Water Ordinance which, although recognised in practice, is lower.

Summing up, therefore, it can be said that if legionella are detected, technical measures must be taken in order to restore the potable water installation to at least comply with the generally recognised rules of engineering.

Besides the legionella, which were examined with respect to any technical measures that might be required, the Potable Water Ordinance provides for further microbiological parameters in Annexes 1, 2 and 3. These relate to microorganisms that allow conclusions to be drawn about the quality of the circulated potable water.

Microbiological parameters	Limit value
Coliform count at 22°C and 36°C	without abnormal variance
Enterococci	0/100 ml
Escherichia coli	0/100 ml
Coliform bacteria	0/100 ml

Tab. 21: Limit values for microbiological parameters

The Potable Water Ordinance does not specify a limit value for pseudomonas aeruginosa. Nonetheless, this parameter must be observed especially in buildings with increased hygienic requirements. For example, it must not be detectable in 100 ml in buildings with medical facilities (see also the German Environment Agency's recommendation "Recommendation on required examinations for pseudomonas aeruginosa, on the risk assessment and on measures to be taken in the event of detection in potable water" of 13 June 2017).

Scientific findings shows the possibility that in stress situations (e.g. disinfection of a system, thermal treatment, etc.) bacteria may survive the process in the so-called VBNC state[1]. This also applies to facultative pathogens such as pseudomonas and legionella. This may make it difficult to assess the effectiveness of measures. After the restoration of environmental conditions which are favourable to them, the bacteria can return to the reproductive state, causing renewed contamination in the system. Sustainable reconstruction always aims to keep the living conditions for microorganisms (temperature range, nutrients, residence times) in the potable water installation system as unfavourable as possible. This the case if the potable water installation is planned, built and operated in accordance with the generally accepted rules of engineering.

[1] **V**iable **b**ut **n**ot **c**ulturable

Chemical parameters

Chemical substances must not be present in concentrations that cause damage to human health (Section 6, para. 1 Potable Water Ordinance). In line with the principle of minimisation, such concentrations should be kept at the lowest level possible for reasonable effort in accordance with the generally recognised rules of engineering (Section 6, para. 3 Potable Water Ordinance). Among the chemical requirements of particular interest to a potable water installation are those with a concentration which may increase in the pipeline network, including the potable water installation (Section 6, para. 2 or Annex 2, Part III). For some of the total of twelve parameters, the concentration is directly linked to materials which are or were installed or used in the potable water installations (piping, devices, fittings, soldering agents, seals). The table below shows the relevant parameters with the respective limit values.

Chemical parameters	Limit value {mg/l]
Lead	0.01
Cadmium	0.003
Antimony	0.005
Copper	2.0
Nickel	0.02
Arsenic	0.01
Iron	0.2
Manganese	0.05

Tab. 22: Limit values for selected chemical parameters in accordance with the Potable Water Ordinance

The concentrations of the metals lead, copper, and nickel in potable water samples taken from the consumer's draw-off point ("tap") depend largely on the following influencing factors:

- Materials installed in the potable water installation
- Operating conditions (periods of flow and stagnation, usage pattern, formation of protective layer)
- Age and complexity (flow paths) of the potable water installation
- Chemical constitution of the potable water
- Water temperature

Sphere of influence of the quality of potable water

Based on current knowledge, potable water hygiene as a whole is based on four basic principles:

- Compliance with the temperature limits in the potable water cold (PWC) and potable water hot (PWH)
- Regular water exchange at draw-off points in the potable water installation, in compliance with the operating conditions used as a basis by the system planners in the engineering process (draw-off quantities, volume flows and simultaneous use)
- Thin pipe dimensioning with sufficient flow-through made of suitable substances and materials
- Limitation of nutrients for microorganisms

The entire field of substances and materials is regulated by law through the assessment criteria of the German Environment Agency. Planners, installers and operators therefore need to consider how the temperature limits and a regular, adequate water exchange can be ensured in the system.

Flow-through, temperature, water exchange and nutrient availability are essential and, at the same time, always interactive variables affecting potable water ecology and hence the hygienic and microbiological potable water quality. The sphere of influence of potable water quality comprises these four variables. In terms of how the ecology of potable water is understood, at least these factors in the potable water installation eco-system interact, see Fig. 73, and jointly influence the hygienic stability and hence the system's potable water quality. The effects can be both parallel and opposing.

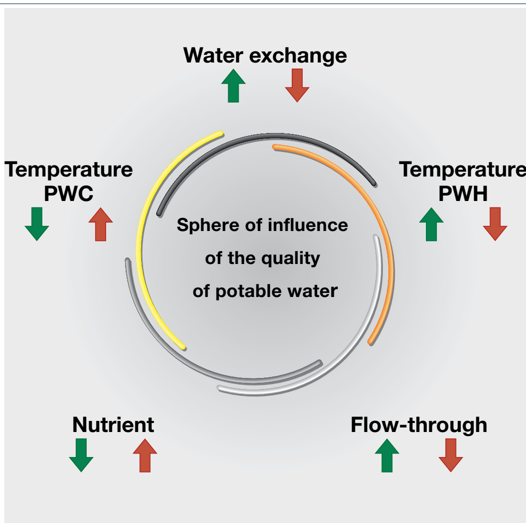


Fig. 73: Sphere of influence of the quality of potable water

Temperature

Temperature is an especially critical factor for potable water hygiene. It is imperative to avoid the temperature range of 25–55°C that numerous pathogenic microorganisms find especially favourable in order to discourage propagation. According to the current state of science and technology, potable water cold (PWC) must not exceed a temperature of 20°C anywhere in the potable water installation up to the draw-off point and should be as cold as possible at all times. Although Legionella can occur in cold water, they are unable to propagate appreciably at temperatures of below 20°C. It is known also from practical experience that evidence of legionella is very rarely found at potable water temperatures of below 20°C (Robert Koch Institute RKI).[1]

It is assumed that for the normal water exchange no critical growth of microorganisms takes place below this temperature. The parameters of building entry temperature, ambient temperature, insulation and the pipeline routing along the entire potable water installation flow path play a key role for the external heating of potable water cold (PWC) and the associated increased hazard potential.
Circulation systems for potable water hot (PWH-C) must be operated in such a way that temperatures of at least 55°C are maintained in all sections. However, the outlet temperature at the potable water heater must be at least 60°C. Furthermore, a hydraulic balance between the legs must be ensured in accordance with DIN 1988-300.

In a potable water installation built and operated in accordance with the generally recognised rules of engineering, the temperature of the potable water hot (PWH) throughout the circulating system should, according to the current state of science and technology, be above 55°C in order to significantly reduce the risk of legionella contamination.

To be able to achieve a reduction in the temperature of potable water hot (PWH) while guaranteeing safe potable water at the same time, technical measures are required to prevent, especially in the critical range of < 55°C, the propagation of legionella and the associated overrun of the technical intervention value of 100 CFU/100 ml (see Nutrients). So far, model projects and current field studies show that a temperature reduction of initially 10 K to at least 45°C under the effect of ultrafiltration in the bypass of the circulation has no negative influence on the systemic hygienic stability. This could result in potentials for reducing the temperature to corresponding usage temperatures following further verification (pilot projects, UF research projects TU Dresden). The current data situation is still definitely inadequate.

This means that UFC technology offers a functional method that is able to effectively contribute to solving the trade-off between energy saving and potable water hygiene. In this way, the use of regenerative heat producers, for example heat pumps, can be supported. In this respect, then, UFC

[1] Source: RKI guide for legionellosis

technology can easily be described as the current state of science and technology.

Water exchange

According to VDI / DVGW 6023, potable water installations are to be planned to ensure that the water is exchanged at least every three days. This refers to complete exchange of the water in all partial sections and in the potable water heater. Water exchange is defined as a complete exchange of the water volume contained in the respective pipeline section by means of withdrawal or draining. While also taking potential water and energy savings into consideration, according to DIN 1988-200, the system should be planned in such a way that, if operated as intended, the water exchange will be sufficient to ensure hygienic operation.

The anticipated simultaneous uses of potable water draw-off points are determined based on the information in the room sheet data (type of use). Excessive dimensioning should be avoided in potable water pipelines as well as in reservoirs and devices. Non-flow pipes and devices holding stagnant water are generally not permitted. For this reason, pipe routing and arrangement of the draw-off points must be planned to ensure maximum possible water exchange. Planning must be carried out based on the component-specific Zeta values (resistance coefficients) in order to achieve the smallest possible pipe cross-sections and system volumes.

Flow-through

Another major factor for potable water hygiene is the dynamic of the water movement in the potable water installation, which is defined by water exchange and flow-through (= flow rate). Even under less favourable environmental conditions with regard to temperature and nutrient supply, a correspondingly slow microbial growth can occur if enough time is available – that means if the water movement is low and/or the water in the piping is partially stagnated. In oversized piping in particular, there is the risk that only a laminar flow will pass through the centre of the pipe – and a water exchange cannot therefore be guaranteed at the pipe walls.

If there is an adequate flow-through and hence shearing forces, a relatively stable biofilm forms, whereas stagnation causes a loose accumulation of bacteria. To prevent these bacteria detaching and putting users at risk, it is just as important to dimension the piping in line with requirements as it is to use the draw-off points regularly. According to DIN 1988-300, the pipe dimensions are to be calculated with the lowest possible Zeta values (resistance coefficients) of the system planned and used. The aim is to plan with the smallest possible pipe dimensions with due consideration for the peak volume flow.

Nutrients

Bacteria depend on nutrients for growth and reproduction. The health-relevant C-heterotrophic bacteria need organic carbon compounds as a source of energy and carbon source (DOC = Dissolved Organic Carbon). Bacteria in biofilms of potable water installations and in the aquatic phase of the potable water can use nutrients from installation materials or the supplied potable water as well as the orthophosphates of a corrosion protection dosage.

The use of UFC technology is regarded as an especially efficient solution for the energy-efficient and hygienically viable operation of hot water installations in terms of a potential energy-efficient temperature reduction in the hot water system, see chapter „Temperature“ on page 78. As current field studies show, ultrafiltration reduces the total bacterial count (TBC) and the nutrient load (DOC) and thus sustainably reduces microbial growth. In this way, the possible growth potential for legionella and other pathogens can be sustainably minimised beyond the temperature limits (hygienic stability).

Selecting the installation system

According to the Ordinance on General Conditions for the Supply of Water (AVBWasserV), only parts and components that comply with the recognised rules of engineering are allowed to be used in a potable water installation. The mark of an accredited testing body – e.g. DIN-DVGW, DVGW or GS mark - suggests that this requirement is met (Section 17 para. 5 Potable Water Ordinance). The ordinance also specifies that work on a potable water installation must be carried out only by a contract installer registered with a water supply company.

According to DIN 1988-200, pipe connections in potable water installations must at least withstand the operating stresses to be anticipated in accordance with Tab. 23. Whereas soft and hard soldering was the dominant technique used from 1970 to 2000, press connecting technology has now taken over the lead role on the connection technology market. As pipes can now be joined cold and in a matter of seconds, the previously used technique for copper pipes has become obsolete and new markets for stainless steel and plastic pipes have opened up. Depending on the pipe material and manufacturer system, a distinction is drawn between radial, axial and raxial press connecting technology.

Design temperature T_D [°C]	Time with t_D [year]	Maximum Tempe-rature T_{max} [°C]	Time with t_{max} [year]	Temperature for malfunction T_{mal} [°C]	Time with malfunction t_{mal} [h]	Typical area of application
70	49	80	1	95	100	Hot water supply 70 °C

Tab. 23: Minimum requirements for operating temperatures for potable water hot (70°C)

Expert planners now have a wide range of criteria that need to be borne in mind in choosing a piping system and the corresponding connection technique. The first pointer for selecting a high-quality product is the test mark of an accredited testing body. This increases the probability that the system in question is in compliance with generally recognised rules of engineering and pipes and pipe connections will withstand the anticipated operating conditions when properly installed. System selection is also often based on stocks and equipment available to the firms doing the work, as well as their purchasing conditions.

Installers prefer systems with which they have already had positive experience on site. For instance, if it is not necessary to calibrate a metal composite pipe from a given manufacturer before inserting it into the connector, this could make for decisively easier handling (Viega Raxofix). This could easily represent an important argument for an expert planner in consultation with the building owner. Ultimately an operationally reliable system is the primary planning goal, but there are also financial advantages to be had with installation – fast processing saves time and personnel expenditure, and hence reduces construction costs. The piping systems available on the market are always specific to the respective manufacturer and differ in the materials used and how they are constructed. This also applies to the differences between the moulded pieces and connection parts with regard to their resistance coefficients. Such differences are fairly small in stainless steel and copper pipe systems, but significant for metal composite pipes. There, the size-dependent values vary a great deal, mainly on account of construction and the way the support sleeve is designed. Influencing factors are primarily the inside pipe diameter, the design of the connectors with or without sealing element as well as the design of the flow deflectors, with small radii affecting the resistance coefficients of the components unfavourably and "soft" radii having a positive impact. This gives rise to deviations amounting to a factor of 10 or more, which has various effects on the determination of pipe sizes, the system volume, water exchange and therefore also on the system-immanent potable water quality.

Although moulded pieces for welding and gluing systems with pipes of polypropylene or PVC-C do not need a support sleeve and therefore have the advantage of a full flow cross-section, the manufacturing process gives rise to angular deflections that in turn lead to unfavourable higher resistance coefficients. The same applies to plastic plug connectors, of which there are externally sealing versions for plastic pipes (PE-X, PB, etc.) and internally sealing versions (multi-layer pipes). According to DIN 1988-300, product-specific resistance coefficients for the moulded pieces are to be taken into account for system design. To this end, they can be measured in accordance with DVGW W 575 and provided to the expert planner or installer by the manufacturer.

Selection of materials

Pursuant to DIN 1988, UBA evaluation basis, DIN EN 12 502 and VDI/DVGW Directive 6023, the quality of the potable water must be taken into consideration as early as the planning phase.
Every pipe material has limits of use which, although generally not reached if the system is operated as intended, can easily be reached if special measures are implemented. Therefore, it is advisable to contact the component manufacturers in case of doubt.

The physical properties of metal piping differ fundamentally from those of plastic piping. The most important criteria for the system selection include:

- Low pH values
- Very high chlorine concentrations – e.g. for shock disinfection
- High temperatures – for thermal disinfection
- Longitudinal expansion coefficient

Where certified piping systems are used according to specifications and taking the material-specific scope of usage into account, the expert planner does not need to adopt any other measures in order to ensure reliable system operation. As a result, the market offers many system solutions involving dissimilar pipe materials and constructions for connection technology. In Germany, the market is dominated by pipes made of copper, stainless steel (1.4401, 1.4521, etc.), PE-X and multi-layer pipes combined with mechanically sealing connectors made of copper, stainless steel, gunmetal, silicon bronze, brass or plastic such as PPSU.

The following pipe materials or systems with DVGW mark can be used without restrictions on the water side:

- Stainless steel: Viega Sanpress/Sanpress Inox
- Stainless steel composite pipe: Viega Raxinox
- Plastic composite pipe: Viega Raxofix
- Internally tin-plated copper

Copper pipes and press connectors can be used for potable water installations,

- If the pH value is ≥ 7.4 or
- If the pH value is between 7.0 and 7.4 and the TOC value of 1.5 mg/l is not exceeded.

If the pH value is < 7.0, copper pipes must not be used, as old systems that are still operated with lead pipes need to be renovated as soon as possible. Stricter limit values for lead in accordance with the Potable Water Ordinance have been in force since 01.12.2013. This usually means that lead pipes have to be replaced by ones made of suitable materials.

In order to reduce time-consuming individual tests on products, the German Environment Agency has been tasked with specifying the hygienic requirements for materials and substances and defining the basis for evaluation. The evaluation bases may include test specifications or positive lists for raw materials or materials and substances. Positive lists conclusively define the source materials or materials and substances that can be used. When using metal materials from the positive list, there is no need for a component-related check of metal release into the potable water. These materials are considered suitable for ensuring potable water hygiene.

Hot dip galvanised iron materials

Hot dip galvanised steel cannot be used for all potable waters because it is susceptible to corrosion (rust) and, due to the high degree of pipe roughness, prone to mineral deposits such as limescale. According to the UBA evaluation basis and DIN EN 12 502, hot dip galvanised ferrous materials may be used for potable water cold if

- the base capacity K_B is 8.2 – 0.2 mol/m^3 and
- the neutral salt quotient $s_1 < 1$.

Hot dip galvanised piping must not be used for potable water hot. The effects of temperature and temperature fluctuations on uniform surface corrosion are complex because the composition of the corrosion products in the surface layer changes with temperature. Up to temperatures of around 35°C, the velocity of uniform surface corrosion increases as the temperature increases. Above this temperature, the corrosion rate shows a decreasing tendency because the corrosion product zinc hydroxide prevalent in flowing cold water, is converted into zinc oxide, which is more difficult to dissolve.

The pipe connections on galvanised steel pipes are made with threads, for which hemp is often used as a sealing material. Threaded connections are a major weakness in potable water installations. If, during assembly, the threaded pipe is cut to the required length from the commercial bar stock using a saw or other cutting tool and a thread is cut open, these points will not be galvanised and this can lead to crust formation and corrosion.

Fig. 74: Galvanised steel pipe with clearly visible corrosion

Essentially, creating a potable water installation from hot dip galvanised steel pipes with threaded connectors is much more time-consuming than a comparable potable water installation made of copper, stainless steel, plastic or plastic composite pipes with press connectors.
The zinc layer of hot dip galvanised steel pipes can be contaminated with lead from the manufacturing process. This can lead to an overrun of the limit value for lead in potable water.

Combination of different materials

The use of dissimilar materials in the potable water installation conforms to the generally accepted rules of engineering. (DIN 1988-200). For example, tubes made of copper, internally tinned copper, stainless steel and multi-layer pipes can be combined with one another. When combining pipes made of galvanised iron materials with other pipe materials, DIN EN 806-4 must be observed.

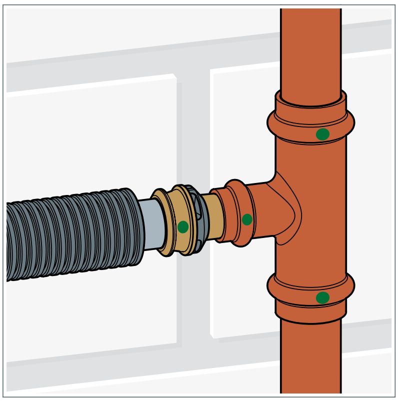


Fig. 75: Profipress–Raxofix transition

When installations are partially renovated or repaired, then the so-called 'flow rule' is to be taken into account for metal materials. Reference is made to the flow rule when dissimilar materials are used in a connected water system. That affects pipes, fittings and containers. According to DIN 1988, this mixed installation is not avoidable in principle and still complies with the generally accepted rules of engineering.

However, mixed installation of dissimilar metallic materials carry the general risk of local elements forming. Local elements are where metal corrosion starts, the effect being that the less noble of two metals dissolves to the point of complete destruction. Less noble metals in a potable water installation include pipes and press connectors from galvanised steel. More noble metals in a potable water installation include copper pipes and press connectors.

If the potable water from the house connection to the draw-off point first flows through components made of less noble materials materials and then comes into contact with the more noble materials, this risk of corrosion is significantly reduced. Conversely, copper ions deposit on iron or zinc surfaces and the less noble zinc or iron dissolves. This results in pitting. Therefore, components and equipment made of copper, copper alloys, tinned copper and copper solders must not be placed in the flow direction ahead of those made of galvanised ferrous materials.

Press connector (or fitting)	**Pipe**		
	Stainless steel	**Hot-dipped galvanised steel**	**Copper**
Stainless steel	Possible	See manufacturer's recommendations	Possible
Hot-dipped galvanised steel	Not possible	Possible	Not possible
Copper	Possible	See manufacturer's recommendations	Possible
Copper alloys	Possible	Possible	Possible

Tab. 24: Combination of pipes and press connectors[1]

If connections have to be made between piping made of stainless steel and galvanised steel, copper alloy components must be used (e.g. gunmetal) in order to reduce or exclude the possibility of contact corrosion based on water quality. This can be done, for example, by installing a shut-off valve. The length of this component must be at least equal to the pipe dimension.

[1] In accordance with table 5 from EN 806-4

Expansion compensators and compensators

The amount of material-specific thermal linear expansion of piping for potable water hot or for the circulation system is proportional to the difference between the installation temperature and the maximum operating temperature, which for thermal disinfections is 70–85°C. The anticipated length differences must be compensated by structural means such as expansion bends, U-elbows or compensators. The thermal linear expansion of metal piping is lower than that of plastic piping systems and multi-layer composite pipe systems. Consequently, basement headers and riser pipes are usually made of copper or stainless steel because less effort is required for expansion equalisation. In pre-wall installations or in floor constructions, most pipes are laid short and change direction several times. As a result, no special measures are required when plastic and multi-layer pipes are used.

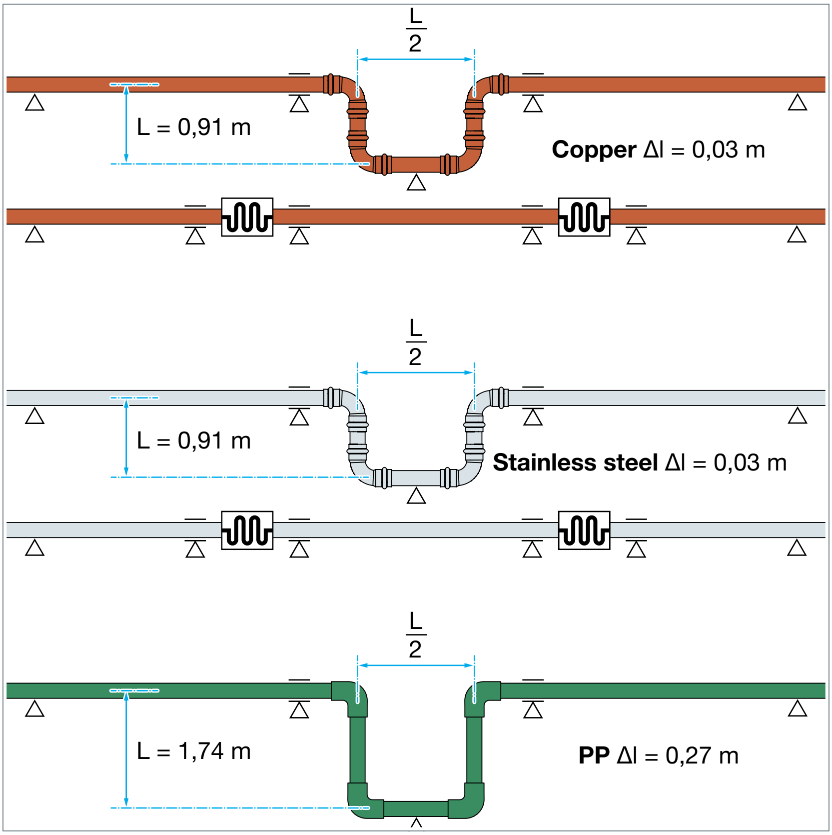


Fig. 76: Linear expansion in piping

Fig. 77: Installation with axial compensators

The thermal linear expansion of copper and stainless steel is almost identical and relatively low, see „Fig. 76: Linear expansion in piping“ on page 87. The more severe changes in length that polypropylene pipes undergo have to be intercepted by expansion compensators, and these require a significant amount of space.

Expansion compensation

If the installation situations allow U-shaped or and Z-shaped expansion compensators to be used, their expansion bend lengths can be calculated as follows:

- Determination of the maximum possible temperature difference $\Delta\vartheta$.
- Determination of the pipe length l_0
- Use these values to calculate the total length by which the pipeline section is extended
- Then read off the necessary pipe bend length L_{BZ} or L_{BU} for the respective pipe sizes using the diagrams below (Fig. 78 on page 89, Fig. 79 on page 90)

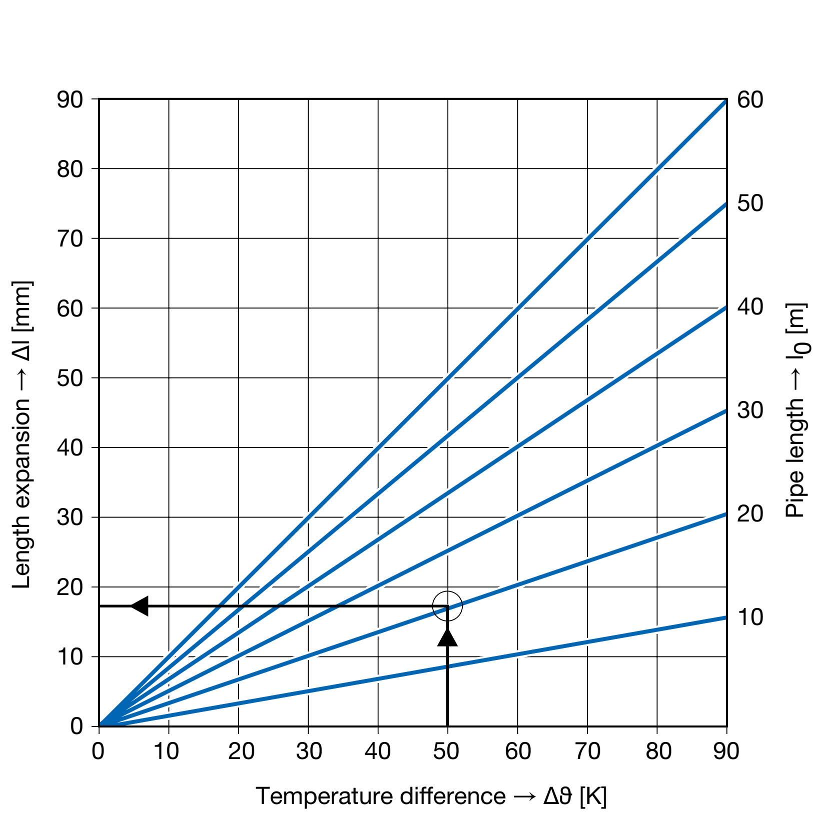


Fig. 78: Linear expansion of metal piping

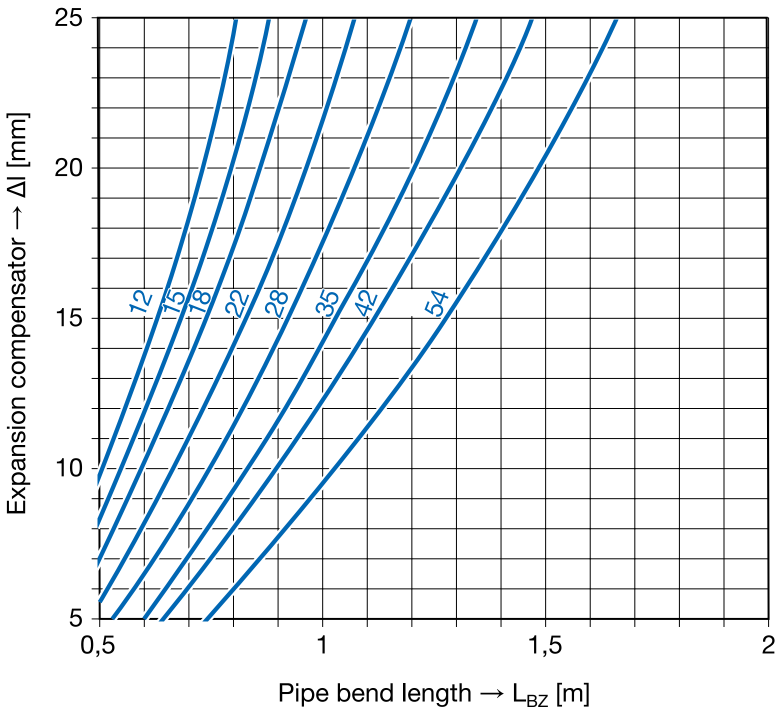


Fig. 79: Z-shaped or T-shaped expansion bend

Example

Given operating conditions:

- The operating temperature is between 10 and 60°C. Hence, $\Delta\vartheta = 50\,K$
- The pipeline section has a length of $l_0 = 20\,m$
- The linear expansion co-efficient for stainless steel and copper pipes is $\alpha = 0.0165$ mm/m·K
- Insert values into the formula $\Delta l = \alpha$ [mm/m·K]·L [m]·$\Delta\vartheta$ [K] Consequently: Δl = 0.0165 [mm/m·K]·20 [m]·50 [K] = 16.5 mm
- Select the U-shape or Z-shape depending on the space available
- Read-off of the required expansion bend length L_{BZ} from the U- or Z-diagram.

In this example for a Z-shaped expansion bend: On the vertical axis at 16.5 mm, trace horizontally to the line of the pipe size used and read off the necessary expansion bend length below on the horizontal axis.
With a selected nominal pipe diameter of Ø 28 mm, the expansion bend length L_{BZ} = 1.3 m. For metal piping, axial compensators can be used as a space-saving alternative to expansion bends. In such cases, the maximum possible expansion range must not be exceeded. If necessary, the calculated expansion requirement has to be spread over several compensators.

Piping with axial compensators must be laid straight so that linear expansions can be accommodated axially. Torsion and shear forces must be avoided. When piping is laid, the manufacturer's specifications for the correct arrangement of fixed points and sliding pipe guides must be observed. The placement of the non-sliding piping for potable water cold stabilises the fixing system (SIKLA) to prevent lateral displacement, and therefore no additional inclined bracing is needed in this case.

Pipe routing downstream of the house service connection

In principle, the responsibility for the house service connections lies with the contract installer.
In this chapter, however, special attention is to be paid to the temperature in the plant room. The latest version of DIN 18012 (April 2018) makes a clear statement in this regard. Section 5.4.3 states that temperatures in the house service connection room that exceed the limit of 25°C are not to be tolerated and, consequently, countermeasures need to be taken. In addition, the term "constantly" has been explicitly defined here once again: it means that the temperature limit has been exceeded for longer than one hour. This temperature is important, since a temperature above 25°C during periods of stagnation also leads to a rise in the temperature in the potable water cold and can encourage the growth of pathogenic microorganisms.
If components such as potable water filters, softening units or systems for treating process water are installed in the room, bacteria are provided with a huge surface on which to thrive. These requirements are also mentioned in VDI 2050 of November 2011. By analogy to VDI/DVGW 6023, this standard recommends that room temperatures of over 20°C are not to be tolerated. In the official draft of this standard of April 2019, however, all references to the temperatures in plant rooms or house service connection rooms have been removed from the text. If these passages are deleted from VDI 2050, it will fall to the experts as to whether this new regulation will find its way into the generally recognised rules of engineering or whether, instead, the hygiene problems occurring in plant rooms at temperatures of 25°C and higher will prevent acceptance as the generally recognised rules of engineering.

Downstream of the water meter, the first few meters are usually the most critical to the hygienic operation of a potable water installation. Here, unmaintained filters – as a breeding ground for pathogenic microorganisms – can contaminate the entire potable water installation from a central point and should therefore be included in the regular maintenance routine. There may also be installation potentials not only for keeping the risks to hygienic operation low, but for reducing financial investment too. If the outlet to the water heater is branched from the cold water pipe early, the dimension of the cold water pipe after the branch can be reduced in some cases, which ultimately means far less risk to hygiene following a period of stagnation. The same is true for the outlet from process water or fire extinguishing lines. Risk assessments show that branching these pipes early significantly reduces the

risk of contamination. This installation method is often observed in practice, but not usually implemented consistently through to the end. It is not only the early branching downstream of the house service connection that reduces the risk to hygiene for the entire installation, but also the positioning of the safety device immediately behind the branch from the cold water pipe. Separating the potable water cold and potable water hot, process water or fire extinguishing lines close to the connection reduces the hygiene risk for the potable water cold, since unprotected supply pipes hold barely any water stagnation-prone water.
To install the manifold, the leg with the largest dimension should be positioned last and the transition created using elbows. This arrangement ensures an optimal flow through the entire manifold, since the biggest decrease occurs in the final leg.

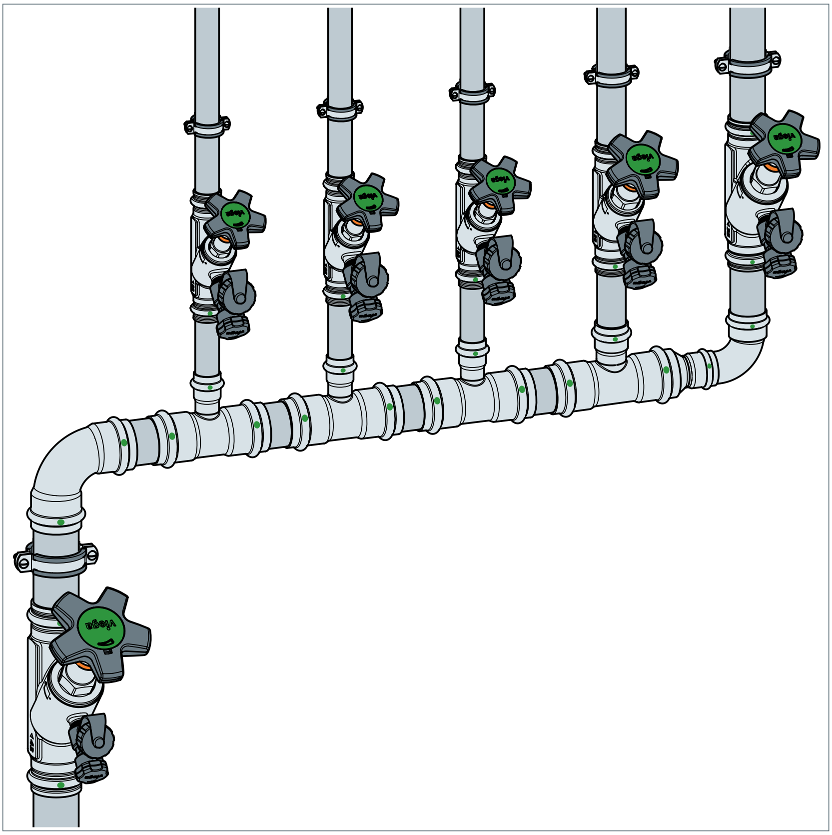


Fig. 80: Hygienically optimised manifold installation

Especially in existing buildings, however, hygienically critical installations that were installed according to the generally recognised rules of engineering at the time can still be found. The installations pictured below clearly show why the legislators chose the wording for the generally accepted rules of engineering. Because whenever new findings reinforce the suspicion that hygiene problems occur within the installation, the operator of a potable water installation must arrange for improvement and repair work immediately.

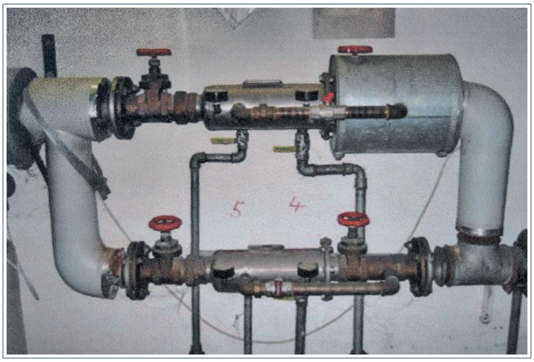


Fig. 81: Filter system (redundant design)

- R 2½ bypass pipe for filter
- Visual inspection of the filter not possible
- Filter elements missing

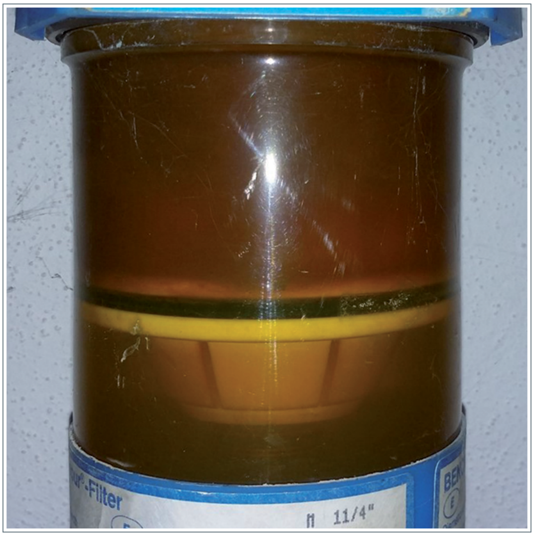


Fig. 82: Filter at the entry to the building without maintenance and inspection

- Inadequately maintained filter
- Large surface encourages the growth of bacteria
- Central contamination of a potable water installation

Distribution concepts for potable water cold

Downstream of the house service connection, potable water cold is installed in the building according to two principles: as a vertical header or a horizontal header. Essentially, the designations vertical and horizontal refer to the position of the storey connection pipes. One example of horizontal distribution is a hospitals, where the supply pipes to the individual service units originate in a common shaft and then run in the suspended ceiling.

Vertical distribution concepts for potable water are found mainly in existing buildings, since here in particular all piping were planned in one common shaft due to the lack of space. In such buildings, heating pipes with hot water and circulation pipes run parallel to the cold water pipes. This frequently leads to shaft temperatures of over 25°C and causes the cold water temperatures to exceed 20°C during periods of stagnation. Compensating for this effect using 100% insulation adapted from the hot water pipe is not the answer. This is because in an insulated pipe, heat absorption is counteracted only slowly and external heating cannot be cancelled out completely. Essentially, there are two possible solutions here if a vertical distribution cannot be avoided. One is to split the hot and cold pipes into two different shafts. It would be necessary to check whether the building has shafts for, e.g. sewer lines and other cold pipes, such as fire mains, cold pipes or ventilation lines. The cold water pipe could be positioned spatially separate from the heat sources.

This version is not a viable solution in all buildings, and therefore a cold water circulation with a cooling facility is required in most cases. Similar to the hot water circulation, a cold water circulation pipe is routed to a central cooling unit where the circulating water is cooled. Since this is relevant in periods of stagnation in particular, positioning the cooling unit in the potable water cold circulation and, in contrast to potable water hot preparation, making its use temperature and time-dependent is sufficient. The circulation system for potable water cold is closed by returning the cooled water to the potable water cold pipe at a suitable point. This is usually close to the house service connection and, for energy optimisation, ideally where the potable water cold has already been drawn off to prepare the potable water hot.

Such circulation systems should be planned digitally using Viptool Engineering tools. Electronic, automatic circulation regulation valves or static circulation regulation valves can be installed for cold water circulations. A cold water circulation offers not only the advantage of hygienically flawless temperatures in the cold water pipe system, but also the benefit of better respecting comfort times in the cold water.
In multi-storey residential buildings, the ejection times required for potable water cold are often not respected. The Smartloop inliner technology (DVGW-certified for potable water cold and hot) is the ideal solution for refurbishment projects. It eliminates the need for additional piping in the shaft; the inliner is simply pushed into the cold water pipe retrospectively. This technology cannot be used if the potable water cold is subsequently distributed up to the storeys and circulated, but does prove to be a cost-

effective solution in residential buildings. As with the hot water pipe, an additional pipeline section should be used. However, the inliner technology is also suitable for hot water pipes, since it significantly reduces the heat-emitting surface and this allows the shaft temperature to be lowered in some cases. Ultimately, this curtails any external heating of the potable water cold during periods of stagnation.

The horizontal method was the established standard for the distribution of potable water cold for some time. However, it has become less and less appealing due to the external heating effect. The methods considered standard to date (100% insulation, thermally insulated components at extraction fittings), have shown in practice that they fail to adequately prevent the hygienically critical temperatures that can occur with this type of installation. This is mainly due to the long parallel run of hot and cold pipes in suspended ceilings. In addition to installing a cold water circulation, there are also planning measures that can prevent elevated temperatures in the potable water cold. Routing the cold water pipes parallel to the wastewater downcomer (vertical) and the pipes for potable water hot horizontally in the suspended ceilings can significantly reduce the admission of heat into the cold water pipe. Other advantages are that the temperature is maintained without technical intervention and the cooling units require no maintenance.

There is additional optimisation potential in pre-wall installations. The external heating of potable water cold can be solved by positioning the potable water cold lines as close as possible to the bottom of the pre-wall and the potable water hot lines as close as possible to the top. This keeps the admission of heat into the potable water cold line to a minimum. If the potable water cold line in a service unit is produced as a ring system and the potable water hot line with circulation pipe for potable water hot routed up to the last draw-off point, also with thermal decoupling, heat is permanently admitted into the potable water cold and it can become contaminated by legionella. If potable water cold also flows through this ring system on the basis of the Venturi principle, local contamination can quickly escalate to become systemic contamination. If the potable water hot circulation remains outside of the service unit, in the corridor for example, the potable water cold within the service unit cannot get hotter than room temperature which, with a few exceptions, remains below 25°C. The connection of the piping itself is also relevant to the temperature of the potable water cold. If the potable water hot and the potable water cold are routed to the extraction fitting in parallel from above or below, the potable water cold will inevitably heat up whenever potable water hot is taken from this draw-off point. If, on the other hand, potable water hot is routed to the draw-off point from above and potable water cold from below, the individual piping sections will be thermally isolated from one another.

The illustration below shows what such a service unit might look like:

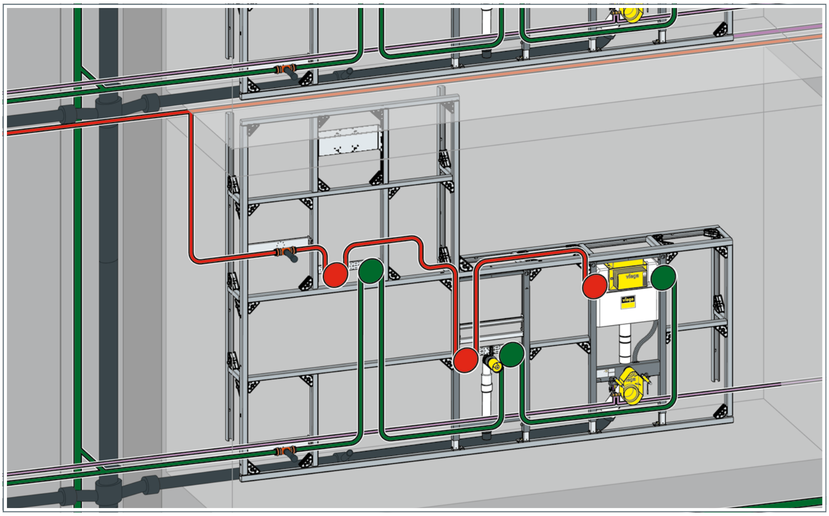


Fig. 83: Connection of a service unit to the potable water cold and potable water hot distribution, connection of the circulation outside the service unit.

Regardless of the pipeline routing, there is a legal obligation to perform a complete water exchange through all draw-off points.

Distribution concepts for potable water hot
According to DIN 1988-200, Item 9.1, pipeline volumes > 3 litres are to be integrated into a circulation system or provided with heat tracing cables. This maximum volume does not mean the sum of all branches of a storey distribution system, it refers instead only to the flow path under specific consideration. Generally, this is also in the correct proportion to the maximum permitted ejection time of 30 seconds, which corresponds to an average extraction quantity of approx. 0.1 l/s. In residential buildings for example, a target ejection time for potable water hot of approx. 10 seconds maximum effectively leads to a "1 litre rule". In practical terms, longer ejection times therefore require a special agreement. In the final analysis, any determination of basic requirements should take this aspect into account. In VDI 6003, these ejection times are listed in comfort levels and offer a framework that can be agreed with the building owner or subsequent user in advance when planning a potable water installation.

The outlet temperature of a potable water heater (storage or central flow-through potable water heater) that constitutes part of a circulation system must be at least 60°C, whereby the temperature difference to the circulation, measured at the entry to the potable water heater, must not exceed 5 K (DVGW Worksheet W 551). The operating temperature of ≥ 55 °C for potable water systems applies generally to potable water hot as a recognised safety margin for the prevention of critical Legionella growth. This assumes operation as intended with water exchange through the whole system (branches and storage volume) after 3 days at the most.

Operating temperatures of ≥ 50 °C for potable water heaters with frequent water exchange are possible where the water exchange for the whole system can be ensured within 3 days, or this is generally to be expected. This regulation makes it possible to ensure economical operation of potable water heaters especially in single-family homes that are heated using energy from renewable sources. With the exception of occasional periods without regular usage (e.g. holidays), favourable hydraulic conditions may be expected all the time. However, opting to take advantage of this regulation obliges the installer to inform the building owner of the possibility of an increased risk of legionella propagation when the system is handed over. Despite the frequent use expected, the temperature parameter is within a range that encourages the growth of legionella.[1] The relatively short flow paths involved in such systems cause high pressure gradients to counter pipe friction, allowing for minimal pipe diameters and good flow-through. Irrespective of the size of the system, the aim should always be to achieve such operating conditions wherever possible. Needs-based planning is key here, and this applies especially to the dimensioning of the potable water.

[1] DIN 1988-200, FEA Report 2019

In well-insulated new buildings to energy standard "KfW Effizienzhaus 40" (efficiency house) and higher, the preparation of potable water hot now accounts for a disproportionately high amount of the total energy requirement. Depending on the insulation standard, it can be as much as 40% of the primary energy requirement. The high energy requirement for PWH is down to complex pipeline networks and circulation systems, with their inevitable thermal losses, and also because the heat load has to be maintained over 365 days for decentralised potable water heaters.

This is also confirmed by the "Bund der Energieverbraucher" (Association of Energy Consumers), which states: Maintaining a constant supply of hot water requires a great deal of energy. Keeping potable water hot at the temperature of 60/55°C required by the standards, however, not only demands a high amount of energy, it is also prohibitive to the use of regenerative heating systems. The optimum operating point of an energy-efficient heating pump, for example, is around 35°C. Such temperatures are ideal for heat generation with the heat distributed through surface heating, but not for preparing potable water hot to a high temperature. To reach the 60/55°C required, therefore, hot water tanks are often reheated by an expensive process using power from fossil energies through an electric heating cartridge. Ecologically and economically, this makes little sense.

The conflict between improved energy efficiency and meeting the protection objective of "maintaining potable water quality" cannot be resolved through the conventional approach. According to Section 9.1 of DIN 1988-200, alternative technical measures can be taken to guarantee the hygiene of potable water.

The latest research results and pilot studies (state-of-the-art in science and technology) suggest that a gradual reduction of the supply temperature of potable water hot to 48/45°C, for example, can be achieved if the framework conditions required for this are met.
This calls for

- hygiene-conscious planning of the potable water installation with reliable hydraulic balancing,
- guaranteed operation as intended and
- reduction of the total cell count according to the sphere of influence for potable water quality by ultrafiltration in the circulation bypass.

In this way, the growth potential for legionella and other pathogens can be sustainably minimised beyond the temperature limits. The aim is neither operating temperatures nor energy efficiency, but that of achieving the required potable water quality.

The German Environment Agency (UBA) has already described the energy-efficient optimisation of operating temperatures in hot water without any compromise on potable water hygiene. Ultrafiltration technology (UFC) in combination with potable water heating zoned in case of need can play a key role here.

Circulating storey connection pipes can be installed in systems with central potable water heating wherever no decentralised consumption measurement is anticipated for the storey concerned. Classic examples of this are the distribution and circulation pipe networks in the suspended ceilings in hospital corridors. Storey and single supply lines with a volume of < 3 litres do not need to be integrated into the circulation pipe. There is a long-held belief that to maintain hygienic conditions in hot water installations, a circulation pipe has to be routed up to the wall plate. This was based on a misunderstanding of the RKI Directive on hospital hygiene and infection prevention, which states: "For the installation of systems, the objective is to have circulation pipes with the shortest possible connections to the draw-off point". In conjunction with the generally recognised rules of engineering, the expression "shortest possible" does not mean routing the circulation pipe up to the wall plate. There is a second aspect in the RKI Directive that deserves special merit – that of preventing cold water from being heated. The generally recognised rules of engineering permit a water volume in hot water of up to 3 litres[1], and this can be used to dimension the potable water installation in compliance with the RKI Directive. Neither is the comfort argument any reason to route a hot water circulation pipe up to the draw-off point, since when comfort level 3 of VDI 6003 is applied, the maximum ejection time for hot water at the shower fitting is 7 s. With a standard shower, this ejection time can also be achieved using a single connection pipeline of up to 10 m in 16 mm multi-layer pipe. This length also clearly shows that a hot water circulation pipe does not have to be routed into the service unit, since the comfort and hygiene criteria can be fulfilled even without this. Another aspect that has received little attention in the application of the RKI Directive is that of preventing cold water from being heated. Routing the hot water circulation pipe into the service unit generates high heat loads in the pre-wall installation. These loads then cause the cold water to exceed the specified temperature, not only locally at the extraction fittings, but also systemically in the supply lines. Here too, it becomes clear that a looped hot water circulation pipe is not the answer to maintaining hygiene because the operator is under an obligation to exchange the water on a regular basis, regardless of the pipe routing.

[1] W 551, DIN 1988-200

The pipelines for potable water hot and circulation are insulated in accordance with EnEV. The Energy Saving Ordinance (EnEV 2014/ab 2016) limits the amount of heat lost through hot piping and fittings in buildings. Section 10, para. 2 of EnEV 2014/EnEV as of 2016 specifies a retrofit obligation in existing buildings for the insulation of piping. Section 14, para. 5 specifies insulation during initial installation and for the replacement of heat distribution and hot water pipes and also of fittings in buildings as follows:

- "Building owners must ensure for heating systems, that previously non-insulated, accessible heat distribution and hot water pipes and fittings not located in heated rooms are insulated according to Annex 5 in order to limit heat dissipation".
- "At initial installation and when replacing heat distribution and hot water pipes as well as fittings in buildings, the heat emitted from these surfaces must be limited in accordance with Annex 5".

The minimum thickness of the insulating layer is the same in both cases and specified in the regulation in Annex 5 (Requirements for the heat insulation of piping and fittings), Table 1 (Heat insulation of heat distribution and hot water pipes, cold distribution and cold water pipes, as well as fittings).

Row	Type of pipelines/fittings	Minimum thickness of the insulating layer based on a heat conductivity of 0.035 W / (mK)
1	Internal diameter up to 22 mm	20 mm
2	Internal diameter over 22 mm up to 35 mm	30 mm
3	Internal diameter over 35 mm up to 100 mm	Same internal diameter
4	Inner diameter over 100 mm	100 mm
5	Pipes and fittings as in rows 1–4 in wall and floor breakthroughs, at intersections, at pipe connection points and for central pipe network manifolds	½ of the requirements of rows 1–4
6	Heat distribution lines according to lines 1–4 installed after 31January 2002 in building sections between heated rooms of different users	½ of the requirements of rows 1–4
7	Pipes in acc. with line 6 in the floor construction	6 mm
8	Cold distribution and cold water pipes as well as fittings in room air and air cooling systems	6 mm

Tab. 25: Heat insulation of heat distribution and hot water pipes, cold distribution and cold water pipes as well as fittings (Annex 5 (to Section 10, para. 2, Section 14, para. 5 and Section 15, para. 4), Table 1 of EnEV 2014)

Exceptions to this table are set out in Annex 5 to EnEV, para. 2:
"In cases of Section 14, para. 4 (Circulation pumps in hot water systems), Table 1 is not to be applied to hot water pipes with a maximum water volume of 3 litres, which are neither integrated into the circuit nor equipped with trace heating (single connection pipeline) and which are located in heated rooms".

According to EnEV, therefore, hot water pipes in pre-wall installations which – as described above – are not integrated into the circulation, require no insulation. This is advantageous from a hygiene perspective because after use, these pipelines cool down at a fast rate and are able to adapt to the ambient temperature, usually 20°C. As a result, they transit the critical range of between 20°C and 55°C in which legionella propagate as rapidly as possible. In addition, because in this case heat is admitted into the pre-wall during use only temporarily, the pipeline for potable water cold likewise located in the pre-wall is protected against inadmissible external heating.

DVGW W 551

DVGW Worksheet W551 entitled "Potable water heating and potable water distribution systems; Technical measures for reducing Legionella growth [...]" from 2004 addresses the planning, construction, operation and refurbishment of potable water installations. This worksheet aims to describe the technical measures and other safeguards required to prevent the health risk caused by legionella from potable water installations. The worksheet sets out the requirements for planning and construction, operation, maintenance, refurbishment following contamination, as well as the process of hygiene and microbiological examinations and evaluations. Essentially, a distinction is drawn between the small and large systems for which different requirements apply. The distinctions between small and large systems are explained in „Tab. 26: Summary of the key criteria for the differentiation and operation of systems for potable water heating“ on page 103.

The so-called 3 litre rule refers to the highest limit for non-circulating potable water; smaller volumes are desirable. No matter what the system, it must be ensured that a temperature of 60°C can be set at the exit from the potable water heater and, if a circulation system is in place, that the maximum temperature drop is no more than 5 kelvin.

For the operation of large systems, there is a legal requirement to permanently maintain a temperature of at least 60°C at the exit from the potable water heater. Brief reductions lasting minutes, however, are tolerable since they do not present a time frame long enough for legionella to propagate.

For small systems, a temperature of 60°C is recommended and a minimum temperature of 50°C at the exit from the potable water heater is legally specified. In this case, however, the operator must be made aware of the increased risk to health. Here again, it would appear that technical regulations do not necessarily reflect the generally recognised rules of engineering. More recent research projects have shown that a temperature of < 55°C verifiably increases the risk of legionella growth. Accordingly, the requirement that temperatures of below 55°C are tolerable in small systems cannot be consistent with the protection objective as stated in Section 1 of the Potable Water Ordinance, since in this case human health can no longer be verifiably protected against the negative effects.

For further information on operational, procedural and structural measures in case of contamination, as well as on the process of hygiene and microbiological examinations and evaluations, see DVGW Worksheets W 551 and W 556.

The basic distinction is made in large and small installations, although these expressions are also defined in the Potable Water Ordinance.

	Small system	**Large system**
Definition (DVGW 551)	Systems with storage potable water heaters or central through-flow potable water heaters ■ installed in single or two-family homes, irrespective of the system volume (potable water heater, piping) ■ with a potable water heater with a volume of ≤ 400 l and ≤ 3 l in each pipeline between the outlet at the potable water heater and the draw-off point. Volumes in any circulation pipes are not taken into consideration.	All systems with storage potable water heaters or central through-flow potable water heaters, e.g. ■ installed in apartment buildings, hotels, homes for the elderly, hospitals, spas, sports facilities, industrial premises, camping sites, swimming baths. ■ with a potable water heater with a volume of > 400 l and/or > 3 l in each pipeline between the outlet at the potable water heater and the draw-off point.
Outlet temperature PWH at the potable water heater (1988-200) (DVGW 551) (VDI 2072)	Besides the recommendation for small systems of 60°C in general, a temperature of 50°C can also be applied if a water exchange within 3 days is guaranteed. For decentralised potable water heaters, an outlet temperature of at least 50°C is recommended.	For large systems, the exit from the potable water heater must be at least 60°C. A temperature reduction is generally possible if the alternative method has demonstrated its efficiency through microbiological investigations.
Circulation system (DVGW 551) (VDI 2072)	Small systems and decentralised systems with pipeline volumes of > 3 l between potable water heater outlet and draw-off point require circulation systems to be installed and operated at a temperature of 60°C or higher, with max. cooling to the re-entry point to the storage heater of 5 K.	As a general rule, large systems require circulation systems to be installed and operated at a temperature of 60°C or higher, with max. cooling to the re-entry point to the storage heater of 5 K.
Potable Water Ordinance requirement	-	For large systems, there is a mandatory requirement to test the potable water in domestic installations for legionella every three years and in public buildings every year.

Tab. 26: Summary of the key criteria for the differentiation and operation of systems for potable water heating

Construction, operation and maintenance

Storage and assembly

All components of a potable water installation must be delivered to the construction site in a perfectly hygienic condition. Nowadays, dry leakage tests that aim to exclude the possibility of the products having being exposed to microbial risk are preferred in the manufacturing processes. Residual water in a fitting that has been tested for leaks using water may prove to be exactly what promotes the propagation of microorganisms, especially during long storage periods in summer. Pipes, moulded pieces and fittings should always be stored in such a way that the ingress of dirt and soiled water can be reliably excluded. Otherwise there is a major risk of components becoming contaminated during the construction phase (which often extends over a long period) before commissioning has even taken place.

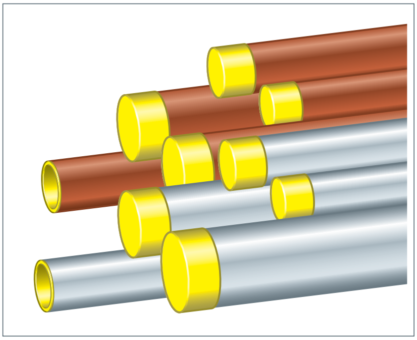


Fig. 84: Pipe plugs as hygiene protection

Viega pipes are generally supplied sealed with plugs, and therefore hygienic transport conditions may be assumed. Protective caps for sealing riser pipes are required during assembly, because this is when the ingress of dry cement dust or similar is most likely to occur, especially in shafts. Although the ingress of such materials is generally considered non-critical from a microbiological perspective, major flushing may be required to clean complex pipeline networks ready for the operational phase.

In contrast, repair and extension work can present a much more serious hygienic risk. A qualified installer is aware of the need to wash their hands thoroughly between work involving soiled material (such as a drainage system) and work on a potable water installation. The risks regarding potable water quality and therefore for the protection objective of preserving health need to be evaluated quite differently for work on existing buildings or during operational interruptions in comparison with work on new installations. This is what is behind the disinfection requirements for components used in local repairs on existing pipework that are laid down in DIN EN 806-4, Item 6.3.5.

For instance, press connectors should be removed from their original packaging only just before use – that way, no disinfection is needed.

Closing caps for devices such as potable water heaters may be removed only immediately before assembly. This eliminates any chance of contamination by small animals that might take to living in these devices. If a potable water installation is contaminated by the carcasses of small animals, it can become polluted by *Salmonella*, *E. coli* or *Enterococcus* to such an extent that a complete refurbishment is required to solve the problem.

Leakage test, dry

To ensure potable water hygiene and protection against corrosion and frost, the potable water installations should be filled only immediately before commissioning. Water left inside a full or partially full system for prolonged periods has negative implications and must therefore be avoided. For this reason, a leakage test using water in accordance with the requirements of DIN 1988-200 should be applied only in certain cases, e.g. if the test is performed immediately before commissioning. It should be remembered that once filled with potable water, a potable water installation cannot generally be emptied again completely, and this would present a risk for the hygiene of the potable water. This makes the dry leakage test essential to eliminating risks for potable water hygiene. Flawless potable water quality and hence human health must always be considered higher protection objectives than the prevention of material damage. Jurisprudence sees the situation in the same light. Planners who select the materials for a project are also instrumental in meeting this objective. They have to assess the materials for the potable water installation for chemical corrosion in advance, for instance. DIN EN 12502, which concerns corrosion protection, must be taken into consideration. This standard also specifies a dry pressure test.

According to DIN EN 806-4, leakage tests are to be carried out dry and the load test that follows wet. A wet leakage or load test must be immediately followed by operation as intended, meaning a complete water exchange is required every 3 days (in accordance with VDI/DVGW 6023), or 7 days at the latest (in accordance with DIN EN 806). As it is virtually impossible to do this in practice for all sections, leakage tests using dry, oil-free compressed air or inert gases are recommended. These should then be followed by load tests which are suitable and approved as an alternative to a wet load test. The requirements in the relevant data sheets, e.g. those issued by ZVSHK or BTGA Technical Rule 5.001, must be met. These data sheets also contain specific instructions for alternative load tests.

During the wet load test, the test pressure must be 1.1 times the maximum operating pressure, as per DIN EN 806-4. The test time for metal pipes is 10 minutes after the temperature has equalised. For plastics, the established initial and main tests are performed.

Generally speaking, a dry load test is permissible for all Viega installation systems. With larger-scale construction projects, the potable water system is often installed in stages and sometimes even split into several lots that are assigned to various trade professionals. The dry leakage test is standard for such projects. This is carried out using compressed air or inert gas at 110 mbar of pressure. With a pipe volume of up to 100 litres, the test duration must be at least 30 minutes after the test pressure has been reached. For larger systems, the test duration increases by 10 minutes for every extra 100 litres. The load test that follows must also be carried out dry for 10 minutes at a maximum operating pressure of 3 bar with nominal widths of up to DN50 or 1 bar with nominals widths > DN50. It is most important that the load test is combined with a visual inspection of all connections for leak tightness.

However, because visual inspections are not always possible in practice and can often be uneconomical, separate regulations exist for connection systems that "leak when unpressed". This is the case for connectors with the SC-Contur from Viega. These have been tested by both the DVGW and Institut für Schadenverhütung und Schadenforschung der öffentlichen Versicherer e.V (Institute for damage prevention and damage research of public insurers). The SC-Contur feature ensures tell-tale leakage from the connector across the entire pressure range from 22 mbar to 3 bar dry and from 1 bar to 6.5 bar wet, regardless of the sealing element, whenever the press connector needs to be sealed. In addition, a cylindrical pipe guide protects the sealing elements in the press connectors of the Viega meal pipe systems. During assembly, the pipe guide ensures that the pipe is inserted into the connector straight and prevents the sealing element from becoming damaged. This flags up any inadvertently unpressed connections during the pressure and load tests.

Threaded connections and screw fittings must be checked manually beforehand. An analysis has shown that these connections cannot be reliably tested from a central point, either by means of a dry or a wet leakage test at either low or at high pressures.

The initial filling of a potable water installation must always be carried out using potable water, irrespective of the type of leakage test employed. Failure to observe this rule often results in long-term microbiological contamination. In one case, for example, the potable water installation for a hospital extension had to be decommissioned and replaced, despite several attempts at chemical and thermal disinfection, because the initial filling had been done using highly contaminated water. The water for this project had been supplied via a provisional pipeline during the construction phase. Just before the water meter was assembled, the installation system was filled from the house service connection without this having been properly flushed, although the water it contained had been stagnant for months. Records and documentation on the commissioning procedure are therefore very important. A potable water installation must be filled only with potable water from a professionally constructed and flushed potable water connection. Sampling of the fill-up water is highly recommended (cf. DIN 1988-200).

Commissioning

The foundations for commissioning are laid with the successfully completed and documented initial hygiene inspection and the dry leakage test performed in advance. A step often overlooked, however, is delivering the documents required for operation as intended. Because subsequent operators are not always involved in the construction work, they may not be aware of the planning specifications. Since the operator of a potable water installation has to hold the system book for operation as intended, the following documents must be handed over at commissioning:

General information

- **Project data**
  The project data communicate the general specifications of the building. They detail the general usage and also any structural specifics.
- **Technical data for potable water installations**
  These are more specific data on the potable water installation, including the type of energy supply or the potable water heating system used.

Planning documents

- **Room books**
  Room data sheets contain the data specific to the service units. These documents specify which fitting is to be used, how the potable water supply has been structured or how potable water hygiene is guaranteed. In addition, the values applied for the planning phase can be kept here. Meaning, for example, which simultaneous use is expected or which usage frequency for the individual sanitary objects is assumed.
- **Calculations (cf. Section 3.5.1 of DIN 18381)**
  These documents provide the subsequent operator with the pipeline network calculation. This makes it possible to check, during operation, whether structural additions can still be integrated into the system hydraulically or whether more extensive construction measures have to be factored in. The target values for circulation regulation valves (Cv values and target temperatures) are also often overlooked. Regardless of the function, Section 3.5.1 of DIN 18381 requires that the hydraulic balancing is carried out using the computed target values. Following commissioning, it is necessary to check whether the determined temperatures actually occur at the circulation valves. DIN 18381 is relevant because it is part of VOB Part C and hence part of most service contracts.

- **Pipeline network plans**
  The pipeline plans – the diagrams of the legs and the layouts in particular – are indispensable to the subsequent operation of a potable water installation. Only these plans show which pipes are intended to be laid where, and at which points along the potable water installation regular maintenance measures are required. This final aspect especially plays a key role since it is not always obvious from the finished system where maintenance activities are required. During commissioning, it is also necessary to check whether these points are accessible and whether the requisite revision openings have been installed (fittings and devices).

Commissioning documents

- **Record for initial hygiene inspection**
  In this record, several aspects that should have been addressed by this execution date are set out and the completeness of these is checked. The basis for the initial hygiene inspection is contained in Section 6.9.2 of VDI/DVGW 6023. This includes checking the documents for completeness, checking the system for compliance with the requirements in the room data sheet and checking the connections to non-potable water systems and the correct separation between the two.
- **Pressure test records**
  The commissioning procedure also includes handing over the pressure test records which, ideally, show a test carried out using dry, oil-free compressed air or inert gases.
- **Analysis report for initial sampling**
  The construction of a system involves mandatory initial sampling and the analysis results obtained belong in the documents that are handed over during the commissioning procedure.
- **Records for handover and instructions**
  The acceptance of a potable water installation includes the transfer of risk, and this should be documented since this is the point in time at which the obligation to ensure system operation as intended passes from the trade professional to the system operator. Moreover, on completion of their work, the trade professional should sign to warrant once again that they have instructed the employees of the contractor and other owners in the hygienic procedures for the potable water installation. Training in accordance with VDI/DVGW 6023 Cat. C is suitable for this purpose.

Manufacturer's documentation

- **Instructions for use**
  As the basis for maintenance documentation to be issued at a later date, the relevant instructions for use must also be provided when the potable water installation is handed over.
- **Maintenance instructions**
  Manufacturers often provide important information in their documentation for the preventive measures required to prevent damage to potable water installations.
- **Maintenance instructions**
  If these documents are provided by the product manufacturers, they should be handed over as well since they help the contractor and other owners to establish a maintenance plan.

Logbook

- **Maintenance documents**
  The manufacturer's documents on maintenance, supplemented by the documents additionally prepared by the contractor and other owners on maintenance procedures, make up an essential part of the logbook. The contractor and other owners should keep copies of these documents so that they can prove they have met their obligations for routine maintenance at any time. Ideally, they include standard work instructions for every component that is relevant to maintenance. All fittings and devices with a control task perform a function that should be checked at regular intervals. The hygiene plan expands the maintenance plan with regular potable water checks using defined parameters, as well as documentation on completion of all measures. It can be a sub-section according to the Protection Against Infection Act (IfSG) or a hygiene regulation.
- **Description of malfunction and energy management**
  Although not essentially part of the planner's remit either, this procedure does ensure that malfunction and energy management is addressed at an early stage rather than leading to expensive retrofits afterwards.
- **Operating instructions**
  The provision of operating instructions is not a task for the planner alone. Indeed, the preparation of such documentation calls for a cooperation with the future operating company. The more complex the system is planned, the more extensive the operation afterwards. Simple piping installations and manageable systems mean that the number of components and hence also the manpower requirements for operation can be significantly minimised. Nonetheless, the planner is able to achieve a cost-efficient operation, as required by DIN 1988 and DIN 18381, through simple, well-arranged installations. Low-maintenance installations can ultimately avoid high maintenance and monitoring costs.

Intended operation
Microbiologically faultless potable water quality at the draw-off points is guaranteed in potable water installations that are planned, built, commissioned, operated and maintained in accordance with the generally recognised rules of engineering. The hygienically safe operation – defined by the generally recognised rules of engineering as "operation as intended" – of the potable water installation plays the key role in faultless potable water quality. According to DIN 1988-200, Section B 1 and VDI/DVGW 6023 Sheet 1, this means operation of the potable water installation across all draw-off points, with regular monitoring routines for proper function, as well as the implementation of the requisite maintenance measures for the operationally safe state in compliance with the operating conditions used as a basis for planning and erection activities (manual or automated flushing)". From a hygiene perspective, manual and automated removal of potable water at draw-off points are the same.

Regular, professional maintenance is the prerequisite for operation of a potable water installation as intended. This is deemed to have occurred if

- the potable water installation is operated as planned,
- critical stagnation is avoided throughout the potable water installation (including by regular draw-off),
- the temperatures for cold and heated potable water are respected and
- the measures for the protection of potable water in accordance with DIN EN 806-5, DIN EN 1717 and DIN 1988-100, as well as the maintenance intervals – the service intervals in particular – are implemented.

During the operating phase, an inadequate water exchange in potable water pipelines that are unused or used insufficiently must be avoided at all costs from the outset. Failure to observe this rule increases the risk of microbiological contamination. The planning objective of dimensioning must be a full water exchange at every point in the potable water installation by means of draw-off every 72 hours, i.e. every three days at the latest. If water is not exchanged at a draw-off point every 72 hours, an operational interruption is deemed to have occurred. If necessary, special measures must be taken at the extraction fittings to compensate for interruptions in use such as vacant periods, seasonal operation or school holidays. In special, property-specific or structural-related cases (e.g. food processing companies, hospitals, care homes for the elderly, increased external heating of the potable water cold – PWC) it may be necessary to define shorter intervals for water exchange (≤ 24 hours).

If the water remains in the potable water installation for longer, the water quality can be impaired by the propagation of microorganisms and by dissolving materials and substances. This impairment depends on the delivered water quality, the materials used in the potable water installation, the operating conditions, the potable water temperature and the dwell time of the potable water (stagnation). The measures to be implemented in case of unavoidable operational interruptions are described in „Tab. 27: Measures to be implemented during operational interruptions in accordance with VDI 3810 Sheet 2 / VDI 6023 Sheet 3“ on page 112.

<table>
<tr><th>Duration of the operational interruption</th><th>Measures at the start of the interruption</th><th>Measures at return (end of interruption)</th></tr>
<tr><td>≥ 4 hours
up to 3 days</td><td>None</td><td>Allow stagnant water to drain until the temperature is constant</td></tr>
<tr><td rowspan="3">> 72 hours to max. 7 days</td><td colspan="2">Operational interruption</td></tr>
<tr><td>Closing the shut-off system</td><td>Open the shut-off system, allow water to flow at several draw-off points simultaneously for five minutes</td></tr>
<tr><td colspan="2">In rarely used parts of the system, e.g. guest rooms, garage or basement connections, refresh the water in the single supply line by drawing-off from fully opened draw-off points at least once per week</td></tr>
<tr><td>Up to max. 4 weeks</td><td>Closing the shut-off system</td><td>At recommissioning, full water exchange
at all draw-off points
by flushing with water in accordance with DVGW W 557 (A)</td></tr>
</table>

Duration of the operational interruption	Measures at the start of the interruption	Measures at return (end of interruption)
> 4 weeks to max. 6 months	On closing, leave the shut-off systems filled (unless there is a risk of frost)	On recommissioning, flush in accordance with DVGW W 557 (A), perform microbiological control examinations as stipulated by the Potable Water Ordinance (TrinkwV) (potable water, hot and cold) and for legionella (potable water, hot and cold)
> 6 months	Have the connection line separated from the supply line by a water supply company or a trade professional	Notification to the water supply company, recommissioning in accordance with DIN EN 806-4 by a registered installation company; on recommissioning, flush in accordance with DVGW W 557 (A), perform microbiological control examinations as stipulated by the Potable Water Ordinance (PWO) (potable water, hot and cold) and for legionella (potable water, hot and cold)
> 6 months	On closing, leave the shut-off valve filled (do not drain) unless there is a risk of frost	Recommissioning by specialist companies, flushing with water according to EN 806-4/ DVGW W 557, carry out regular microbiological checks in accordance with the Potable Water Ordinance (potable water hot and cold) and checks for legionella (potable water hot and cold)
> 1 year	Have the connection lines severed at the supply lines directly by a specialist, report to the water supply company Change of use: Deconstruction of redundant parts of the potable water installation by dismounting them directly at the supply line where flow-through will still occur during intended operation.	

Tab. 27: Measures to be implemented during operational interruptions in accordance with VDI 3810 Sheet 2 / VDI 6023 Sheet 3

If the number of draw-off points, draw-off frequency, simultaneous use and peak volume flows,
for example, change, the relevant sections of the system book (e.g. room data sheets, leg diagrams, existing documentation, maintenance plan and so on), must be adapted. If operating conditions or the purpose for use changes, structural, organisational or operational measures must be taken to adapt the existing potable water installation to the new circumstances.

Intended operation of a potable water installation calls for:
- needs-based planning in accordance with the requirements of the room data sheets
- professional execution, acceptance and hand-over
- documented instruction for the operator (instruction in accordance with VDI/DVGW 6023, Cat. C)
- adequately trained qualified personnel
- availability of relevant planning and operational documents (system book)
- clear assignment of responsibilities (owner/operator)

All relevant planning data, operating parameters and inspections over the life span of the potable water installation are continuously documented in the system book. As part of the system book, the logbook is the place where all relevant documents concerning work on the potable water installation, including analysis results of potable water examinations and maintenance measures, are filed. The logbook is based on the maintenance or hygiene plan (see "Commissioning" chapter).

Draw-off points that are rarely used due to their position or use have a further negative impact. Whether or not such draw-off points are actually required must be verified as early as the planning stage, since the probability of contamination increases with every draw-off point. If such a draw-off point is deemed necessary, measures should be set out in the hygiene plan or flushing schedule in order to prevent unwanted stagnation. In the case of a sink basin in the basement area, for example, the simplest way is the regular manual flushing of the draw-off point. Whether or not proper flushing of such a draw-off point is realistic in real operation, however, is questionable.

Another way of safeguarding such draw-off points up to the wall plate is to integrate them into a service area bordering a series or ring system. If water is tapped in the other service areas because they are highly frequented, the pipeline volume ahead of the wall plate of the rarely used draw-off point concerned has to be exchanged. Ring systems for potable water cold are recommended for installations that are frequently operated by several users at the same time. There are more pressure reserves available for a ring system than there are, for example, for a series installation of the same nominal width. Moreover, the problem of stagnation zones between two draw-off points does not necessarily exist, since the draw-off points tend to be used at the same time rather than individually.

Pipes in series are the ideal solution for service units or installations in which draw-off points tend to be used sequentially rather than at the same time. Although due to the possible simultaneous use of the draw-off points, the piping has to be dimensioned larger than for a ring system installation, the water-carrying piping's route and hence the volume at risk of stagnation reduces.

Maintenance

The term 'maintenance' essentially refers to all technical and administrative activities that serve to maintain or restore the functional state and hence the required function of the component. This includes activities by the management, which must essentially plan and coordinate operations to ensure that all components of an installation are checked on a regular basis. The term 'maintenance' is basically split into four different areas:

1. **Maintenance**
   Maintenance is a preventive activity which is designed to prevent damage before it has had chance to occur. As such, it is carried out at regular intervals before functional impairments occur. From a hygiene perspective, this preserves the ideal condition of a hygienically flawless condition.
2. **Inspection**
   An inspection involves examining the component for its key characteristics. This is done through measurement, observation and function tests. The aim of the inspection is to check the component's function and establish whether a repair is needed or not. The actual hygiene condition is ascertained and assessed.
3. **Repair**
   A repair involves restoring the function of a defective component so that it can once again do its original job. As a result, the hygienically flawless target condition is restored.
4. **Improvement**
   The purpose of an improvement is to increase the reliability, maintainability or even the safety of a system, and hence increase the value of an installation. This makes a hygienically flawless potable water installation even safer.

The general aim of maintenance is to preserve or even improve the condition of a system, in this case the potable water installation. All measures have one thing in common – active components and those with a control function in particular have to be included in the regular maintenance routines. These are the components that are most critical to a potable water installation, because any kind of moving part can be impacted by the dirt and limestone caused by a malfunction.

As part of their legal duty to maintain safety, the contractor or other owners of a potable water installation are obliged to provide the users of their installation with flawless potable water. For this to be guaranteed on an ongoing basis, not only is it necessary to maintain the potable water installation, particular attention must also be paid to accessibility. It is not without good reason that VDI 3810 Sheet 2 stipulates that accessibility for maintenance measures has to be considered as early as the layout planning phase. Even if manufacturers offer their components as maintenance-free, it is always a good idea to question whether the component contains elements that could be affected by a malfunction. It may also be necessary, contrary to the manufacturer's specifications, to maintain the components on a regular basis.

The responsibility for maintenance lies with the contractor or other owners of a potable water installation. It is therefore in their interest to check whether measures are indeed required. They are also responsible, however, for making improvements to the existing system to rule out known vulnerabilities. This includes, for example, the hydraulic balancing of circulation pipes in order to restore compliance with the temperatures specified in DVGW Worksheet W 551.

Another aspect of maintenance that receives too little attention is that of inspection. Contrary to the widespread understanding that an inspection involves nothing more than visually examining the component for damage or any changes, it also includes checking the component to ensure its proper function. Here especially, not only is accessibility to the product a key factor, the inspection options also play a crucial role. For example, can a temperature sensor be installed close enough to the thermostatic circulation regulation valve to be able to check its proper function? Asking questions such as these when a potable water installation is being planned makes it much easier to maintain the system during subsequent operation.

Potable water in first aid facilities

First aid facilities are technical aids that are used for rescue operations to prevent risk to the life and health of individuals. The designation originates from the German law on workplace safety and in also used in the autonomous law applied by the the accident insurers.

Emergency showers are a first aid facility and used primarily in laboratories and production operations.

Although unable to prevent an accident, emergency showers have to function in case of emergency if eyes, hands or the entire body are exposed to aggressive or harmful substances. A distinction is drawn between body showers, eyewashes and emergency face showers.

Legal and normative principles

In occupational safety law, in the Ordinance on Hazardous Substances, in the German workplace ordinance, in accident prevention regulations and in laboratory directives, emergency showers are indicated as an essential first aid facility. A hazard assessment can be used to establish whether an emergency shower is required and if so, where. The internet portal of the Federal Agency for Industrial Health and Safety (BAuA) is available for this purpose.

The Potable Water Ordinance (TrinkwV) should be taken into consideration for the selection and installation of emergency showers and eyewashes. This ordinance is the German implementation of EC Potable Water Directive 98/83/EC, which is implemented worldwide.

In Germany, for example, emergency showers and eyewashes must be provided with legally specified information signs in accordance with DGUV (Deutsche Gesetzliche Unfallversicherung e.V.) Regulation 9 Safety and Health Protection Signage at the Workplace. Internationally standardised rescue signs for emergency showers and eyewash facilities in accordance with DIN EN ISO 7010 have been legally binding since 2013.

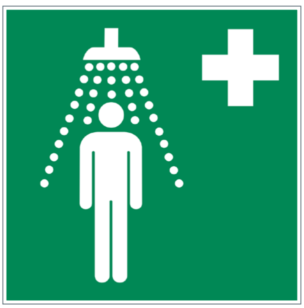


Fig. 85: E05 Emergency shower

Fig. 86: E06 Eyewash

The technical requirements for emergency showers and eyewashes are described in the following standards:

In Germany:
DIN EN 15154-1
Emergency safety showers – body showers with water connection for laboratories
DIN EN 15154-2
Emergency safety showers – eyewashes with water connection
DIN EN 15154-3
Emergency safety showers – body showers without water connection
DIN EN 15154-4
Emergency safety showers – eyewashes without water connection
DIN EN 15154-5
Overhead body showers with water for locations other than laboratories

In the USA:
ANSI Z358.1: Emergency Eyewash and Shower Standard

DIN EN and ANSI are often consulted in other parts of the world. An eyewash supplied with potable water must be installed in laboratories.

Planning information

General

An emergency shower must be freely accessible. It should be erected no more than 15 m from the source of danger and be reachable within 10 s, in laboratories even within 5 s. In the case of highly hazardous substances, the emergency shower should be positioned at the source of danger directly and the water collected in a pan.

Normative specifications for operating parameters

EN 15154 describes the specified volumetric flows and/or water temperatures for body showers and eyewashes with a permanent water connection.

Body showers with water connection for locations other than laboratories:

Standard	DIN EN 15154-5	ANSI Z358.1
Body shower [l/min]	Class I: 30–60	75.6
	Class II: > 60–100	
	Class III: > 100	
Temperature [°C]	15–37 (ideally 20–25)	16–38

Tab. 28: Operating parameters for body showers with water connection for locations other than laboratories

For body showers with water connection for laboratories, DIN EN 15154-1 recommends a volumetric flow of 60 l/min or more. According to DGUV Information Document 213-850, the minimum volumetric flow in Germany is 30 l/min.

Eyewashes with water connection

Standard	**DIN EN 15154-2**	**ANSI Z358.1**
Eyewash [l/min]	6	11.5
Temperature [°C]	15–37	16–38

Tab. 29: Operating parameters for eyewashes with water connection

The water must run for at least 15 minutes.
Observe any existing national regulations on installation and use of emergency safety showers.

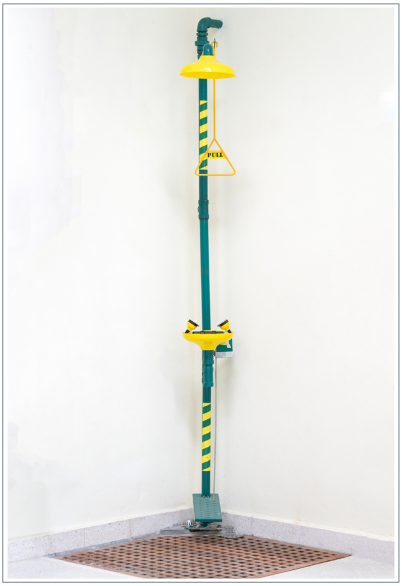


Fig. 87: Combination of body shower and eyewash

Both heated and unheated versions of emergency safety showers are available. However, they can be connected to a hot water supply. The advantage here is that a person who has already been injured is protected from the additional shock of excessively cold water.

The flushing of an emergency shower can be initiated in various ways, including a step grid, foot lever, pull bar, pressure plate or an openable cover on an eyewash.

Minimum pipe cross-sections are specified for the supply lines to emergency showers:

Emergency shower	Minimum pipe cross-section
Body showers	28 mm / 1 inch
Eyewashes	15 mm / ½ inch
Combined eyewash and body shower	35 mm / 1 ¼ inch

Tab. 30: Minimum pipe cross-sections for emergency showers

Commissioning, operation and maintenance

Emergency showers with DVGW approval can be connected directly to the potable water network.

Flush all piping thoroughly before commissioning emergency showers and eyewashes. Check all pipelines and any electrical loads and external sensors.

Briefing vulnerable people is extremely important. The emergency shower's location and mode of operation must be communicated to the employees in such a way that, even in an emergency with impaired vision, they are able to reach and operate the emergency shower.

Check emergency showers for functional safety on a regular basis. The precise intervals are indicated by the emergency shower manufacturers. According to DGUV Information Document 213-850, emergency showers in laboratories, for instance, have to be maintained at regular intervals (usually at least once per month). The water exchange in the supply line can be guaranteed by a suitable pipeline installation in a series pipeline or ring system by actuating the emergency shower or other appropriate flushing devices (e.g. Viega universal flush valve). In the single connection pipeline from the supply line to the draw-off point, the water exchange must be achieved by actuating the emergency shower. If this is done manually, it may need to be organised and documented by means of a formalised flushing plan.

Automatic flush valves allow flushing at the times best suited to the working conditions and patterns. This reduces the danger that stagnant water ahead of the draw-off point can present. Thoroughly clean eyewash atomisers and shower nozzles every six months. Use a water baffle and a bucket to make a visual inspection for signs of corrosion.

Viega solutions

> **i** When selecting materials for fittings, pipes and sealing elements, the special operating and installation conditions, as well as other system requirements, must be considered on a case-by-case basis.
>
> Send your detailed enquiries to the Viega Service Center using the "Enquiry for material durability" form. You can find the form for this on the Viega website *viega.com* by entering "material durability" as the search term.

For use of Viega products for "Potable water in first aid facilities", refer to the planning information for potable water installations (Page 70).

Emergency showers and eyewashes can be connected to the potable water network using the following Viega piping systems:
- Sanpress
- Sanpress LF
- Sanpress Inox
- Sanpress Inox LF
- Profipress
- Raxofix
- Raxinox

When potable water is used in first aid facilities, usage interruptions can usually be expected. To guarantee the required level of hygiene, Viega offers e.g. **the universal PWH/PWC flushing valve**. You can find further information in chapter „Products" on page 250.

Process water

Industrial systems and product manufacturing equipment call for water that meets increased quality standards and has specific properties. This process water is free of any constituents that may cause damage to systems and products. Suitable treatment methods are applied to achieve the required process water quality, depending on the raw water available.

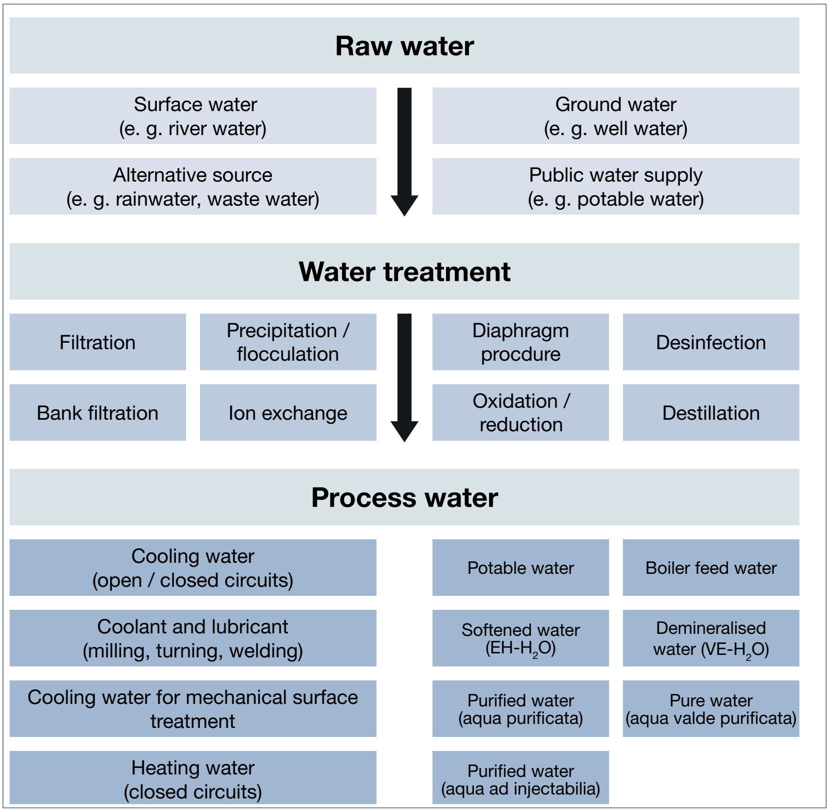


Fig. 88: Industrial process water supply

The treatment of the available raw water involves processes to remove constituents from the water (e.g. cleaning, sterilisation, deferrisation, softening and desalination). The treatment also includes setting parameters such as pH value, electrical conductivity and corrosion properties.
The industrial water treatment process does not refer to the potable water treatment carried out by the water supply companies, where the Potable Water Ordinance (TrinkwV), for example, plays a crucial role.

Water treatment

Raw water

A very high proportion of process water is obtained from raw water.
In the chemical industry, approx. 80% of the total water requirement is taken from rivers and used to cool systems. The remaining 20% is obtained from potable water and used in production, for instance.
Raw water includes ground water, rainwater and surface water (e.g. river water). It contains dissolved salts, bacteria, pathogens and pollutants and must therefore be treated before further use.

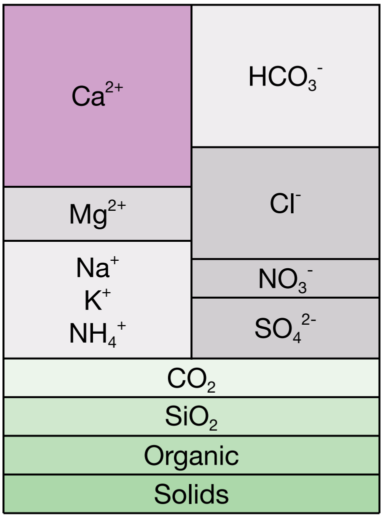


Fig. 89: Constituents dissolved in raw water

Cations
- Calcium [Ca^{2+}]
- Magnesium [Mg^{2+}]
- Sodium [Na^+]
- Potassium [K^+]
- Ammonium [NH_4^+]

Anions
- Hydrogen carbonate [HCO_3^-]
- Chloride [Cl^-]
- Nitrate [NO_3^-]
- Sulphate [SO_4^{2-}]

Gases/solids
- Carbon dioxide [CO_2]
- Silicate [SiO_2]

Water softening

Water hardness is an important factor in many industrial processes. Alkaline earth cations as well as calcium ions (Ca^{2+}) and magnesium ions (Mg^{2+}) that dissolve in water cause damaging boiler scale deposits in piping, machines and devices. Low water hardness is very important, especially for water used in cooling circuits and to supply boilers (steam boilers).

High calcium concentrations also negatively impact
- the service life of machines,
- current consumption,
- the need for cleaning agents to remove calcium residues and
- the taste of food and beverages.

High water hardness is especially problematic in
- the textile industry,
- laundries, bleaching plants, dyeing mills,
- breweries and
- spirit and liqueur production.

Water hardness is an indicator of the proportion of calcium ions (Ca^{2+}) and magnesium ions (Mg^{2+}) in the water. In simple terms, it suggests the amount of "limescale" in the water. In Germany, water hardness is expressed in dH (degree of German hardness). It has its origins in the Detergents and Cleaning Products Act. A distinction is drawn between the following hardness ranges:

Hardness range	Calcium carbonate [mmol/l]	Hardness [°dH]
Soft	< 1.5	< 8.4
Medium	1.5–2.5	8.4–14
Hard	> 2.5	> 14

Tab. 31: Hardness range according to the Detergents and Cleaning Products Act (WRMG)

The purpose of water softening is to reduce a high concentration of calcium ions (Ca^{2+}) and magnesium ions (Mg^{2+}). A detailed description on the softening of potable water can be found in "Viega Engineering Guide – System solutions and services, digital – networked – innovative" in the chapter on potable water treatment and conditioning.

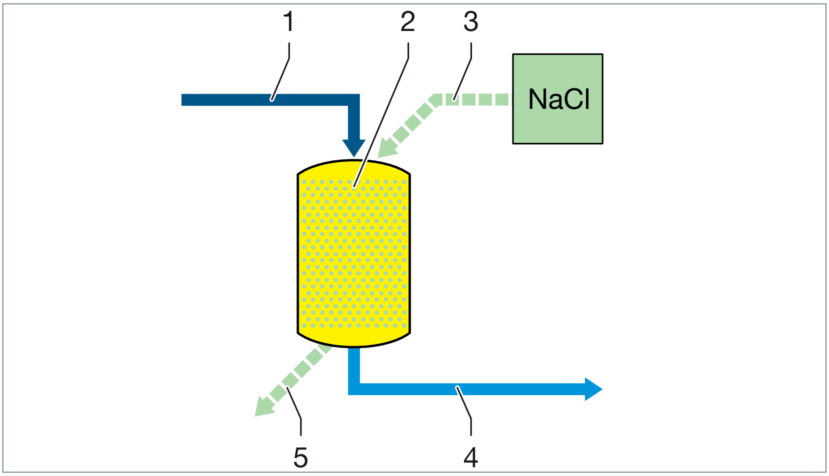


Fig. 90: Softening of raw water using cation exchange resin

1 Raw water
2 Cation exchange resin
3 Regeneration
4 Softened water
5 Wastewater

Demineralisation

Demineralised water, also referred to as deionised water or fully deionised water (demin water) is water without the salts that naturally occur in spring water and potable water. These salts, dissolved as anions and cations, determine the electrical conductivity of water, which is measured in microsiemens per centimetre (µS/cm). This value is considered an indicator of water quality. Significantly elevated conductivity is an indication of contaminated water. The more contaminated the water, the more efficiently it conducts. According to the German Potable Water Ordinance (TrinkwV, Annex 3 to Sections 7 and 14), the limit value for potable water is 2790 µS/cm at a water temperature of 25 °C and 2500 µS/cm at 20 °C.

Demineralised water can either be partially deionised or fully deionised. Partial deionisation involves removing hydrogen carbonate salts from the calcium and the magnesium. With full deionisation, all other dissolved salts are removed.

Limit values and degrees of purity for demineralised water
DIN ISO 3696 distinguishes between three degrees of water purity for analytical purposes:

Parameter	Quality 1	Quality 2	Quality 3
pH value at 25°C	Not applicable [1)]	Not applicable [1)]	5.0–7.5
Conductivity [µS/cm] at 25°C, maximum	0.1 [2)]	1.0 [2)]	5.0
Oxidisable constituents as oxygen content in mg/l, maximum	Not applicable [3)]	0.08	0.4
Extinction at 254 nm and 1 cm optical wavelength, maximum	0.001	0.01	Not specified
Residue after evaporation and drying at 110°C, in mg/kg, maximum	Not applicable [3)]	1	2
Concentration of active silica (SiO_2) in mg/l, maximum	0.01	0.02	Not specified

[1)] Given the difficulties measuring pH in ultrapure water and the questionable significance of the value obtained, no limits for the pH value of water in qualities 1 and 2 have been specified.
[2)] The values for the conductivity of water in qualities 1 and 2 refer to freshly prepared water. During periods of storage, impurities such as carbon dioxide from the air and alkali metal oxide that dissolves from glass receptacles can cause the electrical conductivity to change.
[3)] Limit values for oxidisable substances and for the evaporation residue are not specified for quality 1 because of the difficulty in checking compliance with a requirement for this degree of purity. The quality of this water, however, is ensured as a result of the production process if the other requirements are met.

Tab. 32: Requirements concerning water for analytical purposes in accordance with DIN ISO 3696

ASTM D1193-06 describes four types – I to IV – of analysis water, each subdivided into Grades A, B and C

Type	I	II	III	IV
pH value at 25°C	Not applicable [1)]	Not applicable [1)]	Not applicable [1)]	5.0–8.0
Conductivity [µS/cm] at 25°C, maximum	0.0555	1.0	0.25	5.0
TOC [2)] [µg/l], at most	50	50	200	-
Resistance [MΩ*cm] at 25°C, minimum	18	1.0	4.0	0.2
HBC [3)] [CFU/ml] [4)], maximum	Values based on Grades A, B and C [5)]			
Endotoxin [EU/ml] [6)], maximum	Values based on Grades A, B and C [5)]			
Sodium [µg/l], maximum	1	5	10	50
Chloride [µg/l], maximum	1	5	10	50
Silica [µg/l], maximum	3	3	500	-

[1)] Given the difficulties measuring pH in ultrapure water and the questionable significance of the value obtained, no limits for the pH value of water of types I, II and III have been specified.
[2)] Total organic carbon
[3)] Heterotrophic bacteria
[4)] Colony forming units
[5)] For details, see ASTM D1193-06
[6)] Endotoxin in endotoxin units per ml

Tab. 33: Extract from the requirements concerning water for analytical purposes in accordance with ASTM D1193-06

Demineralised water is used for the following industrial and scientific purposes:

- Laboratory applications and tests
- Carwashes
- Wash water for computer chip manufacture
- Boiler feed
- Laser cutting
- Fuel cell optimisation
- Pharmaceutical production

The semiconductor and pharmaceutical industries require highly pure water. **Purified water** (Aqua purificata) is required to manufacture pharmaceutical products that are not required to be sterile or pyrogen-free. A distinction is drawn between "purified water in bulk" and "purified water placed in containers".

Pure water (Aqua valde purificata) is required to manufacture pharmaceutical products for which water of a high biological quality is required.
Ultrapure water (WFI, Aqua ad injectabilia) is water for injection purposes which is intended for the manufacture of pharmaceutical products for parenteral application and the solvent of which is water. A distinction is drawn between "water for injection purposes in bulk" and "sterilised water for injection purposes". This water is placed in receptacles and sterilised.

Viega piping systems with press connectors cannot be used for the water intended for the manufacture of pharmaceutical products (Aqua valde purificata) or for injection purposes (Aqua ad iniectabilia).

There are various methods for producing demineralised water:

Ion exchange process

When water is demineralised by the exchange of ions, all dissolved ions are removed from the water. The water flows through a cation resin with H^+ for the exchange of all cations and through an anion resin with OH^- for the exchange of all anions. During this process, H^+ and OH^- form pure water.

Electro-deionisation

Electrodeionization (EDI) is an electrochemical process that removes ions and ionisable substances from the water to the greatest possible extent. The process is a combination of ion exchange and electrodialysis using a semi-permeable membrane. The key component of a water treatment plant for this process is the so-called EDI module in which electrodeionization takes place.

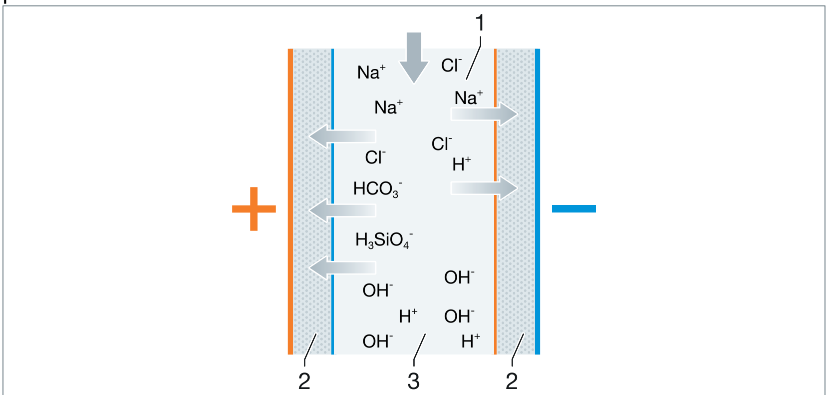
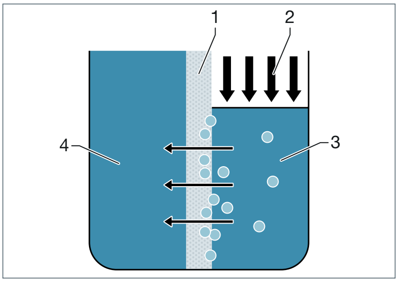


Fig. 91: Principle of electrodeionization in the mixed bed cell

1 Heart of the mixed bed
2 Concentrate
3 Diluate

Reverse osmosis

Reverse osmosis is the process by which the water to be treated is passed through a semi-permeable membrane under pressure. Because the membrane is largely impermeable to dissolved salts, the water can be demineralised to up to 99% depending on membrane, water composition and temperature.



1 Semi-permeable membrane
2 Pressure
3 Salt water
4 Ultrapure water

Fig. 92: Reverse osmosis principle

Distillation

Distilled water is obtained by distilling (evaporating and then condensing) normal potable water or from pre-cleaned water. It is largely free of salts, organic substances and microorganisms. Distilled water may, however, still contain small amounts of volatile compounds. If highly pure water is required, one-step distillation is not sufficient to achieve the desired degree of purity and clarity. Therefore, there is double distilled (bi-distilled) water (aqua bidestillata, aqua bidest for short or Bidestillatus) and triple distilled water aqua tridestillata).
Small traces of silica dissolve from glass receptacles and contaminate the water during and after the distillation process. Therefore, water that is repeatedly distilled is stored in quartz or platinum receptacles after the second process.

Use of process water

Cooling or recooling water in open and closed circuits

Cooling water can be divided into three categories:
Through-flow systems, closed cooling systems and open cooling systems.

Through-flow systems are cost-efficient and simple. After a mechanical clean, the water drawn from a river or canal is routed through a heat exchanger. The water is then returned, either with or without cooling (cooling tower), to the river or canal. As a rule, usage is limited by the maximum permissible heating of the river water to 25°C.

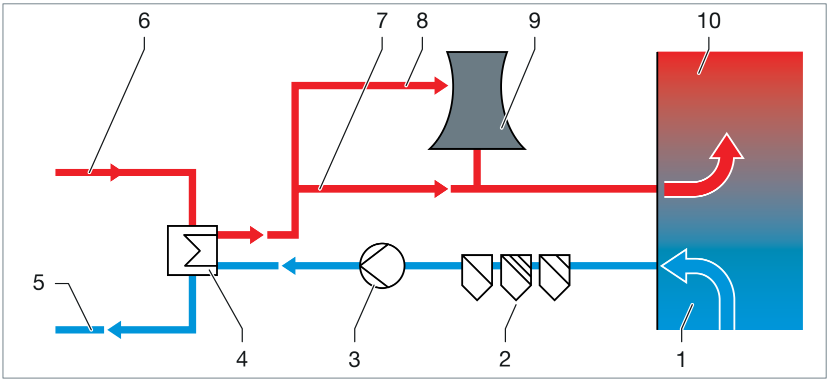


Fig. 93: Through-cooling

1 River water
2 Mechanical cleaning
3 Circulation pump
4 Heat exchanger
5 Cooled process medium
6 Process medium to be cooled
7 Heated cooling water without outlet cooling
8 Heated cooling water with outlet cooling
9 Cooling tower
10 Returned (heated) river water

Open cooling circuits with circulation cooling are commonplace. If damage in the cooling system is to be avoided, requirements concerning water quality, construction and the materials used must be met. Treating water reduces the risk of calcification, deposits, corrosion, fouling and biological growth. Water losses caused by vaporisation must be compensated by adding mechanically or chemically treated make-up water.

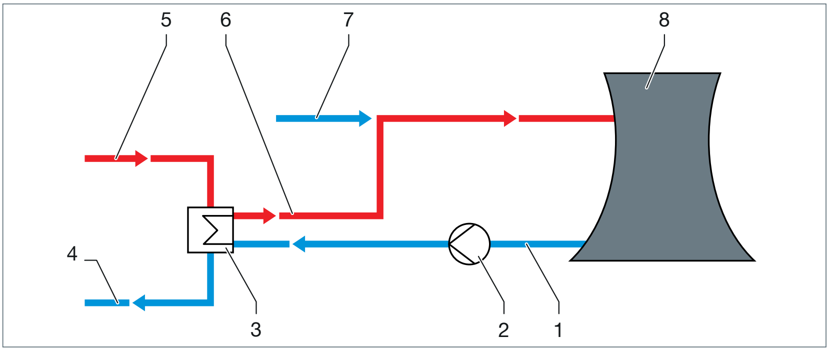


Fig. 94: Open cooling circuit with circulation cooling

1 Cooling water
2 Circulation pump
3 Heat exchanger
4 Cooled process medium
5 Process medium to be cooled
6 Heated cooling water
7 Make-up water feed
8 Cooling tower

Requirements for the quality of water in open cooling circuits
The problem of corrosion and deposits can be resolved by having water treated in a professional manner. The requirements for water quality are partly dictated by the materials used. The following parameters are important:

- Total hardness (sum total of calcium and magnesium salts)
- Carbon hardness
- Total salt content and conductivity
- Chloride content
- Sulphate content
- Iron and manganese content

The iron and manganese content is significant particularly if no potable water is available. A detailed chemical raw water analysis must essentially be conducted for the dimensioning of the water treatment process. The concentrations of matter dissolved in water in a cooling system change constantly due to the special conditions. This change in concentration can be attributed to the thickening caused by the evaporation in the cooling tower. Salts accumulate in the residual water. Therefore, constant monitoring of the water quality is recommended in order to minimise the operating costs.

Closed cooling systems require the least maintenance. They are used to cool transformer oil, diesel and petrol engines, and also for the cold water in air conditioning systems. The cooling water is cooled by a heat exchanger and does not come into contact with the atmospheric air. Since the cooling water is used several times over, a one-time mechanical and/or chemical treatment is required. Water/glycol mixtures with a glycol content of up to 50% are used for numerous industrial cooling processes.

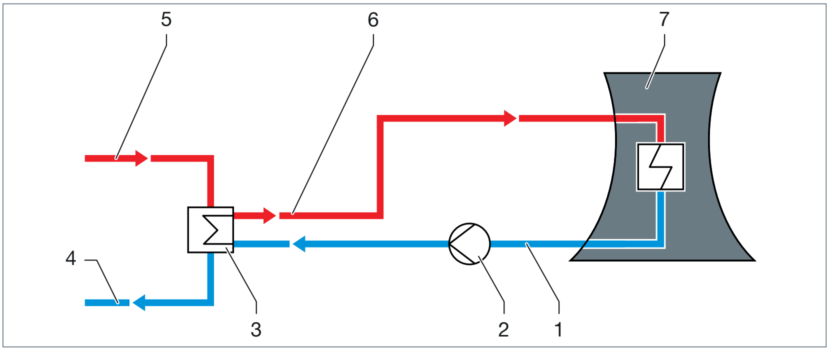


Fig. 95: Closed cooling circuit with circulation cooling

1 Cooling water
2 Circulation pump
3 Heat exchanger
4 Cooled process medium
5 Process medium to be cooled
6 Heated cooling water
7 Cooling tower

Boiler feed water

Boiler feed water is treated water that is used to power a steam turbine, for heating purposes or for engineering processes. The requirements for the purity of the water depend largely on the amount of feed water needed and the dimensioning of the heating circuit. The boiler manufacturer provides information on the permissible concentrations of pollutants. The water used contains harmful constituents in the form of alkaline earth salts which, at elevated temperatures, precipitate on the heating surfaces, form an insulating layer and hence impede the emission of heat. This leads to overheating and, as a result, thermal stress cracks. Moreover, the boiler scale can deposit and cause safety-relevant equipment parts to fail. The O_2 and CO_2 gases dissolved in the water cause corrosion.
Depending on the purpose for which the steam is used, a larger or smaller amount can be reused as feed water in the form of condensate. In a steam power plant, the losses caused by desalination and thermal degasification have to be compensated by make-up water. In processing plants, some of the steam is used for direct heating, and therefore no condensate is available for reuse.
In the case of once-through boilers, all the feed water is evaporated. With this type of boiler, therefore, all dissolved raw water constituents must be removed from the feed water. Therefore, only deionate (= purified water without constituents) may be used.

The requirements for the boiler feed water are described in the following regulations:

- Harmonised European standards:
  - EN 12952-12 / Water-tube boilers – requirements for the feed water and boiler water quality
  - EN 12953-10 / Shell boilers – requirements for the feed water and boiler water quality
- Other regulations published by federations and associations:
  - VGB-S-010-T-00 / Feed water, boiler water and steam quality for power plants / Industrial power plants (previously VGB-R 450 L)
  - VGB-M 410 N / Quality requirements for district heating water
  - VdTÜV MB TECH 1466/AGFW FW 510 / Requirements for the circulation water of industrial and district heat systems
- Operation manuals and warranty conditions for boiler and component manufacturers

Solvents, reaction medium, cleaning agent

Water is the best-known solvent. It is used in the chemical, pharmaceutical, food and beverage industry and also for the manufacture of paints and varnishes. Water is able to dilute or dissolve gases, liquids and solids without causing a chemical reaction between the dissolved substance and the dissolving substance. Water as a solvent is often purified or ultrapure water produced from potable water.
Water is also an important reactant in chemical, biological and engineering processes. The extraordinary properties of water can be explained by its bonding and structural conditions.

Water can be used as a reactant in a broad range of processes:

- Hydration
- Protolysis
- Hydrolysis
- Redox reactions with water
- Complex formation
- Hydration

The medium conveyed in piping, devices and machines often leads to scaling, which adversely affects surfaces and the emission of heat. Sterility or the absence of foreign bodies is required especially in the food and pharmaceutical industries, as well as in medical technology. Treated water is used as a flushing medium, for example.

Process water is also used for cleaning products. Water-soluble flux residues on PCBs, for instance, can be cleaned using water.

Cooling lubricants

In manufacturing technology, cooling lubricants, also referred to as drilling fluid, are used on machine tools during cutting and forming processes to dissipate heat, reduce friction between tool and workpiece and transport away the chips.

Fig. 96: Cooling lubricants in manufacturing technology

DIN 51385 describes two distinctly different types of cooling lubricant:

- Water-miscible and water-mixed cooling lubricants
- Water-immiscible cooling lubricants (cutting oils, see „Oils and diesel fuels“ on page 236)

Cooling water for mechanical surface treatment

The surface machining and cleaning of workpieces has become an indispensable part of industrial production processes. With vibratory finishing, mainly metals are ground or hardened using a mixture of plastic or ceramic to which a water compound is added. Compounds are aqueous , and ensure clean, bright and corrosion-free workpieces during the machining process.

Typical processes are:

- Deburring
- Descaling
- Shining and polishing
- Edge-rounding
- Grinding/rough-grinding
- Dulling
- Degreasing and deoiling

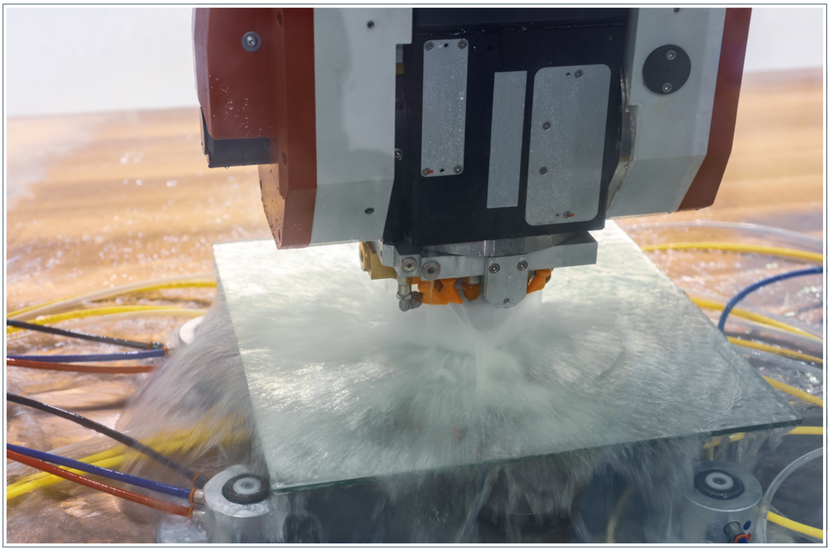


Fig. 97: Glass polishing

Process water as a production aid
Process water is required in industrial plants to manufacture products. Special requirements are placed on water quality, gas content, pH value and water hardness, depending on usage. Typical examples are the food and beverage industry and the paper industry:

Food and beverage industry
As a constituent of food, process water has to meet special requirements in terms of chemical purity, mineralisation and hygiene. Generally, the water from the public potable water supply or wells is treated by special processes to meet the specific requirements of the food industry. Carbonate that has not been removed, for example, can neutralise flavour carriers such as vinegar and fruit acids, and this leads to changes in the flavour of the food.

The food and beverage industry makes use of water in various ways:
- as an ingredient or part of an ingredient
- for processing (e.g. heating, deep-freezing)
- for cleaning

Fig. 98: Cleaning in the food industry

Paper industry

It takes around 100 litres of water to produce one kilogramme of paper. Treated process water is used here too. Soft water with the fewest possible dissolved substances, such as salts of iron, ammonium, calcium and magnesium, minimises the risk of deposits on pumps, fittings, cylinders and piping and is absolutely essential to the quality of the paper.

Fig. 99: Paper production

Viega solutions

> When selecting materials for fittings, pipes and sealing elements, the special operating and installation conditions, as well as other system requirements, must be considered on a case-by-case basis.
>
> Send your detailed enquiries to the Viega Service Center using the "Enquiry for material durability" form. You can find the form for this on the Viega website *viega.com* by entering "material durability" as the search term.

The chemical composition of the raw or process water is a crucial factor in selecting a suitable piping system. Operating conditions and requirements for the system must be taken into account. Process water is chemically more aggressive than potable water. The high dissolving power of the water must be taken into consideration in selecting the material for piping, fittings and seals.
Selecting an optimum piping system therefore often requires a water analysis and knowledge of possible additives such as corrosion inhibitors.

Raw water/cooling water in open systems
The following Viega piping systems can be used for raw water and cooling water applications:
- Profipress
- Sanpress Inox
- Sanpress

Fig. 100: Viega piping system Sanpress XL in a water treatment plant

> **NOTE!**
> **Risk of property damage!**
> Viega press connector systems are not suitable for transporting refrigerants.
> Installations with Profipress or for drilling and cooling lubricants must be agreed with the Viega Service Center on a case-by-case basis.

Cooling water in closed systems/water-glycol mixtures

The following Viega piping systems can be used in closed cooling circuits:
- Profipress
- Sanpress Inox
- Sanpress
- Prestabo
- Megapress
- Seapress

Special water purity
Water purity has a special significance for softened, fully deionised, partially deionised or distilled water, as well as water used as a means of production and purified water.
The following Viega **piping system has proved especially successful here:**
- Sanpress Inox

The Sanpress Inox LF system (PWIS-free) can be used for
- water for analytical purposes in accordance with
  - ASTM D1193-06 Type II and Type IV
  - DIN ISO 3696 Quality 2 and Quality 3

> Viega piping systems in applications where special requirements apply for organic constituents need to be post-cleaned at the draw-off point. Viega piping systems with press connectors cannot be employed for any water used in the production of pharmaceuticals (Aqua valde purificata) or for injection purposes (Aqua ad iniectabilia).

Water for heat transmission

Viega press connector system have proven to be an efficient solution in building services engineering. Beyond that, they are an excellent solution for pipeline networks in local and district heat systems, and also for supplying technical processes and applications involving process heat.

Process heat

Cogeneration

Process heat is the heat required for certain technical processes, particularly in industry. It is mainly generated by burning fossil fuels by means of solar thermal collectors, or as a by-product from cogeneration plants. Process heat at temperatures of up to 90°C is also obtained from the power generated in district heating plants.

Modern high-temperature fuel cells for power generation make the use of heat particularly effective. When pure hydrogen is used as the fuel, extremely hot vapour is emitted. This can be used not only to supply residential blocks with hot water, but also to provide process heat at up to 400°C for industrial applications.

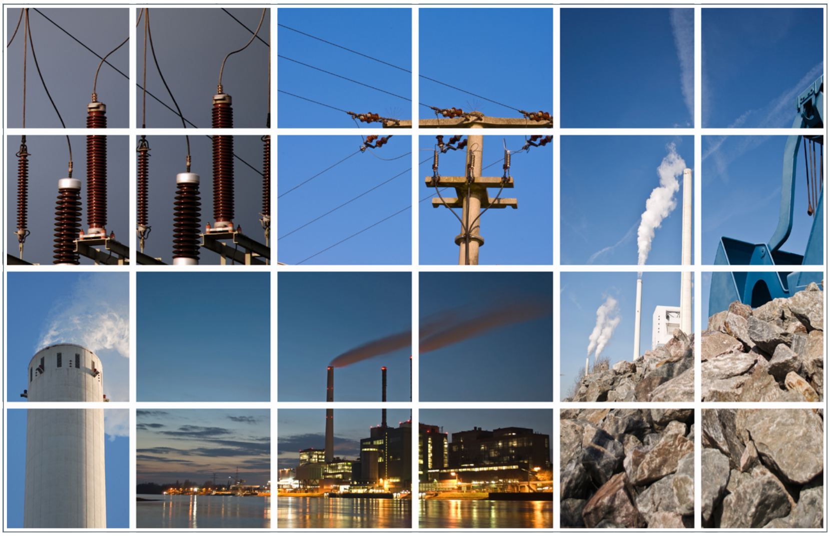


Fig. 101: Cogeneration

Solar heat

Process heat is required in industry and production for numerous processes. In around a third of these processes, the temperature is below 100°C. These temperatures can be reached without a problem using flat collectors. Vacuum tube collectors are used at temperatures of 100 to around 150°C, the levels required in breweries. Process heat is required mainly during the day and the demand is easier to plan than that of private dwellings. Which is why solar heat is able to play an important role in the transition to renewable energies.

Process heat applications

Process heat can be divided into the following temperature ranges:

Temperature range [°C]	Process
< 100	Heat transport mainly with warm/hot water
100–300	Heat transport using overheated vapour or thermal oils
> 400	Furnaces (no water/vapour usage)

Tab. 34: Typical temperature ranges for the use of process heat

The typical processes in which water is used as a heat transfer medium include

- Manufacturing processes in the chemical industry
- Drying
- Refining
- Liquefying
- Forging
- Cleaning (e.g. bottles in bottling plants or washing processes in industrial laundries)
- Heating of potable water and swimming pool water
- Heating support

Fig. 102: Water heated by process heat for cleaning bottles

Local and district heat
The heat transmitted through a local network between buildings for heating purposes is defined as local heat. Unlike district heat, local heat is transmitted over relatively short distances. The transition from local heat to district heat is fluent and defined by the amount of heat and the length of the line.
District heat networks are often supplied with heat from heating plants and district heating plants that are operated as cogeneration plants. The heat sources are often fossil fuels, biomass or waste. There is a clear trend towards sustainable district heat systems with a higher proportion of renewable energies. Geothermal energy, solar energy and large-scale heat pumps are being used with increasing frequency.

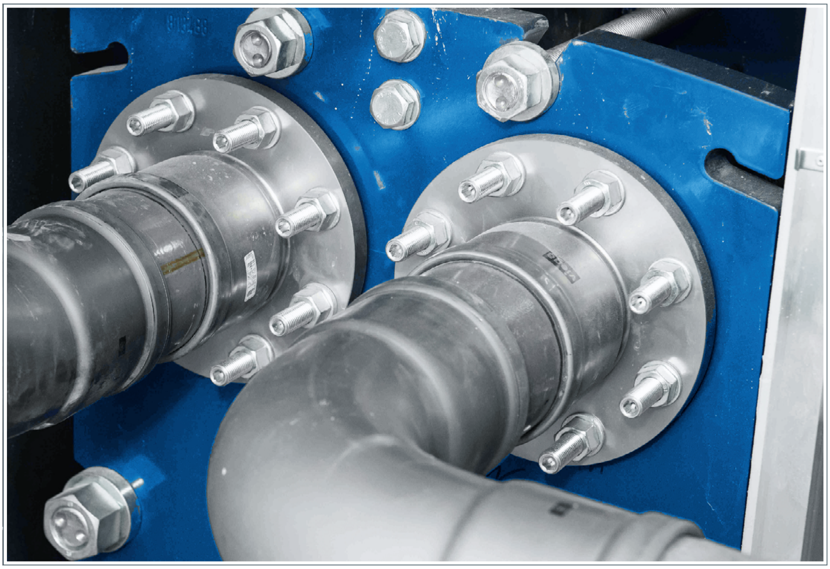


Fig. 103: Secondary connection to a heat exchanger in a district heat transfer station

Local heat networks consist of a central heat generation system, a pipeline network, which is generally shorter than 1 km, and multiple house transfer stations. The heat output is usually less than 1 MW. Typically, the maximum temperatures in the local and district heat networks (primary heating circuit) are 100 to 140°C and in the heat distribution system (secondary heating circuit), a maximum of 100°C. As a rule, the nominal pressure of local and district heat networks is PN16 or PN25.

Requirements for heating water
The circulation water of district heat systems has to meet specific requirements. Basic information is provided by Worksheet AGFW[1] FW 510, as well as VDI Directive 2035.

Worksheet AGFW FW 510 deals with the quality of heating water and provides information for the operation of industrial and district heat supply systems.
VDI Directive 2035, Sheet 1, addresses the the issue of calcification in potable water heating systems and hot water heating systems. VDI Directive 2035, Sheet 2, describes the corrosion on the hot water side.

Water treatment
The insoluble and soluble solids, as well as gases, contained in the raw water, can lead to problems in district heat supply systems. Therefore, they must be removed through water treatment processes or their impact limited.

Insoluble solids can lead to deposits and clogging and therefore need to be removed by means of a suitable filter technology (e.g. candle, bag or precoat candle filter).

Water-soluble substances include
- Alkaline earths
- Chlorides and sulphates
- Hydrogen carbonate
- Organic substances
- Oils and greases

In heating installations, these substances lead to limescale and corrosion as well as to microbiological reactions in the circulation water.

As a rule, dissolved salts are removed by ion exchange processes or by reverse osmosis. Degassing processes such as thermal or vacuum degassing remove the gases dissolved in the water.

Process engineering
In district heating practice, there are essentially two distinctly different water-chemical methods of operation:
- low-salt operation
- salty operation

The characteristic guide values in accordance with VDI Directive 2035 are shown in Tab. 35.

[1] AGFW: Energieeffizienzverband für Wärme, Kälte und KWK e.V. (German Energy Efficiency Association for Heating, Cooling and CHP) (formerly working group for heat and heat and power industry/working group for district heat)

	Low-salt	Salty
Electrical conductivity at 25°C [μS/cm]	>10 to ≤ 100	> 100 to ≤ 1500
Appearance	Clear, free from sedimenting substances	
pH value at 25°C (with aluminium alloys)	8.2 to 9	
pH value at 25°C (without aluminium alloys)	8.2 to 10	
Oxygen [mg/l]	< 0.1	

Tab. 35: Requirements for heating water in accordance with VDI 2035, Sheet 1

Monitoring the condition of heating and make-up water is extremely important to preventing corrosion and calcification in heating installations. VDI 2035, Sheet 1, defines the requirements concerning pH value, water hardness and oxygen content. If the tabular values indicated in the VDI Sheet, (Tab. 36) are exceeded, suitable measures (demineralisation, pH value adjustment) are required. It is advisable to examine the applicable regulations and request a water analysis from the water supply company as early as the planning phase.

Total heat output [kW]	Total alkaline earths [mol/m³]	Total hardness [°dH]
≤ 50	No requirements[1)]	
> 50 to ≤ 200	≤ 200	≤ 11.20
> 200 to ≤ 600	≤ 1.50	≤ 8.40
> 600	< 0.02	< 0.11

[1)] In the case of systems with circulation water heaters and systems with electrical heating elements, the guide value for the total alkali earths ≤ 3.0 mol/m³, equivalent to 16.8°dH.

Tab. 36: Requirements for the hardness of heating water in accordance with VDI 2035, Page 1

Viega solutions

> When selecting materials for fittings, pipes and sealing elements, the special operating and installation conditions, as well as other system requirements, must be considered on a case-by-case basis.
>
> Send your detailed enquiries to the Viega Service Center using the "Enquiry for material durability" form. You can find the form for this on the Viega website *viega.com* by entering "material durability" as the search term.

Pipe connector systems from Viega are an effective solution for the provision of process heat, as well as local and district heat. These systems are equipped with temperature resistant sealing elements and are available for temperatures of up to 140°C, nominal pressures of up to PN16 and nominal widths of up to DN100.
Press connectors for heating water at a maximum operating temperature of 110°C are equipped with the EPDM sealing element. FKM is used up to a maximum operating temperature of 140°C.

Local and district heat systems

With Megapress S in the dimensions ⅜ to 2 inch, it is possible to press thick-walled steel pipes in local and district heat systems in accordance with AGFW FW 524. The Megapress S press connectors can be used from the point of entry to the building for primary and secondary heating circuits with indirect connections, as well as for systems with direct connections.
The Megapress S press connectors up to 2 inch satisfy the high requirements of AGFW Worksheet FW 524. Numerous tests by independent laboratories as well as a test report from the Material Testing Institute (MPA) in Dortmund confirm the suitability of Megapress S press connectors for district heat systems in accordance with AGFW FW 524.

Fig. 104: District heat transfer station connected on the primary side using Megapress S

Fig. 105: Fig. 5: Megapress S plug-in piece model 4312.7

The Megapress S plug-in piece model 4312.7 can be used to easily connect thermometers and pressure gauges, for example. Use of the copper gasket means assembly can be completed without any additional sealants, which are not permitted in many cases.

After consultation with the supply company, Profipress S or Profipress can also be used in district heat systems, depending on the maximum temperature, provided that EPDM is replaced with FKM for the Profipress (cf. „Sealing elements“ on page 12).

Always consult with the supply company before installing press connector systems. This ensures that the system is installed in accordance with the supply company's specifications.

Solar heat

Press connectors of the Profipress S piping system can be used in all solar installations. The permissible anti-freezes and their maximum permissible concentration must be respected. Details can be found in „Media list“ on page 295.
Press connectors of the Profipress piping system can be used in all solar installations with flat collectors. If Profipress press connectors are used for installations involving vacuum tube collectors, the factory-fitted EPDM sealing elements must be replaced with FKM sealing elements.

Firefighting water

Water is often the extinguishing agent of choice for fighting fires. This resource is affordable, readily available and its evaporation temperature of 100°C is lower than the ignition temperature of many combustible substances. Its high evaporation heat permits effective heat dissipation, displacing the oxygen required for the combustion process at the same time. In fire extinguishing systems (FES), water is used to save lives and protect buildings.

Fig. 106: Viega Megapress in a sprinkler unit

Essentially, a distinction is drawn between stationary and mobile fire extinguishing systems. There are different types of stationary fire extinguishing systems – non-automatic FES, automatic FES and fire-fighting aids. Tab. 37 provides an overview of stationary FES.

Fire extinguishing systems (FES)		
Non-automatic FES	**Automatic FES**	**Fire fighting aids**
Wall hydrant type "S" (self-help)	Wet, dry water extinguishing systems with open pipeline network	
Wall hydrant type "F" (fire service), wet, wet/dry	Gas extinguishing system	-
Fire extinguishing system dry (dry riser pipes)	Powder extinguishing systems	

Tab. 37: Classification of stationary fire extinguishing systems

Planning extinguishing and potable water concepts
In the fire protection concept the planner describes which piping system is to be used to provide firefighting water to the individual firefighting water connections. In order to create a functioning fire protection concept, as well as being familiar with the local conditions for the firefighting water supply, the planner also needs detailed knowledge of the properties and possibilities offered by the potable water supply. For example, he must not assume that the supply company also provides a sufficient amount of firefighting water in addition to a sufficient supply of potable water.
Since connected potable water and firefighting water installations can lead to hygiene problems due to stagnation (contamination of the potable water), the fire protection concept must always be the result of close cooperation between the planners in both areas.

Non-automatic fire extinguishing systems

Overview
Non-automatic fire extinguishing systems are firefighting water pipes and draw-off points (e.g. wall hydrants) which, in the event of a fire, allow extinguishing devices to be connected.
A distinction is drawn between "wet" firefighting water pipes, which are always ready for use and constantly pressurised, and "dry" systems that have to be filled with water before they can be used in case of fire.

Classification
- Wet:
  Firefighting water pipes with firefighting water draw-off points which are constantly connected to the potable water supply and hence ready for use at all times. Use by the fire service and lay people, with the exception of wall hydrants with flat hoses.
- Wet/dry:
  Firefighting water pipes with firefighting water draw-off points, which are connected to the potable water supply by means of quick-opening fittings only in case of fire. Use by the fire service and lay people, with the exception of wall hydrants with flat hoses.
- Dry:
  Non-potable water pipelines with firefighting water draw-off points, which are filled by the fire service only in case of fire without any direct connection to the potable water installation. With these systems, the time-consuming laying of hoses is not required. Use only by the fire service.

Potable water installation with wall hydrant type S

Potable water installations with directly connected S type wall hydrants in accordance with DIN 14461-1 and integrated safety combination (backflow preventer and aerator HD design in accordance with DIN EN 1717) are designed for initial fire-fighting by laypeople. Use by the fire service is not envisaged because fire hoses cannot be connected. The main distinguishing feature between wall hydrants of type S and type F is the hose connection valve.

- Type S: DN25, with pipe aerator design HD
- Type F: DN50

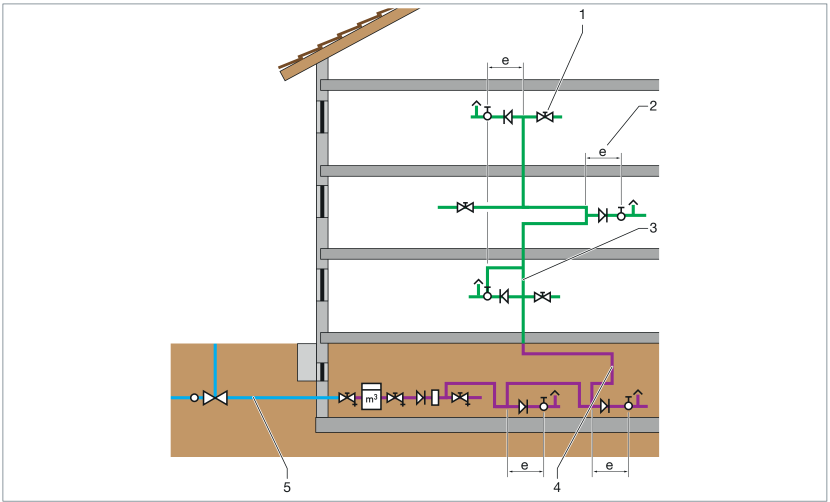


Fig. 107: Potable water installation with wall hydrant type S

1 The volumetric flow of potable water must be greater than the demand for firefighting water, whilst taking simultaneous use into account. The consumer fittings must be designed as fail-safe.
2 e ≤ 10 x d maximum distance between potable water pipeline in which a sufficient volume flows continuously and the shut-off valve of the type S wall hydrant.
3 Non-combustible (A) and combustible (B1/B2) installation pipes are permitted. The installation pipes must be laid behind the non-combustible wall coverings of installation walls or be enclosed in fire-resistant material. Combustible pipes must not be laid exposed. In case of fire, an adequate supply of firefighting water must be guaranteed.
4 Use non-combustible potable water pipelines to supply self-help facilities if the pipeline is laid exposed in the "protection areas" of the self-help facility. Central supply lines that are at an increased risk of fire in the "protection areas" must be non-combustible. Any deviations must be coordinated with the fire protection concept.
5 Supply line

Potable water installations with wall hydrants must be executed in accordance with DIN 1988 or EN 806, with the potable water pipeline being used as the firefighting water pipeline up to the last firefighting water draw-off point.
Where potable water installations are designed with wall hydrants, the pressure losses and the nominal pipe diameters required in accordance with DIN 1988-300 or EN 806-3 need to be calculated.
Take the following planning data into consideration:

Volumetric flow of draw-off	24 l/min
Minimum flow pressure	0.2 MPa
Max. flow pressure at the draw-off point with simultaneous draw-off at the two least favourable firefighting water draw-off points	0.8 MPa
Max. stagnation pressure at the hydraulically most favourable hydrants – nominal pressure PN 12 in accordance with DIN 14461-1	1.2 MP
Hose connection valve with integrated safety combination	DN25

Tab. 38: Planning data

DIN 1988 permits the use of combustible materials such as plastic pipes. They should only be used as firefighting water pipelines if laid underground or used in house connection rooms without fire loads.

Protective goal of potable water quality
Fire extinguishing systems are supplied with either potable water or water that does not comply with the Potable Water Ordinance. Where connected to the potable water supply directly, fire extinguishing systems have to meet specific hygienic requirements (see DIN 1988-600). Firefighting water is generally assigned to Class V in accordance with DIN EN 1717 and DIN 1988.

In order to rule out the possibility of the potable water quality being impacted by stagnation, only type S wall hydrants are allowed to be connected to the potable water installation directly. Incorrectly planned and executed fire extinguishing systems can result in major problems in terms of potable water hygiene in a building and thus also to health problems. Risk factors exist for the following reasons:

- physical – due to temperature increase
- chemical – due to metal ion concentration
- microbiological – due to stagnation

Standards and their implementation are designed to maintain potable water quality. This protection goal can be achieved by:

- Separation of the firefighting water and the potable water supply
- Avoidance of direct firefighting water connections to the potable water supply
- Safe separation of the systems via a free outlet of type AA or AB in accordance with DIN EN 1717
- Avoidance of stagnation in potable water pipelines
- Increase in potable water flow

Since fire extinguishing systems are operated only rarely, new systems in connection with potable water installations must be planned as follows:
To prevent hygiene problems being caused by germ formation, it is necessary to ensure when planning, constructing and operating the system, that no stagnant water occurs or that it is impossible for such water to enter the potable water installations.

Stagnant water can be prevented by:

- Arranging the consumers according to user behaviour
  Arranging frequently used draw-off points in series installations at the end of the installation.
- Guaranteeing regular potable water draw-off
- Precise dimensioning of the piping
- Supplying firefighting water and potable water pipelines for a site via a joint connection line
- Connecting the potable water pipeline directly upstream of the firefighting water transfer point
- Flushing the supply lines to firefighting water connections once per week with 1.5 times the volume of the line content with 20 to 50% of the design volumetric flow
- Securing fire extinguishing and fire protection systems vis-à-vis potable water systems in accordance with DIN EN 1717

Potable water installation with type F wall hydrant

Wet and wet/dry fire extinguishing systems must be executed in accordance with DIN 14462.

The potable water pipeline is used as an firefighting water pipeline up to the firefighting water transfer point.

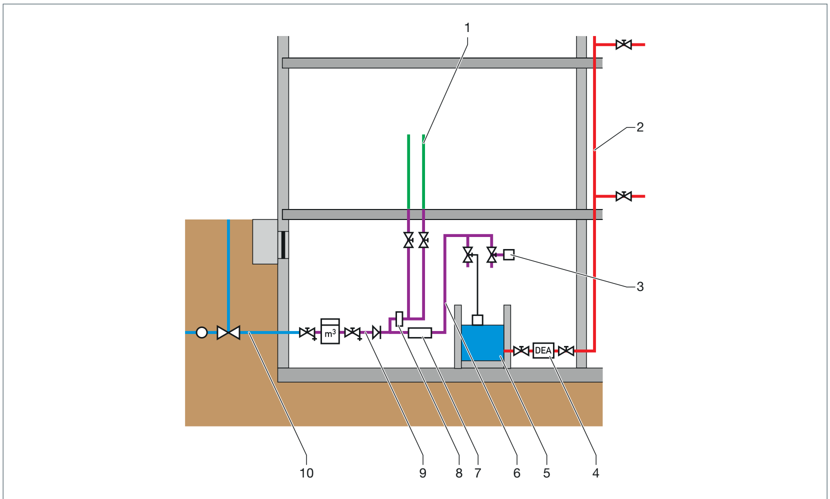


Fig. 108: Firefighting water transfer point with direct connection to the potable water installation

1 Non-combustible (A) and combustible (B1/B2) installation pipes (potable water installation) are permitted. These must be laid behind non-combustible coverings of installation walls. Combustible pipes must not be laid exposed. In case of fire, there must be no risk of the firefighting water supply being inadequate.
2 Non-combustible wet or dry firefighting water pipes in accordance with DIN 14462
3 Flushing system
4 Pressure boosting station in accordance with DIN 14462
5 Intermediate container with free outlet type AA or AB
6 Non-combustible potable water and firefighting water pipes in accordance with DIN 1988-600 for feeding into the intermediate container
7 Stone trap
8 Filter/domestic water station
9 Potable water installation in accordance with DIN 1988-600 with additional requirements in accordance with DIN 14462
10 Supply line

When designing the wet and wet/dry fire extinguishing systems, calculate the pressure losses and determine the required nominal pipe diameters. The possible calculation methods are described in DIN 1988-300/EN 806-3.

Take the following planning data into consideration:

- Draw-off volume of 100 or 200 l/min, according to the fire protection concept
- Minimum flow pressure of 0.3 or 0.45 MPa
- Flow pressure of max. 0.8 MPa at the draw-off point with simultaneous draw-off at the three least favourable firefighting water draw-off points
- Stagnation pressure of max. 1.2 MPa at the hydraulically most favourable hydrant (nominal pressure PN 12) in accordance with DIN 14461-1 and DIN 14461-6
- Hose connection valve DN50

For wet/dry fire extinguishing systems, also calculate the time required to fill the empty pipeline network and furnish proof of this for the acceptance procedure. According to DIN 14462, firefighting water must be available at the draw-off point which is furthest away from the firefighting water transfer point after 60 seconds. This requires the volumetric flow of the pump systems to be dimensioned according to the filling volumetric flow, or the reservoir has to be adequately dimensioned for this filling quantity.

Fig. 109: Wall hydrant with Sanpress Inox XL

Fire extinguishing system dry

Execute fire extinguishing systems dry, „Fig. 110: Firefighting water system dry“ on page 154 in accordance with DIN 14462. For supply fittings refer to DIN 14461-4, for extraction fittings DIN 14461-5.

Dimension the firefighting water pipe to DN80. If smaller nominal widths or lengths of > 100 m are used, adequate dimensioning must be verified by calculations. At the same time, it must be ensured that a flow pressure of at least 0.45 MPa is achieved with simultaneous draw-off of 300 l/min from the two hydraulically least favourable extraction fittings and a supply pressure of 1 MPa.

Calculations can be carried out in accordance with DIN 1988-300 / EN 806-3.

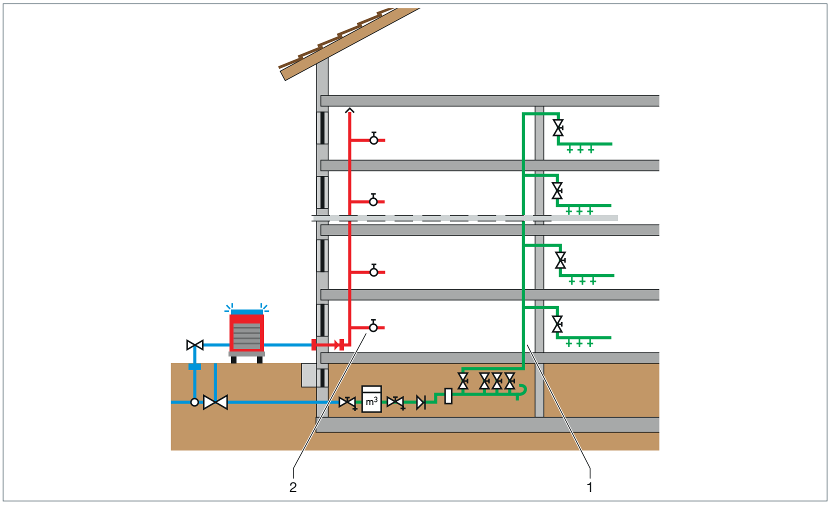


Fig. 110: Firefighting water system dry

1 Non-combustible dry fire extinguishing line in accordance with DIN 14462
2 Non-combustible (A) and combustible (B1/B2) installation pipes (potable water installation) are permitted.

Maintenance

Maintain firefighting water systems in accordance with the specifications of DIN 14462, DIN EN 671-3 and the recognised rules of engineering. They must be maintained regularly and after each use and the work must be documented in an inspection log. The maintenance intervals are specified by the manufacturer. However, they must not exceed two years for dry firefighting water systems and one year for wall-mounted hydrants.

Automatic fire extinguishing systems (sprinkler units)

Function and operating mode

Sprinkler systems are permanently installed devices for automatic fire fighting. They can delay or prevent a fire spreading as soon as it breaks out by targeted use of the firefighting water. Sprinklers installed on storey floors are triggered by the change in temperature in case of fire and thus reduce risks to humans and damage to property.
The advantages of a sprinkler system lie in the spatially limited and effective use of extinguishing agents at an early stage in the course of the fire.
Preferred areas of application:

- Office and administration buildings
- Hospitals and retirement homes
- Hotels
- Schools and universities
- Underground garages and car parks
- Industrial units

Alongside glass bulb sprinklers, fusible link sprinklers are also common for special applications. The various types cover all possible on-site situations and requirements, both in terms of their positioning on ceilings, wall and floors and also with respect to the spraying properties and extinguishing performance in litres per minute.
They must be designed by specialists taking the hydraulic and extinguishing criteria into account.

Glass bulb sprinklers
Sprinkler heads with glass ampoules are mostly installed at defined intervals on the storey floor and are integrated into a fire extinguishing and fire protection installation. The sprinklers' jet openings are sealed with glass ampoules which burst due to the thermal stress in case of fire and release the pressurised extinguishing agent. The trigger temperature for the sprinkler heads should be approx. 30°C above the maximum expected room temperature and can be precisely set to between 57°C and 182°C by using different, colour-coded, types of glass ampoule.

Fig. 111: Colour-coded sprinklers with glass ampoules

Trigger temperature [°C]	Marking	Use
57	Orange	Standard
68	Red	
79	Yellow	Special
93	Green	
141	Blue	
182	light violet	

Tab. 39: Opening temperature classification

Water performance – K factor
Sprinklers with varying water evaporation capacities are required to cover the broad range of possible applications. The water evaporation capacity is calculated using the following formula:

$$Q = K \cdot \sqrt{p}$$

Q = Water volume in l/min
K = Outflow factor of the sprinkler at 0.1 MPa
P = Sprinkler pressure in bar
The minimum pressure is 0.05 MPa, the maximum permitted pressure is 0.5 MPa.

K factor	Thread [R]	Use	Min. performance at 0.05 MPa [l/min]
57	⅜	Low fire load	40.0
80	½	Standard	57.0
115	¾		81.3
160–202	¾	Large drip sprinkler 0.31 MPa	281.7–355.7

Tab. 40: K factors for sprinklers in line with the installation situation

Example
A sprinkler R½ with K = 80 achieves at 0.1 MPa (1 bar)
$Q = 80 * \sqrt{1} = 80$ l/min
At 0.2 MPa (2 bar) the same sprinkler achieves
$Q = 80 * \sqrt{2} = 113$ l/min

Nominal K factors are influenced by the sprinkler angle used. The influences upon the K factor must be taken into consideration in the hydraulic calculation and in the system layout.

Nominal K factor	Total K factor including sprinkler angle
K-80	K-69
K-57	K-53

Tab. 41: Sprinkler use

Fig. 112: Sprinkler unit with Viega Megapress and galvanised steel pipe

Legal and normative principles

Classification – integration in the regulations

The building regulations for the various federal states define the general requirements for structural systems to prevent and fight fires.
The requirements for fire extinguishing systems are derived from the building regulations of the federal states and the respective ordinances, guidelines and recognised rules of engineering.
The special building regulations issued by the federal states formulate requirements for the various types of fire extinguishing systems depending on the size of the building and it use.

	Non-automatic	Automatic
Garage regulations	x	x
Assembly Area Ordinance/ Directive	x	x
Sales Premises Ordinance/ Directive	x	x
Building Code for Hospitals	x	
High-rise building guidelines	x	x
Industrial building guidelines		x

Tab. 42: Fire extinguishing systems in special building regulations

The fire protection authorities can specify further requirements with due regard to the principle of proportionality.
A core component of the building permit process is the fire protection concept which formulates the requirements for fire extinguishing systems, which often go beyond the aforementioned regulations. Automatic fire extinguishing systems often need to be installed in order to prolong the life of components in case of fire, erect fire compartments or increase the permissible length of escape routes. These serve to save lives, protect individuals and fight fires. For this reason, special requirements are placed on the planning, installation and operation of these systems.
Fire extinguishing systems can reliably fulfil their protective function only if the principal/building owner employs a suitable concept from as early as the planning phase.
This so-called "fire protection concept" comprises planning, execution and operation. They include:

- Using products and systems with proof of suitability similar to the usability and compliance certificates for materials and components
- Assigning the planning process to authorised expert planners
- Involving fire extinguishing systems experts who are recognised by the building authorities.
- Assigning installation, repair and maintenance work on the systems to authorised specialist companies
- Creating a back-up concept in case the fire extinguishing system is decommissioned

- Drawing up an understandable description of the fire protection concept, taking any necessary deviations, e.g. for adjacent buildings, into account

The importance of the fire protection concept is clearly shown by the current sample high-rise building regulations (MHHR). In contrast to the previous directives, the MHHR assumes that the fire service will fight the fire from inside the building. Even with building heights of up to 22 m, in terms of planning fire fighting efforts from the outside are the exception to the rule. That is why MHHR section 6.3 stipulates that, in addition to automatic extinguishing systems, wet riser pipes must be installed with wall hydrants in all the necessary stairwells (incl. safety stairwells) on each floor.
Dry riser pipes are not permitted here as any impairment can go unnoticed and, in case of fire, their functionality first has to be restored by the deployed fire service.
Depending on the building floor area and the fire hazard class, with sufficient planning of the wall hydrants, up to a third fewer fire extinguishers may be kept.
In the industrial sector wall hydrants with flat hoses are used to in order to be able to provide large amounts of water to fight fires. Given the special features of these systems, their usage must be practiced regularly and they must only be deployed by trained personnel.

Standards and regulations
Fire extinguishing and fire protection systems must be planned and executed by specialist companies. In addition to the legal building regulations and technical construction provisions, the following standards and regulations must be observed:

- Potable Water Ordinance (TrinkwV)
- Model directive on technical requirements for fire protection with respect to piping systems (MLAR)
- DIN 4102-4: Fire behaviour of building materials and building components: Synopsis and application of classified building materials, components and special components
- DIN 1988-200: Codes of practice for potable water installations - Part 200: Installation Type A (closed system) - Planning, components, apparatus, materials; DVGW code of practice
- DIN EN 1717: Protection against pollution of potable water installations and general requirements of devices to prevent pollution by backflow; German version EN 1717; Technical rule of the DVGW
- DIN 1988-500: Codes of practice for potable water installations - Part 500: Pressure boosting stations with RPM-regulated pumps; DVGW code of practice
- DIN 1988-600: Codes of practice for potable water installations – Part 600: Firefighting water installations in connection with fire fighting and fire protection installations; DVGW code of practice
- DIN EN 806-1: Specifications for installations inside buildings conveying water for human consumption – Part 1: General; German version EN 806-1:2001 and A1:2001

- DIN EN 806-2: Specification for installations inside buildings conveying water for human consumption – Part 2: Design; German version EN 806-2
- DIN EN 806-3: Specifications for installations inside buildings conveying water for human consumption – Part 3: Pipe sizing – Simplified method; German version EN 806-3
- DIN EN 806-4: Specifications for installations inside buildings conveying water for human consumption – Part 4: Installation; German version EN 806-4
- DIN EN 806-5: Specifications for installations inside buildings conveying water for human consumption - Part 5: Operation and maintenance; German version EN 806-5
- DIN 14461-1: Delivery valve installations for firefighting purposes – Part 1: Wall hydrants with semi-rigid hose
- DIN 14461-2: Delivery valve installations – Part 2: Filling station and output system connected with "dry" water conduit for fire extinguishing
- DIN 14461-3: Delivery valve installations for firefighting purposes – Part 3: Fire hose valves for nominal pressure PN 16
- DIN 14461-4: Delivery valve installations for firefighting purposes – Part 4: Filling valves PN 16 connected with firefighting pipes
- DIN 14461-5: Delivery valve installations for firefighting purposes – Part 5: Tap PN 16 connected with firefighting pipes
- DIN 14461-6: Delivery valve installations for firefighting purposes – Part 6: Wall hydrants with flat hose for trained personnel according to DIN EN 671-2
- DIN 14462: Water conduit for fire extinguishing – Planning, installation, operation and maintenance of fire hose systems and pillar fire hydrant and underground fire systems
- DIN 14463-1: Water systems for fire extinguishing – Filling and draining devices operated by remote control - Part 1: For hose reel systems
- DIN 14463-2: Filling and draining devices operated by remote control – Part 2: For water extinguishing systems with empty and non-pressure pipeline network; Requirements and testing
- DIN 14463-3: Water systems for fire extinguishing – Filling and draining devices operated by remote control – Part 3: Valves for ventilation PN 16 of fire extinguishing pipe systems
- DIN 14464: Assembly with direct connection for sprinkler systems and extinguishing systems with open nozzles – Requirements and testing
- VDI/DVGW 6023: Hygiene in potable water installations – Requirements for planning, execution, operation and maintenance
- Association for Sanitation, Heating and Air Conditioning (ZVSHK) potable water hygiene; T88/1: specialist information – technical measures for compliance with potable water hygiene

Piping systems

General notes

System approvals
Plastic pipes may only be used as firefighting water lines if placed underground or used in house connection rooms without fire loads.

> **NOTE!**
> **Risk of property damage!**
> Installation systems with press connectors in fire extinguishing systems (dry and wet/dry) may be used if they have been approved for the specific area of application.

Piping systems for non-automatic fire extinguishing systems
DIN 14462 is the most important standard for the installation, operation and maintenance of fire extinguishing systems. Tab. 43 shows the permitted materials for fire extinguishing systems.

<table>
<tr><th>Pipe material</th><th>Pipe regulations</th><th>Standard connection technologies</th><th>Connector regulations</th><th>Pipe connection regulations</th></tr>
<tr><td rowspan="2">Galvanised ferrous materials</td><td rowspan="2">DIN EN 10255
DIN EN 10240
DIN EN 10305-3</td><td>Threaded connection</td><td>-</td><td>DIN EN 10242</td></tr>
<tr><td>Clamp connection
Press connection</td><td>-</td><td></td></tr>
<tr><td rowspan="2">Stainless steel</td><td>DVGW GW 541</td><td>Press connection</td><td>-</td><td rowspan="2">DVGW W 534</td></tr>
<tr><td></td><td>Clamping ring screw fitting</td><td>-</td></tr>
<tr><td rowspan="5">Copper</td><td rowspan="5">DIN EN 1057
DVGW GW 392</td><td>Brazed connection</td><td>DVGW GW 6
DVGW GW 8
DIN EN 1254-1
DIN EN 1254-4
DIN EN 1254-5</td><td rowspan="8">DVGW GW 2</td></tr>
<tr><td>Welded connection</td><td>DIN 2607
DIN EN 14640</td></tr>
<tr><td>Press connection</td><td>DVGW W 534
DIN EN 1254-7</td></tr>
<tr><td>Clamping ring screw fitting, metallically sealing</td><td>DVGW W 534
DIN EN 1254-2
DIN EN 1254-4</td></tr>
<tr><td>Plug connection</td><td>DVGW W 534</td></tr>
<tr><td rowspan="3">Internally tin-plated copper</td><td rowspan="3">DIN EN 1057
DVGW GW 392</td><td>Press connection</td><td>DVGW W 534</td></tr>
<tr><td>Clamping ring screw fitting, metallically sealing</td><td>DVGW W 534
DIN EN 1254-2
DIN EN 1254-4</td></tr>
<tr><td>Plug connection</td><td>DVGW W 534</td></tr>
</table>

Press, clamp and plug connectors in dry and wet/dry extinguishing systems are permitted only if they are fit for this purpose and have been tested by a test authority for use in dry sprinkler systems.

Tab. 43: Permitted pipe materials for fire extinguishing systems according to DIN 14462

Fixing technology

The following must be observed for the execution and fixing of firefighting water pipes and supply lines to firefighting water transfer points:

- Planning of connection line lengths according to DIN 1988-600
- Firefighting water pipes are allowed to be laid in pipe routes
- The use of plastic dowels is not permitted
- Installation based on DIN 4102-4 in conjunction with DIN V 4102-21
- Ensure the stability of the fixing points in accordance with the expected duration of use – 2 hours in accordance with DIN 14462
- Design fixing points and fixing structures (crossbeams, crane arms, etc.) according to the expected duration of use and, if relevant, apply a fire protection wall coating

Special requirements may be specified in the course of the construction approval process whilst taking the principle of proportionality into account. These requirements are specified in the fire protection concept or the construction regulations.
Fixations are to be made of steel without flexible connecting links and must be dimensioned so that the mathematical stresses do not exceed the limit values indicated in Tab. 44. Suspension components must be at least 1.5 mm thick.

Load	Fire resistance class according to DIN 4102-4	
	L30 or L60	L90 or L120
Tensile stress σ in vertical parts [N/mm²]	9	6
Shear stress τ in screws of strength class 4.6 according to DIN EN ISO 898-1 [N/mm²]	15	10

Tab. 44: The approved stresses in suspensions correspond to the fire resistance class

Horizontal firefighting water lines may only be fixed to beams or ceilings with the same fire resistance duration. The use of plastic dowels in fire protection systems is not permitted.
If dowels are used for fixation, the various requirements for dowels with and without fire protection proof of suitability must be met.
According to DIN 14462, brackets must generally be at a distance of max. 4 m with galvanised ferrous materials and stainless steel with a wall thickness of > 2.6 mm.
In the case of copper piping and piping made of galvanised ferrous materials and stainless steels with a wall thickness of < 2.6 mm, the fixation spacing is 2 m.
The various specifications of the fixation technique given in the regulations apply for sprinkler systems.

Fixing points
Fire extinguishing pipes may expand linearly when exposed to fire. The resultant forces must not destroy fire stops. For this reason, fire extinguishing pipes must be fixed in place at a sufficient number of points in order to divert these forces in a controlled manner via expansion compensators (L or U pipe) or other compensators.
Additional fixing points must be provided in wet/dry and dry firefighting water lines in order to compensate for the reaction forces of the firefighting water pipe during the filling process. These additional fixing points must be located on the connection of pressure booster systems on the pressure side and on remote-controlled filling and emptying stations (wet/dry stations) according to DIN 14463. Standard structures made of non-flammable building materials have proved to be effective for the fixing points, e.g. pipe bows.

Use dowels
In terms of the quality and execution of fixations with dowels **without** fire protection proof of suitability the following applies
- Steel material
- Minimum size M8
- Installation depth = at least twice the dowel length
- Max. mathematical tensile load = 500 N

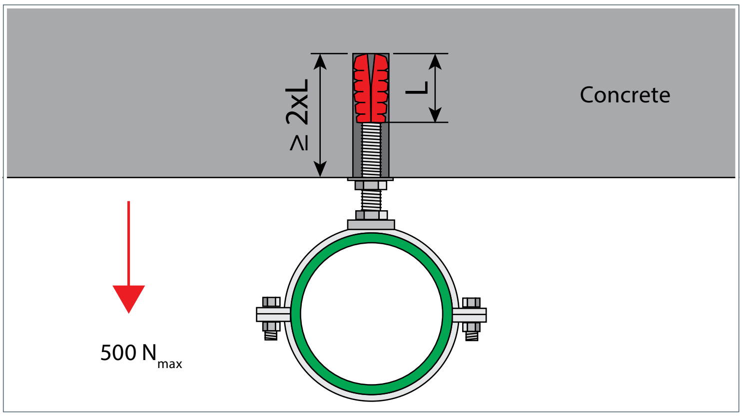


Fig. 113: Steel dowel without fire protection proof of suitability

The maximum load and installation type for dowels **with** fire protection proof of suitability are defined in the proof of suitability documentation.

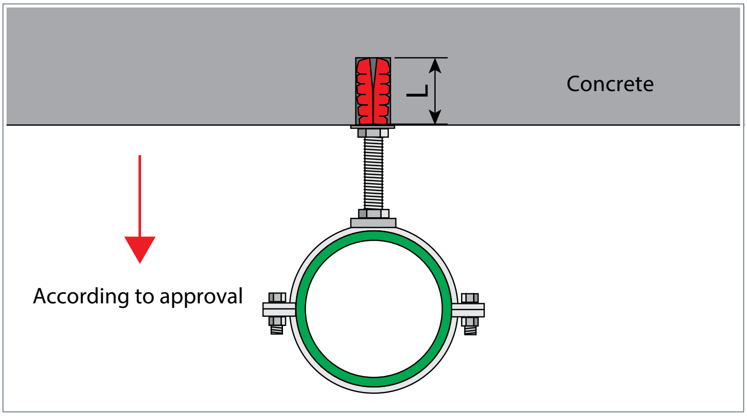


Fig. 114: Steel dowels with fire protection proof of suitability

In both cases, the permitted fixing distances according to the manufacturer's information must be observed.
When fixing firefighting water pipes onto steel components with fire protection cladding, use force-fit fixing elements instead of dowels. The specified limit for mathematical tension must be respected. Extend the fire protection cladding of the steel components to a length of at least 300 mm on the suspension. This prevents the fire resistance duration of the steel components being impaired by connection of the suspending brackets.
The length of the suspension (distance from bottom edge of the fire extinguishing line and bottom edge of the ceiling) must not exceed 1.5 m with unprotected suspension brackets.

Fire protection cladding for piping
Execute firefighting water pipes and the supply line to the firefighting water transfer point according to the expected duration of use of 2 hours as per DIN 14462.
Firefighting water pipes and mounting brackets must be dimensioned and protected so that they do not exceed the critical temperature for mechanical loading of 500°C in case of fire. This is the only way to ensure the functionality of the extinguishing system even when it is subjected to additional maximum loads, e.g., from falling objects.
When laying dry and wet/dry firefighting water lines in areas with high fire loads, additional measures must be taken.

Installation site	Measures
In fire load-free stairways, lock systems and escape routes	None
In areas with automatic extinguishing systems (e.g. sprinkler systems)	Coordination with the fire protection concept and local fire protection authorities
In areas with fire loads	Cladding of the pipeline according to DIN 4102-4 or equivalent

Tab. 45: Fire protection measures for firefighting water pipes

The following can be used for the fire protection cladding of firefighting water pipes

- Exposed and metal-concealed fire protection pipe casing
- Mineral fibre wool in accordance with DIN 4102-4
- Approved fire protection systems made from other construction materials

The cladding thickness must be selected separately for each component in line with the general building supervisory approval for piping systems. If, on the basis of the calculated loads, the brackets have tensile loads well in excess of 6 N/mm^2, the suspension brackets must also be cladded to comply with the basic rules outlined in DIN 4102-4.

Commissioning non-automatic fire extinguishing systems

Pressure test report
In line with the requirements of DIN 14462, firefighting water pipes, including their fittings, must be subjected to strength and leakage tests before commissioning.

The latest pressure test record for firefighting water systems can be downloaded from the Viega homepage by entering "Druckprobenprotokoll" (Pressure test record) as the search term.

System control book
Furthermore, an inspection log containing the following data must be created for the fire extinguishing system:
- Installation site/address
- Owner's address
- Operator's address
- Installation company's address
- Competent water supply company
- Constructional requirements and planning fundamentals
- Technical documents for the components used
- System diagram with wall hydrants, feed-in and extraction fittings as well as other key components
- Pipeline dimensions
- Flooding time calculation for dry or wet/dry fire extinguishing systems
- Record: Pressure/leakage test
- Record: Rinsing
- Record: Instructing of the operator by the installation company
- Installation company's declaration of compliance
- Acceptance test
- Records on servicing work
- Records on maintenance performed
- Records on malfunctions and their causes

Piping system for automatic fire extinguishing systems

(Sprinkler systems)
During the planning, installation and commissioning of sprinkler systems, the following points, amongst others, should be taken into consideration:
- Applicable and agreed regulations as well as the recognised rules of engineering
- Deviating country-specific requirements and regulations
- Product information provided by the manufacturer

The pipeline network must be executed in such a way that every section can be drained completely and at any time. Any reverse incline in the piping must not mean that water can remain in the system after draining.

If offsets are required, e.g. at a concrete lintel, a suitable draining facility must be provided at the lowest point. According to VdS CEA 4001 section 13.6, flushing connections via which the pipeline network can be flushed and aerated must be placed at the end of all secondary distribution pipes. Depending on the installation design, it may be necessary to fit further pipeline sections with bleeder valves.

Commissioning of automatic fire extinguishing systems (sprinkler units)
A pressure test must be carried out before commissioning the system.
The pipeline network must be easily and fully accessible for the pressure test and must not be concealed.
If the system is not put into operation immediately after the pressure test, carry out a pressure test with oil-free compressed air or inert gases.

Procedure for a pressure test:
- Visual inspection of the complete system for obvious defects – thorough flushing of the entire pipeline network required
- Completely fill the system with the test medium, such as inert gases/oil-free compressed air/filtered potable water in accordance with the PWO
- Carry out a pressure test in accordance with the generally recognised rules of engineering (e.g. VdS CEA 4001, Chapter 17)
- Document the results of the pressure test in a log.
- Have an authorized expert sign the record and hand it to the customer

Viega solutions

When selecting materials for fittings, pipes and sealing elements, the special operating and installation conditions, as well as other system requirements, must be considered on a case-by-case basis.

Send your detailed enquiries to the Viega Service Center using the "Enquiry for material durability" form. You can find the form for this on the Viega website *viega.com* by entering "material durability" as the search term.

	Profipress	Sanpress Inox	Sanpress	Prestabo hot dip galvanised	Megapress / Megapress S
Area of application	Exclusively Fire extinguishing systems wet	Fire extinguishing systems wet wet/dry dry	Fire extinguishing systems wet wet/dry dry	Exclusively Fire extinguishing systems wet	Fire extinguishing systems wet wet/dry dry
Pipe	Copper according to DIN EN 1057	Stainless steel 1.4401 or 1.4521	Stainless steel 1.4401 or 1.4521	Internally and externally galvanised steel pipe	Steel pipes, galvanised, in accordance with DIN EN 10255, galvanising in accordance with DIN EN 10240
Nominal diameter	DN10 12 x 1.0 mm DN12 15 x 1.0 mm DN15 18 x 1.0 mm DN20 22 x 1.0 mm DN25 28 x 1.5 mm DN32 35 x 1.5 mm DN40 42 x 1.5 mm DN50 54 x 2.0 mm 64.0 x 2.0 mm DN65 76.1 x 2.0 mm DN80 88.9 x 2.0 mm DN100 108.0 x 2.0 mm	– – DN15 18 x 1.2 mm DN20 22 x 1.2 mm DN25 28 x 1.2 mm DN32 35 x 1.5 mm DN40 42 x 1.5 mm DN50 54 x 1.5 mm 64.0 x 2 mm DN65 76.1 x 2 mm DN80 88.9 x 2 mm DN100 108.0 x 2 mm	– – DN15 18 x 1.2 mm DN20 22 x 1.2 mm DN25 28 x 1.2 mm DN32 35 x 1.5 mm DN40 42 x 1.5 mm DN50 54 x 1.5 mm 64.0 x 2 mm DN65 76.1 x 2 mm DN80 88.9 x 2 mm DN100 108 x 2 mm	– – – DN20 22 x 1.5 mm DN25 28 x 1.5 mm DN32 35 x 1.5 mm DN40 42 x 1.5 mm DN50 54 x 1.5 mm 64.0 x 2.0 mm DN65 76.1 x 2.0 mm DN80 88.9 x 2.0 mm DN100 108.0 x 2.0 mm	– – – 3/4 (DN20) Wall thickness 2.6 to 3.3 mm 1 (DN25) Wall thickness 2.6 to 3.3 mm 1 1/4 (DN32) Wall thickness 2.6 to 3.3 mm 1 1/2 (DN40) Wall thickness 2.6 to 3.3 mm 2 (DN50) Wall thickness 2.6 to 3.3 mm 2 1/2 (DN65) Wall thickness 2.6 to 4.5 mm 3 (DN80) Wall thickness 2.9 to 5.0 mm 4 (DN100) Wall thickness 3.2 to 5.4 mm
Press connectors	Copper and Gunmetal/silicon bronze	Stainless steel	Gunmetal/silicon bronze	Galvanised steel	Non-alloyed steel
Sealing element	EPDM	EPDM	EPDM	EPDM	≤ DN50 EPDM / FKM ≥ DN65 FKM
Pressure range	1.6 MPa	1.6 MPa	1.6 MPa	1.6 MPa	1.6 MPa
Standard, Certificate, Proof of suitability	DIN 1988-600; DVGW certificate VdS: G 4980009	DIN 1988-600; DVGW certificate; DEKRA: 172146869-01 VdS: G 4070017	DIN 1988-600; DVGW certificate; DEKRA: 172146869-02	VdS: G 4090017	VdS: G414021
Note				Do not connect to potable water installations. Testing intervals acc. to DIN 14462-6 (maintenance) are permitted	

Tab. 46: Area of application of Viega piping systems in fire extinguishing systems in accordance with DIN 14462

	Profipress	Sanpress Inox	Prestabo hot dip galvanised	Megapress / Megapress S
Application area	Fire extinguishing systems wet	Fire extinguishing systems wet wet/dry dry	Fire extinguishing systems wet	Fire extinguishing systems wet wet/dry dry
Pipe	Copper, according to DIN EN 1057 R 290 (hard)	Stainless steel 1.4401 or 1.4521	Internally and externally galvanised steel pipe	Black steel pipes, galvanised, industrially painted or powder-coated in accordance with DIN EN 10255, DIN EN 10216-1, DIN EN 10217-1 or DIN EN 10220 (galvanising in accordance with DIN EN 10240)
Nominal diameter	DN20 22 x 1 mm DN25 28 x 1.5 mm DN32 35 x 1.5 mm DN40 42 x 1.5 mm DN50 54 x 2 mm	DN20 22 x 1.5 mm DN25 28 x 1.5 mm DN32 35 x 1.5 mm DN40 42 x 1.5 mm DN50 54 x 1.5 mm DN65 76.1 x 2 mm DN80 88.9 x 2 mm DN100 108 x 2 mm	DN20 22 x 1.5 mm DN25 28 x 1.5 mm DN32 35 x 1.5 mm DN40 42 x 1.5 mm DN50 54 x 1.5 mm 64 x 2 mm DN65 76.1 x 2 mm DN80 88.9 x 2 mm DN100 108 x 2 mm	3/4 (DN20) Wall thickness 2.6 to 3.3 mm 1 (DN25) Wall thickness 2.6 to 3.3 mm 1 1/4 (DN32) Wall thickness 2.6 to 3.3 mm 1 1/2 (DN40) Wall thickness 2.6 to 3.3 mm 2 (DN50) Wall thickness 2.6 to 3.3 mm 2 1/2 (DN65) Wall thickness 2.6 to 4.5 mm 3 (DN80) Wall thickness 2.9 to 5.0 mm 4 (DN100) Wall thickness 3.2 to 5.4 mm
Press connectors	Copper and gunmetal	Stainless steel	Galvanised steel	Non-alloyed steel
Sealing element	EPDM	Wet fire extinguishing system: EPDM Wet/dry systems: FKM Dry system: FKM	EPDM	≤ DN50 EPDM / FKM ≥ DN65 FKM
Pressure range	1.6 MPa	DN20 to DN65: 1.6 MPa DN80 to DN100: 1.25 MPa	DN20 to DN65: 1.6 MPa DN80: 1.25 MPa DN100: 1.0 MPa	DN20-DN65: 1.6 MPa DN80: 1.25 MPa DN100: 1.0 MPa
Certificate	VdS: G 4980009	VdS: G 4070017	VdS: G 4090017	VdS: G414021
Fire hazard classes according to VdS CEA 4001	LH, OH1 - OH3, OH4 restricted to exhibition halls, cinemas, theatres, concert halls	LH, OH1 - OH3, OH4 restricted to exhibition halls, cinemas, theatres, concert halls	LH, OH1 - OH3, OH4 restricted to exhibition halls, cinemas, theatres, concert halls	LH, OH1 - OH4, HHP1 - HHP4 and HHS1 - HHS4
Note		No certification for pipe size 64.0 mm		

Tab. 47: Sprinkler unit in accordance with DvS Directives

PWIS conformity

The introduction of water-soluble paints into the automotive industry brought with it the toughest requirements for the systems and accessories used in the painting processes. Impurities, such as lubricants or softeners from sealing materials, on the components to be painted lead to coating defects, referred to as "cratering". To avoid such situations, the industry demands products that are free of paint-wetting impairment substances, PWIS for short. The interaction between substances and the coating system was initially observed with silicones, but also occurs with release agents, oils, greases and other substances. For this reason, the expression "PWIS-conformity", commonly known as "PWIS-free", defines a requirement relevant to all substances.

Fig. 115: Impeccable painted surfaces

Freedom from PWIS refers not only to components involved in painting applications, it also includes all substances, lubricants and packaging materials used in paint shops.

Sources of PWIS

During painting processes, microscopic impurities can lead to surface tension defects. As a result, the paint is unable to wet the surface uniformly.

Contamination by paint-wetting impairment substances is typically introduced by two sources: operational processes and human beings.

Examples of operational sources are:

- Lubricants (for moving parts of appliances and systems)
- Release agents and softeners from plastic mounted parts in systems engineering or workpieces
- Residues of drawing agents and lubricants
- Hoses and sealants
- Impurities distributed through ventilation and air conditioning or compressed air systems
- Carryover from other areas of production

- Contaminated paint material, caused by improper storage, transport or unsuitable additives or solvents, for example
- Equipment and resources, such as cleaning agents, cleaning rags, abrasives, polishes, adhesive tapes or mounting units

Human sources include:
- Cosmetics, skin care products, shampoo, hairspray, hair gel, hair dyes, spectacle cleaners, deodorant, lipstick, aftershave, make-up, skin protection cream
- Clothing (e.g. impregnation), gloves, shoe care products
- Eating and drinking (fatty acid esters, e.g. butter or fats), as well as drinking cups (release agents in coffee machines)
- Plastic wrist bands or jewellery, fitness trackers, smartphone cases
- Natural skin oils

WFIS-compliant production
WFIS-compliant production requires suitable measures to be taken and constantly monitored along the entire production chain. This includes the use of WFIS-free production equipment and materials, such as:
- Materials, elastomers in particular
- Additives and operating substances
- Materials
- Transport container
- Care products such as soap and skin protection cream
- Workwear and personal protective equipment

WFIS-free press connector installation systems from Viega have to satisfy specific criteria, from the production process itself through to the packaging stage:
- Cleaning of the press connector after the production process (casting/deformation/machining)
- Mounting of special sealing elements using lubricants free of paint-wetting impairment substances
- Marked with a blue dot on the press connection, Fig. 116
- Packaging with WFIS-free marking, Fig. 117

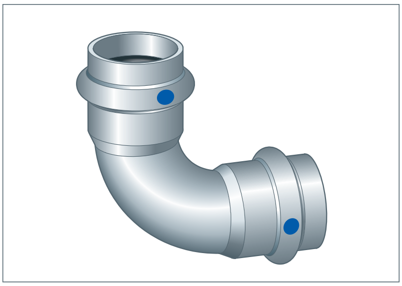


Fig. 116: Sanpress Inox LF

Fig. 117: Sanpress Inox WFIS-free, individually packed

Quality control
The production of press connectors free of paint-wetting impairment substances at Viega is subject to strict internal testing. For quality assurance purposes, the so-called "crater records" of all well-known German car manufacturers who continually test Viega products are available.

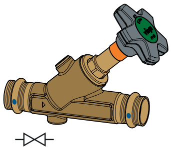
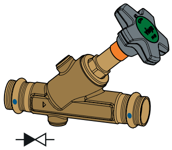
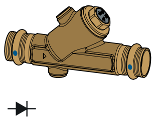
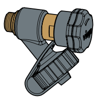
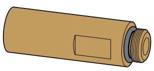
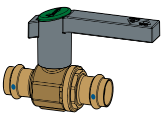
Viega solutions

> When selecting materials for fittings, pipes and sealing elements, the special operating and installation conditions, as well as other system requirements, must be considered on a case-by-case basis.
>
> Send your detailed enquiries to the Viega Service Center using the "Enquiry for material durability" form. You can find the form for this on the Viega website *viega.com* by entering "material durability" as the search term.

Three WFIS-free press connector systems that were developed specifically to meet these requirements are currently available:
- Sanpress LF
- Sanpress Inox LF
- Prestabo LF

All three systems can be supplied with threaded and XL components. The product range is being expanded by WFIS-free gunmetal/silicon bronze fittings from the Easytop series (Easytop LF). „Tab. 48: Overview of WFIS-free Easytop shut-off valves and ball valves“ on page 172 provides an overview of the WFIS-free range of fittings.

All the Easytop fittings listed in this section are DVGW-approved and feature Viega press connections. Just like the press connectors, fittings free of paint-wetting impairment substances are marked with a blue dot on the press connection.

Figure	Model	Product name	Size d [mm]	Article number
	2237.5LF	Easytop slanted seat valve, free-flow valve	15 18 22 28 35 42 54	757 120 757 137 757 144 757 151 757 168 757 175 757 182
	2238.5LF	Easytop CRV slanted seat valve, free-flow with backflow preventer	15 18 22 28 35 42 54	757 458 757 465 757 472 757 489 757 496 757 502 757 519
	2239.4LF	Easytop backflow preventer	15 18 22 28 35 42 54	757 786 757 793 757 809 757 816 757 823 757 830 757 847
	2234LF	Easytop drainage valve	G ¼	565 312
	2234.5LF	Easytop drainage valve extension	G x L ¼ x 50	565 329
	2270LF	Easytop ball valve	15 18 22 28 35 42 54	575 304 575 311 575 328 575 335 575 342 575 359 575 366

Tab. 48: Overview of WFIS-free Easytop shut-off valves and ball valves

Compressed air

Compressed air is used in various industrial applications. It is employed as part of a process (active air), for transmitting energy (control air) and for generating vacuum.

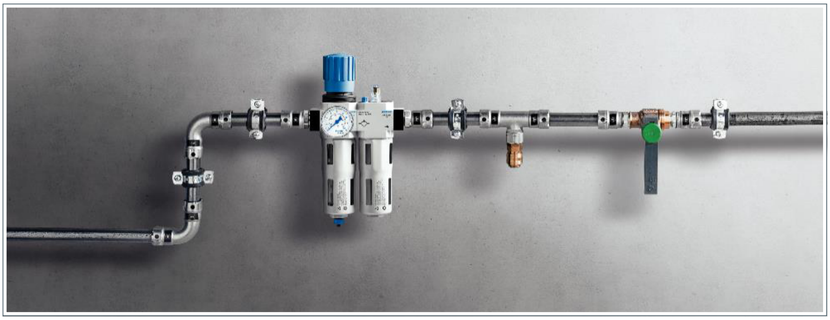


Fig. 118: Compressed air installation with Viega Megapress

Active air

Compressed air that is used as part of a process is referred to as active air. The quality of this compressed air is crucial, because it comes into contact with the product.

Typical applications for active air are:

- Transport of bulk material
- Sandblasting
- Aeration and drying processes
- Injection moulding

Fig. 119: Active air for sandblasting

Control air
Control air is used to store and transmit energy in the process of carrying out mechanical work. Pneumatic production facilities are the main area of application. Compressed air cylinders or valves can be controlled rapidly, flexibly and precisely using compressed air, especially for processes in the advancing field of miniaturisation. Control air is stored in stationary and mobile tanks for later use.

Typical applications for control air are:
- Driving machines
- Instrument air
- Pneumatic door openers


Fig. 120: Compressed air diaphragm pump

Vacuum
The use of compressed air to generate vacuum eliminates the need for decentralised equipment at the point of use.

Typical applications are:
- Packing
- Drying
- Lifting
- Positioning
- Exhausting

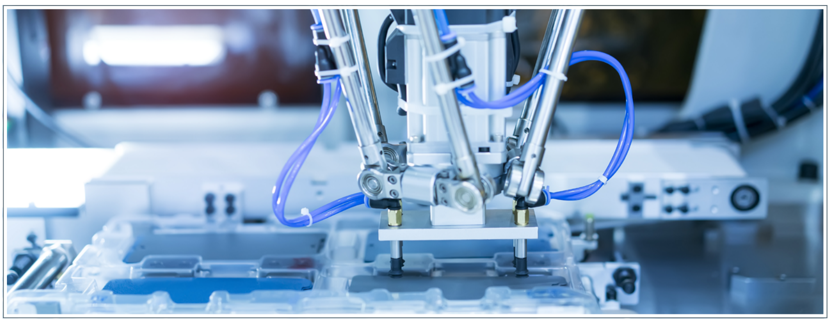


Fig. 121: "Pick and place" application using compressed air

Basics

Definition of compressed air

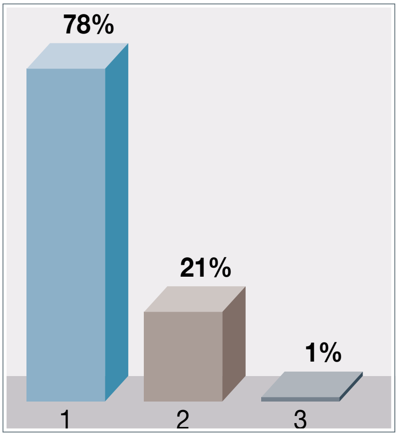


Fig. 122: Composition of air

Compressed air is air kept under a pressure that is greater than atmospheric pressure. Its composition is as follows: 78% nitrogen, 21% oxygen and 1% other gases. The compression process turns this air into an energy store. The energy released when the air expands can be used as service air for various technical applications.

1 Nitrogen
2 Oxygen
3 Other gases

The thermal parameters of temperature, volume and pressure determine the state of the compressed air. The volume and pressure of the gas are inversely proportional (ideal gas law):

$$\frac{p \cdot V}{T} = \text{constant}$$

Physical principles
The Boyle-Mariotte law can be used to describe the following compression processes.

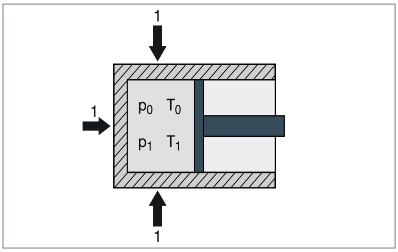


Fig. 123: Isochoric compression

Isochoric compression at constant volume

1 Heat

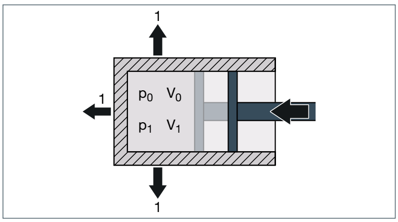


Fig. 124: Isothermal compression

Isothermal compression at constant temperature

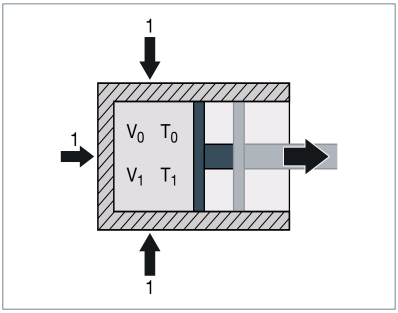


Fig. 125: Isobaric compression

Isobaric compression
at constant pressure

1 Heat

Kinetic compressed air

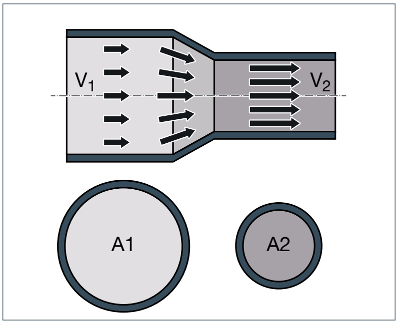


Fig. 126: Flow behaviour in case of changes to the cross section

Consideration should be given to the laws of kinetic compressed air in the dimensioning of compressed air installations. The volumetric flow is calculated from the cross-sectional area of the pipeline and the flow velocity:

$$\dot{V} = A1 \cdot V1 = A2 \cdot V2$$

The flow velocity is inversely proportional to the pipeline diameter. The flow velocity in compressed air installations is 2 to 3 m/s and should never exceed 20 m/s. Higher velocities transform the laminar flow into a turbulent flow. The consequences of this are flow noises, a bigger pressure drop and heat losses.

Compressed air quality

Untreated compressed air

On average, one cubic metre of untreated air contains
- 180 millions of dirt particles measuring 0.01–100 µm,
- 5–40 g of water,
- 0.01–0.03 mg of oil in the form of aerosols and uncombusted hydrocarbons and
- traces of heavy metals.

Compressing atmospheric air at 0.1 MPa to form compressed air at 1 MPa increases the concentration of the constituents by a factor of 11. High compressed air quality is therefore crucial to a system's economic efficiency and production safety.

Advantages of correct compressed air conditioning

The impurities contained in atmospheric air can negatively impact the compressed air installation and the consumers. Ultimately, the quality of products can suffer.

Conditioning compressed air in the proper manner has the following advantages:
- The service life of the downstream compressed air consumers is extended.
- Product quality is improved and becomes more consistent
- The compressed air lines remain free of condensate and corrosion
- There are fewer malfunctions
- Condensate collectors are no longer required
- Maintenance effort is scaled down
- The pressure losses caused by leaks and flow resistance are reduced
- The less severe pressure losses cut energy consumption

Compressed air qualities according to ISO 8573-1

To ensure smooth-running production processes, there must always be sufficient amounts of compressed air of consistent quality and at adequate pressure. The trouble-free operation of a compressed air system hinges on maintenance tailored to operational requirements.
ISO 8573 defines compressed air qualities in various classes:

<table>
<thead>
<tr><th rowspan="2">Class</th><th colspan="3">Maximum particle count pro m³/ Mass concentration C_p [mg/m³]</th><th rowspan="2">Pressure dew point [°C] / residual moisture content C_W [g/m³]</th><th rowspan="2">Oil content [mg/m³]</th></tr>
<tr><th>0.1–0.5 µm</th><th>0.5–1 µm</th><th>1–5 µm</th></tr>
</thead>
<tbody>
<tr><td>0</td><td colspan="5">Specified by the device user or supplier, more stringent than Class 1</td></tr>
<tr><td>1</td><td>≤ 20,000</td><td>≤ 400</td><td>≤ 10</td><td>≤ -70°C</td><td>≤ 0.01 mg/m³</td></tr>
<tr><td>2</td><td>≤ 400,000</td><td>≤ 6,000</td><td>≤ 100</td><td>≤ -40°C</td><td>≤ 0.1 mg/m³</td></tr>
<tr><td>3</td><td rowspan="3">Not specified</td><td>≤ 90,000</td><td>≤ 1,000</td><td>≤ -20°C</td><td>≤ 1 mg/m³</td></tr>
<tr><td>4</td><td rowspan="2">Not specified</td><td>≤ 10,000</td><td>≤ 3°C</td><td>≤ 5 mg/m³</td></tr>
<tr><td>5</td><td>≤ 100,000</td><td>≤ 7°C</td><td rowspan="5"></td></tr>
<tr><td>6</td><td colspan="3">≤ 5 mg/m³</td><td>≤ 10°C</td></tr>
<tr><td>7</td><td colspan="3">5–10 mg/m³</td><td>≤ 0.5 g/m³</td></tr>
<tr><td>8</td><td colspan="3" rowspan="2"></td><td>0.5–5 g/m³</td></tr>
<tr><td>9</td><td>5–10 g/m³</td></tr>
<tr><td>x</td><td colspan="3">> 10 mg/m³</td><td>> 10 g/m³</td><td>> 5 mg/m³</td></tr>
</tbody>
</table>

* If particles larger than 5 µm have been measured, classes 0–5 cannot be applied.

Tab. 49: Compressed air purity classes according to ISO 8573-1

Typical compressed air purities for various areas of application

The typical purities indicated below are taken from VDMA Unit sheets 15390-1, 15390-2, as well as 15390-3, and are empirical values from industrial applications and subject to change. They are intended as a reference point for users of compressed air if the machine/appliance manufacturer has not provided any data for the required purity of the compressed air.

Use	Purity classes			
	Particles	Moisture (vaporous)		Total oil content
		Ambient temperature		
		> + 10°C	≤ + 10°C	
	A	B_1	B_2	C
Mining				
Control air (working equipment and shaft installations)	7	4	2–3	4
Petrochemical				
Control air for refineries	5	4	2–3	2
Control air for drilling sites (gas/oil)	7	4	2–3	4
Food industry				
Control air in production facilities Indirect contact with the packaging material and/or product	2	4*	2–3	1
Process air Direct contact with the material used for non-sterile packaging	2	4*	2–3	1
Tobacco processing				
Control air	3	4	2–3	2
Process air (conveying air)	3	4	2–3	1
Textile sector				
Control air	3	4	2–3	2
Process air (conveying air)	3	4	2–3	2
Paper industry				
Control air	3	4	2–3	2
Process air (conveying air)	3	4	2–3	2
Publishing and printing sector				
Control air	3	4	2–3	2
Process air (conveying air)	3	4	2–3	1
Chemical industry				
Control air	3	4	2–3	2
Process air (conveying air)	3	4	2–3	1
Pharmaceutical industry				
Control air in production facilities (indirect contact with the packaging material and/or product)	2	4*	2–3	1
Process air (direct contact with the material used for non-sterile packaging)	2	4*	2–3	1
Rubber and plastics industry				
Control air	3	4	2–3	2
Process air (conveying air)	2–3	4	-	1
Blast air	2–3	4	-	2
Glass and ceramics industry				
Control air	3	4	2–3	2
Process air (conveying air)	3	4	2–3	2–3

Use	Purity classes			
	Particles	Moisture (vaporous)		Total oil content
		Ambient temperature		
		> + 10°C	≤ + 10°C	
	A	B_1	B_2	C
Metal production and metalworking				
Control air	3–4	4	2–3	3
Process air (blowing out moulds)	4	4	2–3	3
Casting shops				
Control air	3–4	4	2–3	3
Process air (core shooting)	4	4	2–3	2–3
Surface finishing				
Control air, general	2	4	2–3	2
Process air (powder coating)	1	4	-	1
Control air	2	4	2–3	2
Control air not coming into direct contact with the paint, solvent or substrates to be painted	2	4	2–3	1
Blast and/or conveying air (spraying air) coming into direct contact with the paint (paint guns/nozzles)	1	2–4	2–3	1
Machine and plant engineering				
Control air (drive air)	3	4	2–3	3
Blast air	3–4	4	2–3	3
Electrotechnology, electronics				
Control air	2	4	2–3	2
Cable production	3	4	-	3
Energy supply				
Control air	3	4	2–3	3
Process air (decentralised conveyance of pulverised coal)	-	4	2–3	-
Measuring and testing systems				
3D measurement technology	2	3–4	-	1
Measuring and test air	2	3–4	3–4	1

* Higher compressed air purities may be required, depending on the compressed air system (see VDMA 15390-2, 4.1 to 4.5) and/or the applications, as well as and in particular the hazard assessment of critical control points under the HACCP concept

Tab. 50: Typical purity classes and their applications (selection from VDMA Unit sheets 15390-1, 15390-2 and 15390-3)

The itemised points, tables or lists are merely isolated examples from a number of methods and representations. The table is not intended to be exhaustive, nor does it claim to have precisely interpreted the existing legal regulations. The special features of the products concerned and their various potential uses must be taken into account.

Compressed air systems

Advantages of compressed air

Compressed air offers numerous advantages in industrial applications:

- **Central provision and distribution**
  The compressed air generated by the centrally installed compressors can be distributed via a pipeline network.
- **Storability in tanks**
  Compressed air can be delivered in tanks of all sizes – mobile and stationary – even to exposed sites.
- **Low weight of drives**
  Drives operated by compressed air are lighter than electrical ones. This is an advantage especially with hand-held tools.
- **Cleanliness**
  Residue-free use with advantages for the food, textile, paper and packaging industries.
- **Operational safety**
  Compressed-air devices are spark-free and can therefore also be used in areas at risk of fire and explosion.
- **Quick cycles**
  High flow speeds of >20 m/s ensure quick switching times for valves and high working speeds for machines. The valve switching time at 0.6 MPa is approx. 50 ms. Piston speed in pneumatic cylinders approx. 15 m/s.
- **Adjustability**
  The forces, torques and speeds of drive and control elements can easily be adapted to the requirements using pressure and flow rate controllers.

Compressed air reprocessing

Multi-stage compressors based on the piston compressor principle have proven themselves effective for the central supply of industrial compressed air installations involving large quantities of compressed air, it should be noted here that the operating pressures are mostly below 1.0 MPa.
Compressors suction in air from the surroundings and compress this to the required operating pressure. Depending on where they are set up, the air can contain pollution such as soot, dust, machine emissions and humidity which has to be removed before the air is fed into the compressed air installation. Impurities increase proportionately to the level of compression. When compressed air is produced at 1.0 MPa, the concentration of impurities increases 11-fold.
The aim of compressed air conditioning is, in addition to the removal of oil and dirt, to reduce air moisture. Energy-saving cold drying is used mostly for financial reasons.
Reprocessing is based on the specified requirements. According to ISO 8573-1, compressed air is divided into purity classes with corresponding requirements. The required purity classes for particles, water content and oil content can be completely different.
For example, the size and number of particles according to Class 2, the residual water content of Class 3 and the residual oil content of Class 1 can be set as requirements for the operator. As such, reprocessing must be planned and executed on a case by case basis. According to ISO 8573-1, compressed air of this nature should carry the designation "ISO 8573-1 [2:3:1]".
Compressed air installations in areas at risk of frost are fitted with an absorption dryer instead of a cold dryer. Absorption dryers achieve a lower residual moisture content (pressure dew point), which prevents systems from icing up at low ambient temperatures.

Air pollution – condensation

In the industrial sector in particular, the quality of the outside air used to generate compressed air depends on the site concerned. Particles and aggressive components must be filtered out – either before being suctioned in by the compressor or, at the latest, during compressed air conditioning before being fed into the system. If this is not achieved or not done adequately, this has a negative impact on the compressed air installation and the functioning of the connected fittings, machines and devices. Any contaminated compressed air which leaks out can also be harmful to health and impair production quality. It is therefore advisable to provide pre-filters for the suctioned air and adapt the extent of compressed air conditioning to the conditions concerned.

Impact of unclean compressed air on system parts and human beings:

- **Condensate formation from solid particles and oils**
  Premature machine wear from abrasion and corrosion
- **Transport of germs/aggressive chemicals**
  Damage to health from the inhalation of leaking compressed air
- **Oil deposits**
  Cross-section constriction caused by resinification leads to loss of power and energy, which reduces the system's efficiency
- **Water accumulation**
  Leaks are rendered more likely due to electrochemical corrosion; impairment of lubrication systems in connected devices and machines; frost damage

Mixtures of water, oil, greases and the above-mentioned solid impurities which result from the compression of air are referred to as condensates. Mixing very different substances makes compressed air condensate extremely harmful and bad for the environment. In Germany, for example, the correct procedure for disposing of condensate is laid down in the Federal Water Act. Section 7a specifies that water containing hazardous substances must be reprocessed in line with the "generally recognised rules of engineering".
Wherever condensate accumulates (pressure vessels, filters, dryers), it must be automatically drained away and collected to prevent it from being re-introduced into the compressed air flow.

System components

Requirements of compressed air systems

Compressed air systems can be divided into three parts:

- Compressed air generation – compressor with heat recovery
- Compressed air conditioning – storage, cleaning
- The piping system – distribution

The system components are selected based on the system requirements. They concern:

- the nature of compressed air generation – compressor type
- provision – centralised or decentralised
- the nature of heat usage or recovery
- the nature of storage – storage type
- the nature of compressed air processing – system type
- the piping system – material and execution

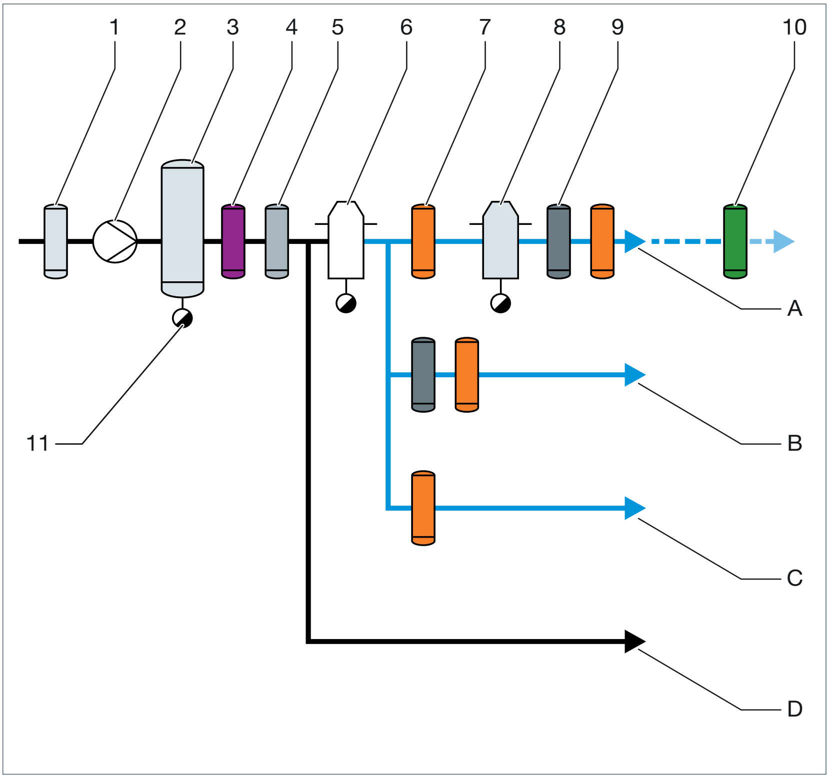


Fig. 127: Principle of a compressed air system

1 Suction filter
2 Compressor with heat recovery
3 Store
4 Cyclone separator
5 Pre-filter (sieve)
6 Cold dryer
7 Microfilter (volume filtration)
8 Absorption dryer
9 Microfilter (activated carbon)
10 Microfilter (sterile filter)
11 Condensate trap

A Top quality
B Better quality
C Normal quality
D Low quality

Compressed air generation
The following are required to dimension the compressor type:
- the sum of the required compressed air amounts
- the necessary reserve air amounts
- the necessary operating pressure
- the details on the planned future requirement

Depending on the amounts of compressed air required and the pressure levels, different types of machines are used to produce compressed air.

- **Ventilator**
  For large quantities of air at low pressure.
  Rotating propeller blades create an air flow, mainly in the work area itself.
  Use: for cooling

- **Radial compressor**
  For low quantities of air at medium pressure.
  Air is routed to the centre of a rotating rotor and propelled to the periphery by the centrifugal force. The pressure increase is achieved by routing the accelerated air through a diffuser before it reaches the next rotor. As a result, the kinetic energy is converted into static pressure.
  Use: turbo charger in cars

- **Axial compressor**
  For large quantities of air at medium pressure
  The air alternatively flows through a series of rotating and stationary blades. The air is initially accelerated and then compressed. The blade channels form diffuser-like expanded channels in which the kinetic energy created via circulation stalls the air and converts it into pressure energy.
  Use: Aircraft turbines

- **Compressor**
  For medium and large quantities of air at high pressures.
  Compression of suctioned in air using pistons, often over several stages during intermediate storage, until the required operating pressure is achieved – designed as plunger or screw compressors.
  Use: Feeding large quantities of air into small stores (e.g. (scuba tanks) or central compressed air provision with long transport routes

Industrial building directive

- The operating room for compressors with a motor output in excess of 40 kW must feature special fire protection.
- Compressors with a motor output in excess of 100 kW must be set up in a separate, fire-resistant room.

Requirements for fire-resistant operating rooms

- Walls, ceilings, floor structures and doors must comply with at least Fire Resistance Class F30.
- No flammable liquids may be stored.
- The floor structure around the compressor must be made of non-flammable material.
- Leaking oil must be prevented from spreading over the floor.
- There must be no flammable materials within a three metre radius of the compressor.
- There must be no flammable system parts above the compressor (cable trays, plastic pipes etc.).

Compressed air storage

Pressure vessels are a core component of any compressed air system. The required vessel size depends on the compressed air requirements and the type of compressor.

Pressure vessels have to perform the following tasks:

- Buffer for consumption peaks
- Pulsation damper when using piston compressors
- Condensate separation

Compressed air distribution

Piping systems

Compressed air-driven tools, devices, machines and systems are supplied with compressed air via a piping system. The basis for efficient and economic operation is the differentiated dimensioning of the pipeline diameters during the planning and professional execution of the installation.
Compressed air systems are required to achieve high levels of performance:

- Sufficient amounts of compressed air of consistent quality and pressure must be supplied to each consumer.
- The piping system must be leak-free.
- The piping system must be divided into blockable sections. Expansions, maintenance and repairs must not lead to failure of the system as a whole.
- The system must be executed in line with the applicable safety regulations.

A piping system is divided into the sections

- Supply line
- Manifold
- Connection line

It is important to calculate the pressure losses in the individual pipeline sections. The total pipe length, also referred to as "fluidic pipe length", includes the equivalent pipe lengths for moulded pieces and fittings. With the equivalent length method, the pressure loss through elbows, fittings and other pipeline components is described by means of tables as the pressure loss along the length of a straight pipe.
If the piping route is not known during planning, the fluidic pipe can be estimated by multiplying the straight pipe length by 1.6.
The nominal widths of the individual pipeline sections are determined using a layout diagram, with due consideration for the air quantity assigned to the pipeline section and the pressure loss to be respected, as well as pressure at which the system is operated.

Supply line

The compressor station with compressed air conditioning and the compressed air tanks are connected via the supply line. According to "VDMA 15391-1", the pressure drop Δp in the supply line should not exceed 30 hPa. From the supply line, the compressed air is routed through a header. In the header (ring system or single connection pipeline), the pressure drop should not exceed Δp 30 hPa.

Ring system as manifold

A ring system is a closed distribution ring. Areas of the piping can be shut-off individually for maintenance purposes. This ensures the supply to most of the other consumers at all times. Ring systems typically have short distances, low pressure losses and small nominal pipeline widths.

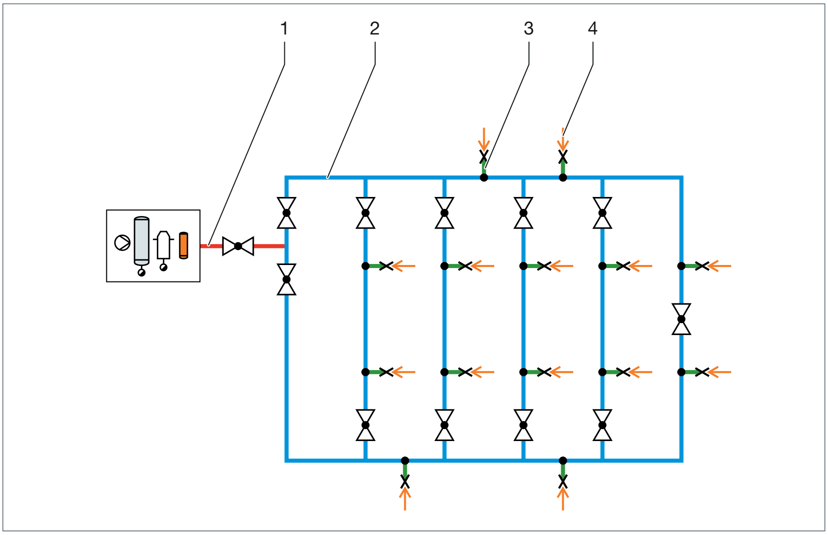


Fig. 128: Compressed air supply with ring system

1 Supply line
2 Ring system
3 Connection line
4 Connection point

Advantages:

- Sections possible
- Section-by-section maintenance
- Short distances to the connection points
- Low pressure losses
- Smaller pipeline nominal widths

Disadvantages:

- More material required than with a ring system installation

Single connection pipeline as manifold

A single connection pipeline branches from the supply line as an individual distribution leg and leads to the connection lines, which in turn lead to the consumer. Although less material is required, single connection pipelines must be dimensioned larger to prevent higher pressure losses. Single connection pipelines should be equipped with a shut-off valve for maintenance purposes.

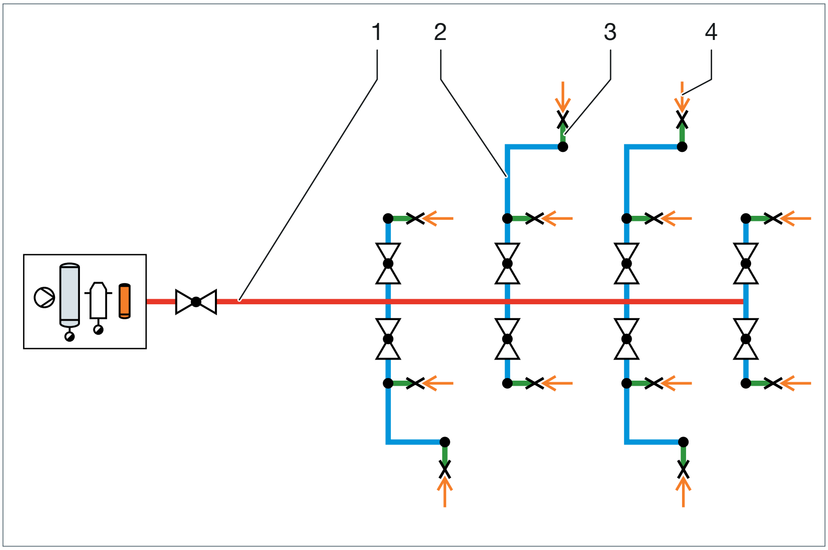


Fig. 129: Compressed air supply with single connection pipeline

1 Supply line
2 Single connection pipeline
3 Connection line
4 Connection point

Advantages

- Less material required than for a ring system

Disadvantages

- Frequently occurring high pressure losses
- Large pipeline nominal widths

Connection line

The consumers are supplied with compressed air through the connection line. If the consumers are operated at different pressures, a maintenance unit with pressure regulating valve, via which the supply pressure is reduced to the operating pressure of the consumer, has to be installed in front of the consumer. Maintenance units – consisting of filter, separator, controller and oiler – are not required for treated compressed air. The pressure drop Δp in the connection lines should not exceed 40 hPa. Connection lines with a nominal width of DN25 are recommended in industry for a compressed air requirement of 1800 l/min and a pipe length of 10 m.

Total pressure loss for the compressed air system

The total pressure loss for a compressed air system should not exceed 0.1 MPa for economic and ecological reasons.

With a pressure loss of 0.1 MPa (1000 hPa), the system parts can be assigned the following pressure losses on a pro rata basis:

- 100 hPa Pipeline network with supply line, manifold and connection line
- 700 hPa Provision with drying, cleaning, storing, supply line connection
- 200 hPa Reserves, tool or machine connection

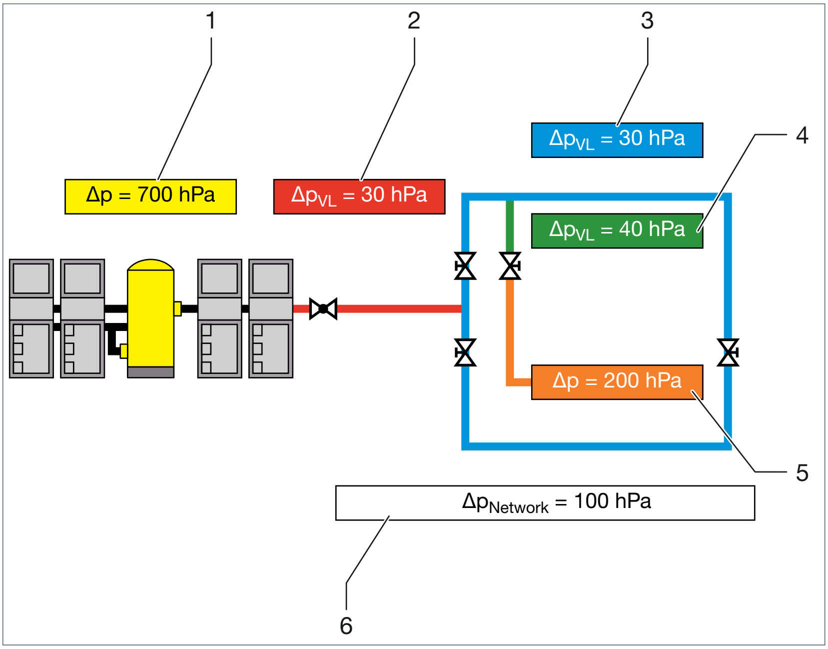


Fig. 130: Pressure losses from a compressed air system

1 Provision
2 Supply line
3 Manifold
4 Connection line
5 Tool or machine connection
6 Pressure loss in the pipeline network (2 + 3 + 4)

Piping calculations

Compliance with the commercially recommended pressure losses calls for accurate dimensioning of the piping system. Pipe strength is determined by the maximum pressure. Pipe dimensioning is based on the maximum volumetric flow with the lowest possible pressure loss. A uniform flow pressure must be maintained at every draw-off point. The flow velocity of the compressed air in piping is generally 2 to 3 m/s and, to prevent flow noises and turbulence, should not exceed 20 m/s. The flow velocity of compressed air containing condensate should be no higher than 3–4 m/s. This is to

ensure that the condensate is not entrained. Higher flow velocities may be required for process-related reasons, in machines with fast production cycles for example. The pressure loss from the piping system as a whole should not exceed 0.01 MPa.
The VDI Heat Atlas can be used to assist with the pressure loss calculation. The nomograph from VDMA 15391-1 provides a practical aid to calculating the clear nominal pipe diameter.

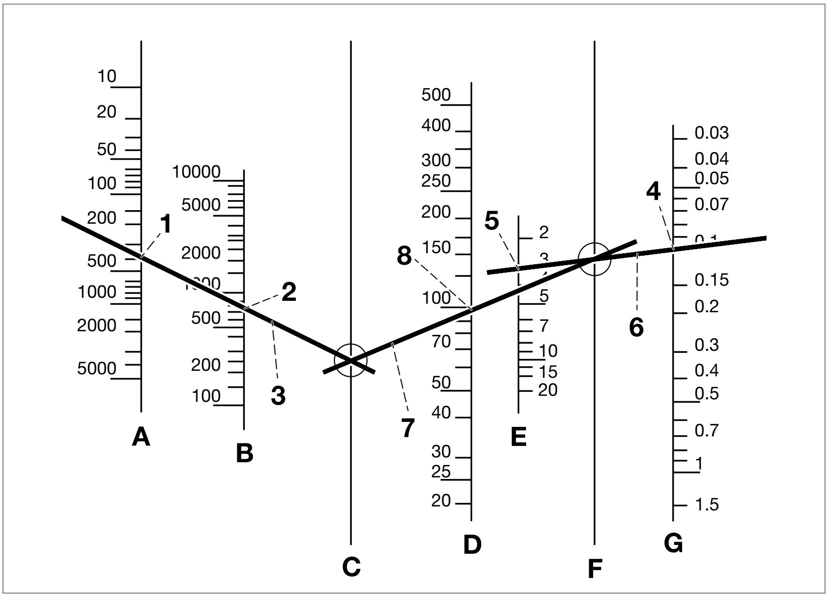


Fig. 131: Nomograph for calculating the clear nominal pipe diameter

A Pipe length [m]
B Suction volume [m^3/h]
C Auxiliary axis 1
D Clear pipe values [mm]
E System pressure [bar]
F Auxiliary axis 2
G Pressure losses [bar$_{abs}$]

Determine the nominal pipe diameter as follows:
1. Axis A: mark equivalent pipe length.
2. Axis B: mark suction volume.
3. Connect points 1 and 2 with a straight line and intersect Axis C.
4. Axis G: mark pressure loss.
5. Axis E: mark system pressure.
6. Connect points 4 and 5 with a straight line and intersect Axis F.
7. Connect Axes C and F intersection points with a straight line.
8. Axis D: read off pipe nominal width.

Additional planning notes

- Lay compressed air lines for dry compressed air in a straight line
- Create direction changes using elbows and Y-sections
- Do not use T-sections or kneepieces for dried compressed air
- Avoid abrupt cross-sectional changes

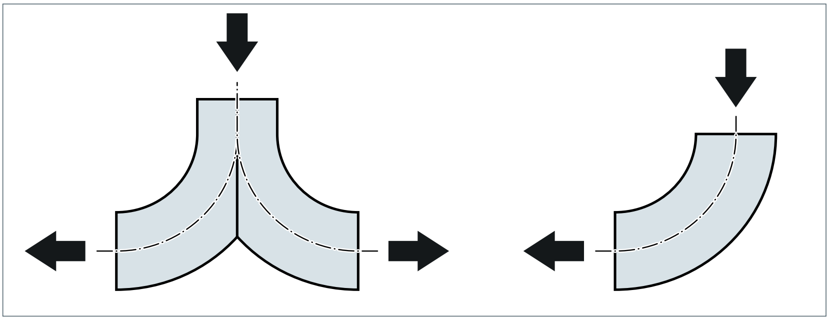


Fig. 132: Y-section and elbow

Pipeline networks without compressed air drying

If the drying stage is omitted from compressed air conditioning, condensate can form throughout the pipeline network. The following measures should be taken to prevent damage to compressed air consumers:

- Do not allow compressed air to cool down in the process
- Lay piping sloping (gradient of 1.5–2‰)
- Lay the supply line vertically downstream of the compressor
- Install condensate drainers at the lowest points of the compressed air installation
- Branch connection lines upwards in the direction of flow
- Install maintenance units with filter, water trap and pressure reducer

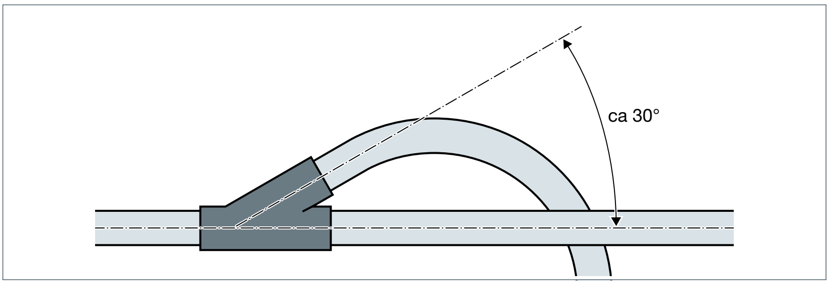


Fig. 133: Laying the connection line

Pipeline networks with compressed air drying
A number of measures can be omitted in pipeline networks with compressed air drying:

- Piping can be laid horizontally
- Condensate drainers installed only at filters, containers and dryers
- Connection lines can be laid facing downwards
- Pressure reducers can be provided without water separator

Material selection and connecting technology for piping systems

Compressed air installations should be maintenance-free if possible and dimensioned to suit requirements. Within the scope of planning and material selection for the pipeline installation, it is important to take the individual, mechanical and chemical factors into account.
In order to determine the material suitable for use in compressed air systems, the advantages and disadvantages of the materials normally used must be weighed up on a case-by-case basis:

- Comparison of the pipe materials' mechanical and chemical properties
- Influence of pipe material on compressed air quality
- Mounting and fixing requirements for piping
- Synergy effects from the use of certain pipe materials, e.g. lower energy consumption due to reduced pipe friction pressure losses, use of press connector systems in other areas (potable water, technical gases, etc.)

The same criteria apply when selecting a suitable pipe connecting technology as when selecting the material. More importance is attached to the use of resources for mounting.
Important criteria for the pipe connecting technology:

- Components – manageable amount, simple to handle
- Properties – high tensile strength, pressure-proof
- Personnel qualifications – no special qualifications required
- Mounting – quick, with only few tools and personnel

Acceptance of compressed air systems

A compressed air system requires monitoring. This system is bound by acceptance regulations in accordance with the latest German Pressure Equipment Directive (DGRL) and Industrial Safety Regulations (BetrSichV). Pressure systems are therefore required to be tested prior to initial commissioning, after any modifications that have to be inspected and also after periodic tests. The obligation to test compressed air systems is a specified requirement in EU Directive 2014/68/EU (Official Journal of the European Union). Data Sheet T 039/BGI 619 of April 2012 from the Employer's Liability Insurance Association for Raw Materials and Industry describes the test procedure. In the EU, these tests fall only to certified inspection bodies, in Germany to DEKRA and TÜV for example.

Viega solutions

When selecting materials for fittings, pipes and sealing elements, the special operating and installation conditions, as well as other system requirements, must be considered on a case-by-case basis.

Send your detailed enquiries to the Viega Service Center using the "Enquiry for material durability" form. You can find the form for this on the Viega website *viega.com* by entering "material durability" as the search term.

The compressed air quality can be influenced by various factors. Such factors include the compressed air compressor, the piping systems employed and the transport, storage and installation of the components used.
During operation of the compressed air system, the possibility of particle abrasion and the condensing of atmospheric moisture also play an important role. To prevent atmospheric moisture from condensing in the piping, it must be ensured during the planning phase that the temperature does not drop below the dew point.
Tab. 51 provides an overview of the Viega piping systems and their potential applications in accordance with ISO 8573-1. To achieve the required purity classes, suitable measures must be taken to protect the components from contamination during transport, storage, installation and commissioning.
The use of FKM or HNBR sealing elements make the Viega piping systems suitable for oil-containing compressed air also.
To be able to use products from Viega for "compressed air" applications, the purity classes for compressed air in accordance with DIN ISO 8573-1 are a crucial factor.

Considering the requirements of DIN ISO 8573-1, Viega piping systems are a good choice for compressed air.

The following systems can be used:
- Profipress, Profipress S, Profipress G
- Sanpress
- Sanpress Inox, Sanpress Inox G
- Sanpress Inox LF
- Prestabo
- Prestabo LF
- Megapress, Megapress S, Megapress G
- Seapress

system name	pipe material	Sealing element[12]	p_{max} [MPa]	T_{max} [°C]	Solid particles[13] class									Residual moisture content class											Oil content class					
					0	1	2	3	4	5	6	7	X	0	1	2	3	4	5	6	7	8	9	X	0	1	2	3	4	X
Profipress	Copper pipe acc. to DIN EN 1057	EPDM	1,6	60	O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✗
Profipress S		FKM			O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓
Profipress G		HNBR			O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓
Sanpress	1.4401 model 2203/2203XL	EPDM			O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✗
		FKM[15]			O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓
	1.4521 model 2205/2205XL	EPDM			O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✗
		FKM[15]			O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓
	1.4520 model 2204/2204XL	EPDM			O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✗
		FKM[15]			O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓
Sanpress Inox	1.4401 model 2203/2203XL	EPDM			O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✗
		FKM[15]			O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓
	1.4521 model 2205/2205XL	EPDM			O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✗
		FKM[15]			O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓
	1.4520 model 2204/2204XL	EPDM			O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✗
		FKM[15]			O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓
Sanpress Inox G	1.4401 model 2203/2203XL	HNBR			O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓
Sanpress Inox LF	1.4401 model 2203/2203XL	EPDM			O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✗
	1.4521 model 2205/2205XL	EPDM			O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✗
	1.4520 model 2204/2204XL	EPDM			O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✗

[12] EPDM sealing element for oil concentrations < 25 mg/m³

[13] Recommendation for classes 1 to 3: Flush the line before commissioning

[15] The EPDM factory-fitted sealing element can be exchanged for a FKM sealing element on-site

✓ = For use

✗ = Not for use

O = Conditional use, consultation with the Service Center required

Tab. 51: Area of application of the Viega piping systems by purity class as per ISO 8573-1, Part 1 of 2

system name	pipe material	Sealing element [12]	p_{max} [MPa]	T_{max} [°C]	Solid particles [13] class									Residual moisture content class											Oil content class					
					0	1	2	3	4	5	6	7	X	0	1	2	3	4	5	6	7	8	9	X	0	1	2	3	4	X
Seapress	Copper nickel wrought alloy to DIN 86019 WL 2.1972.11 or WL 2.1972.22	EPDM	1.6	60	O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✗
		FKM [15]			O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓
Prestabo	Externally galvanised model 1103/1103XL	EPDM			✗	✗	✗	✗	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✗
		FKM [15]			✗	✗	✗	✗	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓
	PP coated model 1104	EPDM			✗	✗	✗	✗	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✗
		FKM [15]			✗	✗	✗	✗	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓
	Externally and internally galvanised model 1106/1106XL	EPDM			✗	✗	✗	✗	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✗
		FKM [15]			✗	✗	✗	✗	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓
Prestabo LF	Externally galvanised model 1103/1103XL	EPDM			✗	✗	✗	✗	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✗
	PP coated model 1104	EPDM			✗	✗	✗	✗	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✗
	Externally and internally galvanised model 1106/1106XL	EPDM			✗	✗	✗	✗	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✗
Megapress	Steel pipes according to DIN EN 10255 DIN EN 10220 DIN EN 10216-1 DIN EN 10217-1	EPDM			✗	✗	✗	✗	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✗
Megapress S		FKM			✗	✗	✗	✗	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓
Megapress G		HNBR			✗	✗	✗	✗	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓

[12] EPDM sealing element for oil concentrations < 25 mg/m³

[13] Recommendation for classes 1 to 3: Flush the line before commissioning

[15] The EPDM factory-fitted sealing element can be exchanged for a FKM sealing element on-site

✓ = For use

✗ = Not for use

O = Conditional use, consultation with the Service Center required

Tab. 52: Area of application of the Viega piping systems by purity class as per ISO 8573-1, Part 2 of 2

Technical gases

Technical gases are gases that are produced by a technical process and have to achieve a specified purity. They are used primarily in trade and industry. They often have a high degree of purity, which can usually be achieved only through specific treatment techniques. Conceptually, they are differentiated from industrial gases since there is no specified purity for these substances. Technical gases are pure gases consisting of one element or mixtures of pure gases.

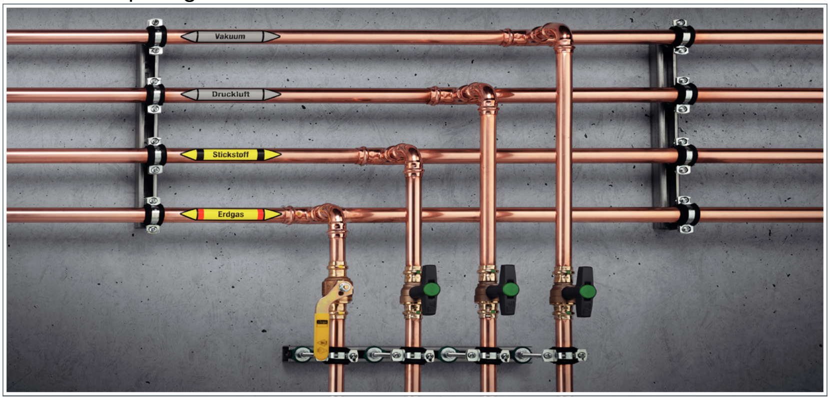


Fig. 134: Piping system for technical gases with Viega Profipress

Nowadays, technical gases are used in almost every sector of industry. Employed as control, protective and carrier gases, they transmit energy and have a reactive, reductive, oxidising, neutralising, cryogenic or thermal effect. Sectors in which technical gases are typically used include:
- Food industry
- Automotive industry
- Chemical industry
- Pharmaceutical industry
- Petrochemical industry
- Metalworking industry

The chemical and physical properties of technical gases determine their area of applications. They are used mainly as:
- Protective gas during welding and hardening processes
- Inert gas
- Fuel gas
- Respiratory gas (and other medical technology applications)
- Gas for leakage tests
- Means of transport (pneumatic conveyance of explosive and combustible bulk materials)
- Packaging gas

The examples below illustrate the broad range of potential applications.

Welding technology
Various gases are used, depending on the welding process:
- Acetylene/oxygen:
  Autogenous welding
- Argon/helium mixture:
  Metal Inert Gas welding (MIG), Tungsten Inert Gas welding (TIG)
- Argon/carbo dioxide/oxygen mixture (e.g. Corgon®):
  Metal Active Gas welding (MAG)

The protective gas displaces the air to prevent an explosive air/gas mixture from forming. During gas metal arc welding processes, it prevents combustion and corrosion because the metal is unable to react with oxygen. In the case of high-alloy steels containing aluminium and titanium, high-grade protective gas eliminates the risk of tarnishing. DIN EN ISO 14175 specifies the purities of various technical gases used specifically for welding.

Fig. 135: Gas metal arc welding

Hardening technology
In hardening technology, nitrogen and hydrogen prevent the unwanted effect of the steel to be hardened being altered by oxygen. Once hardened, steel components for example have a polished surface that is free of any residue.

Fig. 136: Protective gas furnace for hardening gearwheels

Food technology

Oxygen accelerates the oxidation of food and the growth of aerobic microorganisms. Nitrogen and carbon dioxide, on the other hand, prevent this phenomenon and are therefore used as protective gases in packaging technology.
Conversely, oxygen is widely used in meat and vegetable processing. It acts as a stabiliser for the red colour of the meat and keeps vegetables fresh for longer.
As well as its role in packaging technology and for carbonating beverages, carbon dioxide can also be used as dry ice.

Fig. 137: Carbon dioxide for carbonating beverages

Leakage tests

Helium is used as a medium for carrying out leakage tests on technical systems in numerous sectors of industry:

Leakage tests	
Automotive	Airbag detonators, shock absorbers, sensors
Semiconductor industry	Integrated circuits
Aviation	Hydraulic components, engines
Vacuum systems	Gas-carrying pipes
Plant engineering	Leakage testing of piping
General information	Packaging, drums, timers

Medical technology

Oxygen, carbon dioxide, nitrous oxide, helium and nitrogen are used in medical technology. Applications such as respiratory support and anaesthesia, as well as for calibrating medical devices. Medical gases are required to have a specific purity. Therefore, in Germany for example, the provisions from the Pharmaceuticals Act must be taken into account.

Basics

Overview of technical gases

Technical gases differ in terms of their physical, chemical and physiological properties and are classified as follows:

- Inert gas
- Combustible and self-igniting gases
- Oxidising gases
- Corrosive gases
- Toxic gases
- Testing and calibration gases

Certain technical gases are recovered from the atmosphere by means of air separation units. These include:

- Oxygen
- Argon
- Nitrogen
- Xenon
- Neon

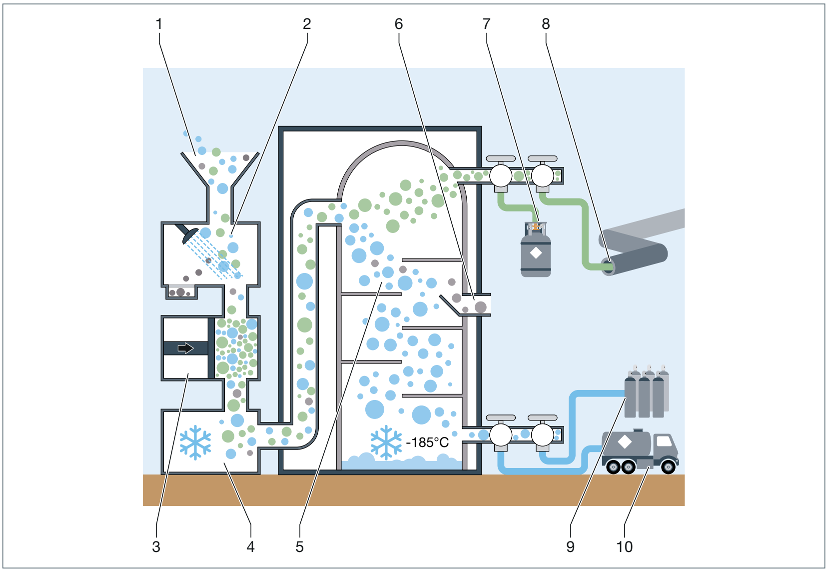


Fig. 138: Principle of an air separation unit

1	Intake of air
2	Pre-cleaning
3	Compression
4	Pre-cooling
5	Separation
6	Raw argon removal
7–10	Bottling

Other technical gases are obtained by different methods. Carbon dioxide, for example, is recovered from the waste air discharged by industrial operations. Hydrogen and acetylene are produced by chemical processes.

Examples of technical gases
Important properties, safety precautions, material compatibilities and relevant regulations for essential technical gases are listed below.

> An overview of suitable Viega piping systems can be found in „Media list“ on page 295 and on the Viega website *viega.com*.

Ethyne (C_2H_2), also called acetylene

Properties:	Colourless, mildly odorous, flammable, lighter than air
Application:	Extremely important to industrial processes. Used as a starting compound in the large-scale production of important base chemicals. Other applications: autogenous welding and cutting processes.
Safety:	Non-toxic, flammable gas. Forms explosive mixtures in the presence of air (ignition range: 1.5–83 volume percent). Under unfavourable circumstances without the involvement of oxygen, the high-energy acetylene molecule can decompose and release energy. This self-disintegration can be initiated by an acetylene cylinder in a hot environment, or is caused by a flashback into the cylinder. The start of disintegration is signalled by heat development inside the cylinder. Countermeasures: Clear the danger zone. Cool down the cylinder with copious amounts of water from a safe distance.
Pipe material:	Stainless steel Copper is forbidden as a pipe material for acetylene, since acetylene reacts with copper to form copper acetylide. In its dry state, this compound is extremely sensitive and can be caused to explode simply through friction. Fittings made of copper alloys must not contain more than 70% copper.
Regulations:	Code of Practice for Acetylene

Argon (Ar)

Properties:	Colourless, odourless, inert
Application:	Serves as an inert gas in metallurgy and for arc welding. Used in numerous different mixtures for welding technology, argon usually being the primary component and hence dominating the properties. Used as a food additive (E938) and as a protective gas in food packaging processes.
Safety:	A non-toxic, inert gas that forms practically no chemical compounds. Just like nitrogen, argon is capable of displacing the oxygen required for respiration. Because argon is heavier than air, it accumulates in case of leaks, particularly at ground level and in recesses. Check the O2 content! Prevent liquid argon from coming into direct contact with the skin. Wear protective gloves and safety goggles!
Pipe material	Copper and stainless steel For argon and noble gases such as helium, crypton, xenon, radon Steel For argon
Regulations:	UVV gases (BGV No. B6)

Oxygen (O_2)

Properties:	Colourless, odourless
Application:	Used to intensify combustion processes, e.g. in the steel industry and for autogenous welding and cutting operations. Also supports biological processes, including breaking down pollutants in purification plants. In its purest form, it is used as medical oxygen for respiration.
Safety:	A non-toxic gas and does not burn, it does however promote combustion. A slight increase in the oxygen content of air can significantly speed up combustion processes. In the presence of pure oxygen, even supposedly incombustible materials such as steel can burn. Under atmospheric conditions, the temperature of liquid oxygen is approx. -183°C. Liquid oxygen should therefore be prevented from coming into direct contact with the skin. Wear protective gloves and safety goggles!
Pipe material:	Copper, stainless steel and standard steel All parts coming into contact with oxygen must be free from oil, grease, glycerine or other carbon-containing lubricants due to the risk of explosion.

Regulations:	UVV Oxygen (BGV No. B7) UVV Welding and cutting (BGV No. D1) BG Information on handling oxygen (BGI No. 617) BG Information on the risks presented by oxygen (BGI No. 644)

Nitrogen (N_2)

Properties:	Colourless, odourless, inert
Application:	Used as an inert gas for the safe storage of combustible liquid and dusts, and also as a protective gas for annealing metals. In its cryogenic, liquefied state, acts as a refrigerant in the food sector and for industrial production processes, for example.
Safety:	Non-toxic, inert gas. When handling nitrogen, remember that it can thin or displace the atmospheric oxygen required for respiration. When evaporated, 1 litre of liquid nitrogen expands to form around 700 litres of nitrogen gas. As a result, evaporating liquid nitrogen can appreciably reduce the oxygen content of closed rooms. Eliminate this risk by aerating or exhausting. Prevent liquid nitrogen from coming into direct contact with the skin. Wear protective gloves and safety goggles!
Pipe material:	Copper, stainless steel and standard steel

Hydrogen (H_2)

Properties:	Colourless, odourless, combustible
Use	Used as a protective gas in the heat treatment of metals and for hydrating processes in the chemical industry. In the electronics industry and food technology sector, it is used as a process gas. In addition, hydrogen is used in drive technology.
Safety:	Forms explosive mixtures in the presence of air (ignition range 4-75 volume percent). Is much lighter than air and rises quickly in case of leaks. Therefore, the risk of explosion usually exists only for a short time if hydrogen is released (in contrast to liquid gas). Combusts with air in an almost colourless, practically invisible flame.
Pipe material:	Copper and stainless steel
Regulation:	BG Information on hydrogen (new BGI No. 612, old ZH 1-288)

Carbon dioxide (CO_2)

Properties:	Colourless, odourless, inert, readily soluble in water
Application:	Used as a protective gas for packing food and for carbonating beverages. Also used as an inert gas for covering and conveying explosive and combustible silo solids. Other applications include the preservation of fruit, vegetables and crops, as well as use as a fire extinguishing agent. It is used for cooling purposes in the form of dry ice.
Safety:	Very mildly toxic, almost inert gas. Carbon dioxide is capable of displacing the oxygen required for respiration. It is 1.5 times heavier than air. In case of major gas leaks, therefore, it can lead to dangerous concentrations at ground level, in recesses and in basements. Prevent dry ice (temperature of -78°C from coming into direct contact with the skin. Wear protective gloves and safety goggles!
Pipe material:	Piping must be executed in cold-resistant materials (e.g. stainless steel). To prevent chemical reactions with the pipe material, the carbon dioxide must be technically dry and moisture must be prevented from penetrating the piping system.
Regulation:	UVV Gases (new BGV No. B6, old VBG 61)

Corgon® (mixture of CO_2 and Ar)

Properties:	Colourless, odourless, inert
Application:	Used as a protective gas for MAG welding.
Safety:	Non-flammable. Can cause suffocation in high concentrations. Heavier than air. In case of major gas leaks, therefore, it can lead to dangerous concentrations at ground level, in recesses and in basements.
Pipe material:	Copper, stainless steel and standard steel

Medical gases
(e.g. oxygen, carbon dioxide, nitrous oxide, helium, nitrogen)

Properties:	In Germany, for example, governed by the German Pharmaceuticals Act and therefore have to meet high quality standards. Consequently, only extremely pure technical gases can be used for medical purposes.
Application:	Used for respiratory support and anaesthesia, as well as for calibrating medical devices.
Safety	Used as pharmaceutical or medical products and are therefore in direct contact with living bodies.
Pipe material:	The technical regulation DIN EN ISO 7396 specifies the use of corrosion-resistant materials for medical gases. Currently, the hard soldering and welding processes are carried out under protective gas.
Regulation:	DIN EN ISO 7396 Must have a specific degree of purity. Therefore, in Germany for example, the requirements specified by the Pharmaceuticals Act must be taken into account.

Purity classes of technical gases

The purity of a substance is defined as the amount of the substance itself compared to the total amount of the mixture. Chemical substances are assigned purities of "raw" all the way through to "for analysis". In the case of technical gases, on the other hand, the so-called point notation has become the established standard. The substance amounts are expressed in volume percent. A substance without any impurities at all has a purity of 1 or 100%.

- The digit before the point indicates the number of "nines" in the value for the percentage of the pure gas.
- The digit after the point indicates the first decimal point to deviate from the digit "nine".

Point notation	Percentage of substance amount
2.0	99%
2.5	99.5%
3.0	99.9%
5.0	99.999%
5.7	99.9997%
6.0	99.9999%

Tab. 53: Examples of purity classes

A distinction can be drawn between the following gas purities

Gas types	Gas quality	Purity [%]	Residual grease content [mg/dm^2]	Leakage rate [mbar·l/s]
Technical gases	< 4.5	99,995	0.2–0.4	≤ 10^{-4}
Pure gas	4.5 – 5.0	99.995 – 99.999	≤ 0.2	≤ 10^{-5}
High-purity gas	> 5.0 – 6.0	99.999 – 99.9999	≤ 0.1	≤ 10^{-8}
Ultra-pure gas	> 6.0	> 99.9999	< 0.1	≤ 10^{-9}

Tab. 54: Overview of gas types and degrees of purity

Technical gases contain residual impurities, such as moisture, hydrocarbons and other gases. These are specified by the manufacturers in a non-uniform manner and can be as follows:

Argon 5.0 (99.999%)	
O_2	≤ 2 ppm
N_2	≤ 4 ppm
C_nH_m	≤ 0.3 ppm
H_2O	≤ 3 ppm

Tab. 55: Example of the residual constituents of Argon 5.0

Gas purities for various areas of application

Technical gases must have a purity class appropriate for the application. Tab. 56 shows examples of purity classes depending on the application.

Use	Gas	Purity level	Standard
MIG welding gas	Argon	4.8	ISO 14175 Group I1
Laser welding	Helium	4.6	ISO 14175 Group I2
Metalworking	Carbon dioxide	4.5	ISO 14175 Group C1
Gas chromatography, measuring technology	Nitrogen	5.0	ISO 14175 Group N1
Dry ice (food quality E290)	Carbon dioxide	3.0	EU Ordinance 231/2012

Tab. 56: Typical purities of technical gases

The purity requirements of EU Ordinance No. 231/2012 must be fulfilled when using technical gases in the food industry. In practice, the purity requirements are often exceeded.

Legal and normative principles

Piping for technical gases must be laid in compliance with the relevant regulations. These include Code of Practice for Acetylene, AD 2000, TRBS, DVS Data Sheet.
In Germany, the safety regulations of the government and the Employer's Liability Insurance Association must be observed for the handling of gases. The Ordinance on Hazardous Substances (GefStoffV) defines most gases as hazardous substances. This ordinance states that employees have to be protected against the possible damaging effects of hazardous substances. It stipulates, among other things, that substance-specific operating instructions have to be drawn up for the handling of hazardous substances.

When handling technical gases, the following important regulations valid on the publication date of this document must be observed:

- Product Safety Act (ProdSG)
- Industrial Safety Regulations (BetrSichV)
- 14th Ordinance Equipment and Product Safety Act (Pressure Equipment Directive – 14th GPSGV)
- German Social Accident Insurance (DGUV) Rule 113-001 Explosion Protection Regulations (EX-RL)
- Technical Rule for Hazardous Substances 510 (TRGS) "Storage of hazardous substances in non-stationary tanks"

Piping inspections

The Industrial Safety Regulations (BetrSichV) apply for the use of materials and aim to guarantee the health and safety of employees.
Their area of application includes pressure systems and hence pipeline installations for ignitable or toxic gases.
The regulations specify tests prior to commissioning and before every restart after modifications subject to mandatory inspections. Periodic inspections for ensuring reliable operation must be performed in due time.
Approved inspection bodies, such as TÜV, DEKRA or Lloyd's Register Deutschland GmbH are listed in the Product Safety Act, Section 37 (5).

Emergency shut-off

When "piping" pressure equipment is produced, Pressure Equipment Directive 2014/68/EU is the basis for the classification, hazard analysis, inspection and declaration of conformity. According to this directive, it must be possible to block off piping for combustible, oxidising or toxic gases that lead into closed buildings from a safe location.

Piping systems

General notes

A distinction is drawn between the decentralized and central gas supplies used to supply consumers with technical gases. A direct supply of gas to consumers is called a decentralised gas supply. With a central gas supply, the consumers of an operation are supplied from one central gas storage tank via a pipeline network.
Single cylinders, banks of cylinders, drums, banks of drums and tank systems can be used as storage facilities.

The advantages of a central gas supply are:

- Space saving
- Reduced accident risk
- Lower transport costs
- No interruption to operations
- Uniform drainage of the cylinders/tanks
- Easier monitoring of the inventory
- Smaller cylinder pool

The physical and chemical properties, as well as the physiological effects of the gas, have to be taken into consideration to ensure the correct choice of piping system. All these characteristics have a bearing on material selection, type of connection and flushing process.
An overview of suitable Viega piping systems can be found in „Media list“ on page 295 and on the Viega website *viega.com*.

Piping calculations

The calculation of pipe diameters must include the system's economic viability. The system costs are derived from the total of the investment and operating costs. Small nominal pipe diameters lead to low investment costs, but to higher operating costs as well due to the greater pressure losses. Using the recommended flow velocities to calculate the nominal pipe diameters achieves efficient pipe dimensions and optimises the overall costs. The dimension of piping for technical and medical gases is calculated based on a pressure loss within the piping of $0.1*p_B$ (operating pressure).

The formula for calculating the clear pipe dimension d [m] of a gas supply line is as follows:

$$d = \sqrt{\frac{Q * 4}{\pi * v}}$$

Q = flow rate [m^3/s], v = flow velocity [m/s]

Material selection

Piping for the technical gases mentioned here must be made of metallic materials.

Copper or stainless steel pipes are normally used for lower purity gases. Copper with a residual grease content of ≤ 0.2 mg/dm^2 can be used for gases with a quality of up to 5.0.
Gases with a quality higher than 5.0 require copper or stainless steel piping systems with a residual grease content of ≤ 0.1 mg/dm^2.
Piping systems with gas purities of 6.0 and higher, such as those used in the microelectronics sector for example, usually consist of stainless steel and are often welded.

The material selection may be limited due to the properties of the gases. Copper must not be used for acetylene, for example (see also „Examples of technical gases“ on page 201).

Use sealing materials to suit the type of gas. This applies also to solvents carried along in the gas such as acetone (Propanon-2) and/or dimethylformamide (DMF) in acetylene lines or NO_X additives for welding protective gases.

Pipe connection technologies

Besides welding and other connection technologies, press connectors have proven to be the best solution for connecting pipes.
The advantages of press connecting technology include:
- Huge time savings
- Less manpower
- Better safety – no fire risk (no fire precautions and no fire watch)
- Reduced assembly costs (shorter hire periods for working platforms, etc.)
- No X-ray costs
- Minimal system shutdowns

Pipe mount material

- In principle, non-ablative pipe mount material should be used to avert a fire risk
- To prevent contact corrosion, piping from austenitic stainless steel or copper must not be allowed to come into contact with ferritic mount materials
- Use pipe clamps with insulation/inlay
- Series and conduit clamps in conjunction with C-profile rails are considered the standard solution for installing pipes in gas systems

Pipeline installation

Ensure good accessibility when installing exposed pipes. With parallel routings and intersections, the pipe spacing must allow repair and maintenance work without endangering the pipelines. Protect the piping systems against vibrations and displacement. Gas-carrying pipes must be laid above water-carrying pipes. Pipes for lighter gases should be laid above those for heavier gases.

Observe the following instructions (extract from VDMA 4390-2):

- Lay pressurised gas lines horizontal or vertical wherever possible
- Lay pipe routes supported wherever possible
- Do not lay the piping through the components of other systems (e.g. ventilation ducts)
- Do not fix piping in concrete or masonry
- Bridge separation points to buildings (e.g. expansion joints) with expansion bends in the piping
- Pipe routes that are exposed to severe temperature fluctuations between day/night or summer/winter must be fitted with expansion bends.
- Exhaust pipes must not contain shut-off valves or loops as condensate can collect in them.
- If piping is laid parallel to low-voltage electrical lines of up to 1000 V alternating voltage, work with a minimum distance of 50 mm. Convergence to less than 50 mm is permissible at intersections. However, the two systems must never be allowed to come into contact.

Piping with press connectors for technical gases should always be laid by trained personnel from a specialist company. Viega offers the relevant training, see *viega.de/de/service/Seminare.html*
Mark the pipes in accordance with DIN 2403 for the gas being transported.

Fig. 139: Acetylene with hazard symbol

Viega solutions

When selecting materials for fittings, pipes and sealing elements, the special operating and installation conditions, as well as other system requirements, must be considered on a case-by-case basis.

Send your detailed enquiries to the Viega Service Center using the "Enquiry for material durability" form. You can find the form for this on the Viega website *viega.com* by entering "material durability" as the search term.

Taking into account the required purity class, Viega piping systems are a good choice for technical gases.
The following systems can be used:

- Profipress, Profipress G
- Sanpress Inox, Sanpress Inox G
- Megapress, Megapress G

Tab. 57 provides an overview of the possible uses for Viega piping systems and shows the existing sealing element (Page 70).

	Profipress, Sanpress Inox	**Profipress G, Sanpress Inox G**	**Megapress**	**Megapress G**
		Sealing element		
	EPDM	**HNBR**	**EPDM**	**HNBR**
Compressed air	✓	✓	✓	✓
Carbon dioxide dry	✓	✓	✗	✗
Nitrogen	✓	✓	✓	✓
Argon	✓	✓	✗	✓
Corgon® protective gas	✓	✓	✗	✓
Vacuum	✓	✓	✓	✓
Oxygen	✓	✗	✓	✗

Tab. 57: Viega piping systems for technical gases

Viega piping systems are suitable for the following gas purities, for example:

- N_2 4.8
- O_2 2.8
- Ar 4.0

Agree the suitability for higher gas purities and other gas types with the Viega Service Center.

Thanks to the good compressibility of the connectors, Viega piping systems have a high degree of leak tightness with leakage rates $< 10^{-5}$ mbar l/s.

Fuel gases

Fuel gases are combustible gases that are used primarily as fuel. The most common fuel gas today is natural gas.

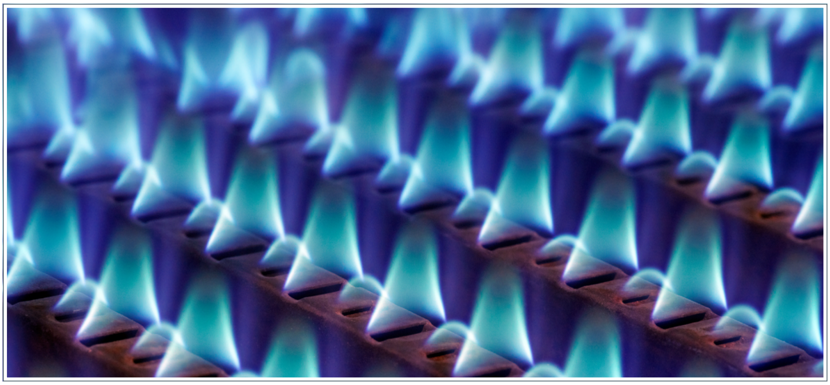


Fig. 140: Fuel gas

When fuel gases are liquefied by cooling or compression, they are referred to as liquid gases. In liquid form, they are very easy to transport and store in large quantities because their volume is less. At the moment of consumption, they are transformed back into the gaseous phase.

Fig. 141: Example of a liquid gas cylinder

Gas families

Different fuel gases with similar combustive and physical properties are grouped together in one gas family. This classification system is used primarily in domestic gas installations and is described in DVGW Worksheet G 260.

Gas family	Fuel gases	Comment
1	Town gases (coal gases)	These gases are produced in large quantities through the gasification of coal. They often contain large quantities of toxic carbon monoxide (CO). Town gases have declined in significance and have not been fed into public grids since around 1950.
2	Natural gases and oil gases	These gases are fossil fuels from natural deposits that evolved in the geological past from decomposition products of dead vegetation and animals.
	Natural gas	This regenerative fuel is obtained from biological materials, e.g. as manure gas, landfill gas or sewage gas.
3	Liquid gases	These gases, also referred to as refinery gases because of their origin, contain primarily propane and butane (sub-groups P and B).
4	Air/ liquid gas mixtures	This gas, also called aerogenic gas, is a mixture of the vapour from benzine and air. In former times, before the advent of electrical lighting, it was used to light gas lanterns.
5	Hydrogen	Considered to be a low-emission fuel and a propellant and most often obtained by synthesis.
		Group A[1] hydrogen content ≥ 98%
		Group B[1,2] hydrogen content ≥ 99.97%

1) See ISO 14687
2) See DIN EN 17124

Tab. 58: Gas families in acc. with DVGW worksheet G 260

Regulations

Domestic technology and comparable installations for gas families 1, 2 and 4 up to an operating pressure of 0.1 MPa (1.0 bar) are covered by the "Technical Rule for Gas Installation TRGI 2018" (DVGW Worksheet G 600). Their scope of application starts behind the main shut-off device and ends at the point where the waste gas enters the atmosphere.
Commercial applications are regulated in DVGW Worksheet G 631 "Installation of industrial gas applications in systems for bakeries and confectioners, butchers, restaurants and catering establishments, smokehouses, ageing and drying facilities, as well as laundry services".
Industrial applications are covered by DVGW Worksheet G 614 "Exposed gas supply lines on factory premises behind the transfer point".
Installations in gas family 3 in accordance with DIN 51622 are regulated by the "Technical Rules for Liquid Gas (DVFG-TRF 2021)".

Pressure Equipment Directive 2014/68/EU must be observed for other fuel gas applications at a maximum permissible pressure exceeding 0.05 MPa (0.5 bar).

Specificities

For the technical use of fuel gases, other properties in addition to the calorific value are also important and have to be considered. These include the dew point, the flash point and the explosion limits.
Because fuel gases can usually form explosive mixtures in the presence of air, see Fig. 144 on page 219, the safety aspect of handling fuel gases is extremely important.

Higher thermal resistance (HTR)

The correct choice of material for piping systems is especially important due to the risk to the installation from fire or explosion. One criterion is the higher thermal resistance of the system used.
The criterion for higher thermal resistance (HTR) is based on the ignition temperature of natural gas in air (approx. 640°C). To prevent the formation of an explosive mixture, in case of fire, no dangerous quantity of gas must escape at any point in the building that is below the ignition temperature.
For gas installations in the domestic sector, only components labelled as "higher thermal resistance (HTR)" may be used. Components that are not HTR-resistant must be separately secured by a thermal shut-off system (TSS). According to DIN 3537-1, the HTB criteria are fulfilled if products resist a fire and remain functional for at least 30 minutes at an operating temperature of 0.1 MPa (1 bar) and an ambient temperature of 650°C. Leak tightness even at extreme ambient temperatures prevents the spread of fire due to gas escaping unchecked and buys time for closing the shut-off systems.
Products that meet the criteria in accordance with DIN 3537-1 at a required max. operating pressure of 0.1 MPa (1.0 bar) are provided with the "GT 1" marking.
Products that achieve the increased thermal capacity even at a higher maximum operating pressure are marked accordingly, e.g. with "GT 5" for the maximum operating pressure of 0.5 MPa (5.0 bar).

Natural gas

Basics

Natural gas is a fossil energy carrier that occurs naturally in underground deposits, see Fig. 142. It occurs most frequently with crude oil and coal because it evolved through similar processes.

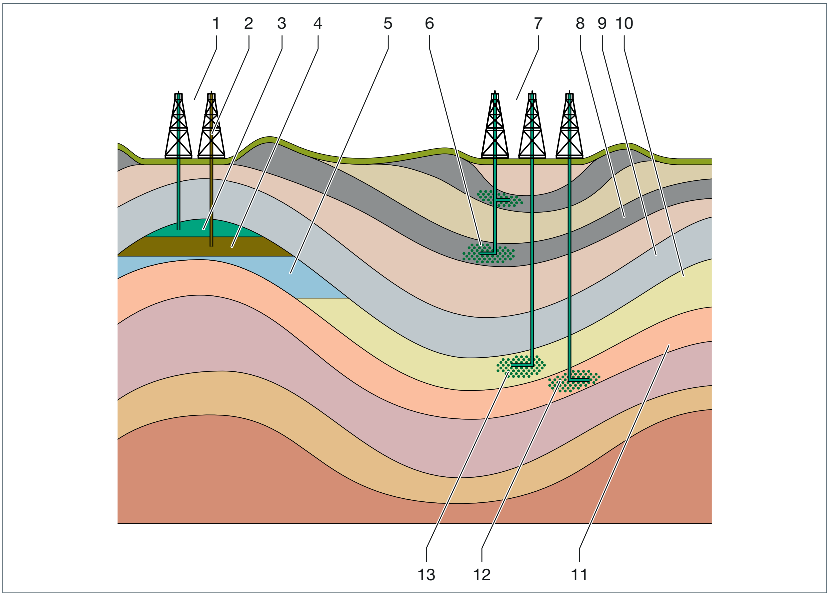


Fig. 142: Natural occurrence of natural gas

1 Conventional deposits
2 Oil source
3 Natural gas
4 Crude oil
5 Reservoir water
6 Coal gas deposit
7 Unconventional deposits
8 Hard coal
9 Impervious rock strata
10 Dense sandstone
11 Oil shale
12 Shale gas deposit
13 Gas deposit

Its main constituent is the highly combustible methane (CH_4), the simplest constituent hydrocarbon. Crude gas, which is obtained directly from its source, also contains ethane, propane, butane and pentane in various concentrations. Depending on the deposit, however, the composition can vary greatly. Therefore, natural gas has to be treated in refineries before being used for technical purposes. During this process, unwanted constituents are removed and the methane is enriched to the required concentration.

The additional constituents also lead to the expression "wet natural gas", which has two different meanings. First, it refers to raw gas with a higher content of ethane, propane, butane and pentane, which can be liquefied under slightly increased pressure and therefore also carry the English name of natural gas liquids (NGL), see Fig. 143. The other meaning is that of raw gas with a relatively high water vapour content.
"Dry natural gas", on the other hand, has a very low content of readily condensable gases.

DIN EN 16723 lays down the requirements for feeding natural gas into the natural gas network and for its use in transport.

For transport applications, natural gas is either compressed under high pressure (compressed natural gas (CNG)) of liquefied by cooling to reduce the transport volume (liquefied natural gas (LNG)), see Fig. 143.

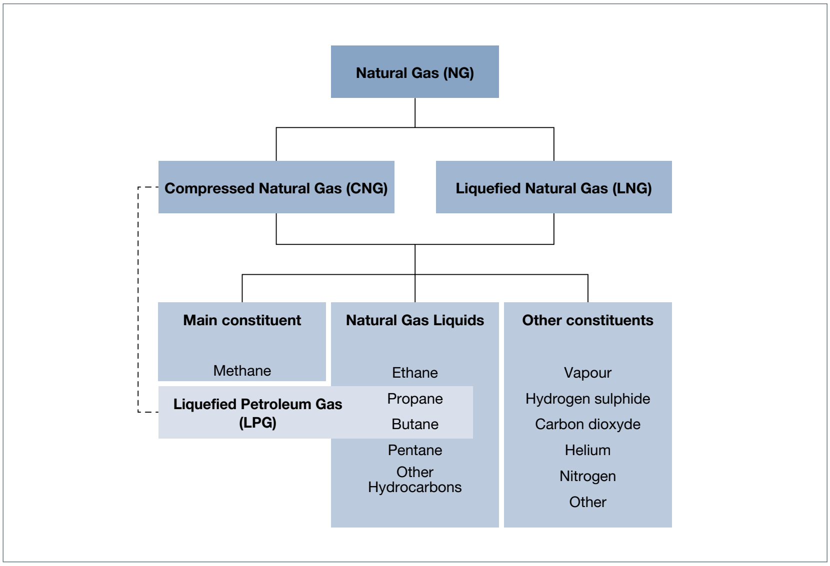


Fig. 143: Terms and abbreviations

Due to its high energy content, natural gas is used primarily for heating buildings and in thermal processes in trade and industry. It is also widely used in power generation and in the drive technology for motor vehicles and ships. It is also an important chemical raw material, e.g. for the fertiliser industry, steel production and for manufacturing hydrogen gas.

Properties

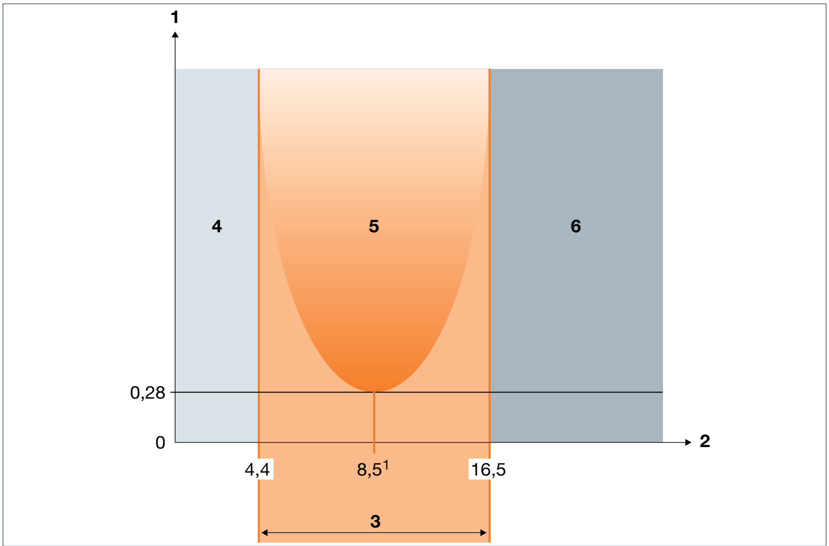
The methane in natural gas is colourless and odourless under atmospheric conditions. It is lighter than air and forms explosive mixtures in its presence, see Fig. 144. It burns with a bright bluish flame. It is barely soluble in water, but does dissolve in ethanol and diethyl ether.

Biological hazard

Although natural gas is non-toxic, it does have a narcotic effect because it displaces the oxygen in inhaled air and starves the brain of oxygen. Further down the line, it can lead to unconsciousness and, at higher concentrations, even respiratory arrest. For this reason, an odorant is added to the colourless and almost odourless gas so that a gas leak is perceptible at early stage.

Risk of fire and explosion

Natural gas is combustible and, in the presence of air, forms explosive mixtures (ignition range approx. 4.4-16.5 volume percent) which can be made to explode by even a small spark. The indicated ignition range and also the ignition temperature of approx. 640°C may vary depending on the composition of the gas. These values can be found in the safety data sheets issued by the manufacturer.



[1)] Technical Rules for Hazardous Substances TRGS 727 – Annex G

Fig. 144: Explosion limits of methane at 20°C

1 Ignition energy [mJ]
2 Volume percent of methane [CH_4]
3 Explosive range
4 Too lean
5 Ignitable mixture CH_4/air
6 Too rich

Biogas
Biogas is a combustible gas that is produced during the microbial degradation of organic substances. The syllable "bio" refers to the biological origin in which, in contrast to fossil natural gas, living organisms are involved. The most important element of biogas from a technical perspective is methane, and this is covered in section „Natural gas“ on page 217.

Acetylene (ethine)

Properties
Acetylene (ethine) is a chemical compound consisting of carbon (C) and hydrogen (H) and carries the chemical formula C_2H_2. Under atmospheric conditions, pure acetylene is a colourless and odourless gas. In its less pure, commercial form, it has an odour typical of garlic.

It is slightly lighter than air and combusts in the presence of air with a very hot, illuminating and sooty flame. At atmospheric pressure, the explosive range of the acetylene-air mixture is between 2.3% and 82% acetylene.
In addition, acetylene very readily decomposes spontaneously into carbon and hydrogen. This can occur at even low to medium pressure in two ways. Degradation under so-called deflagration[1] occurs at a relatively low reaction speed, whereas under detonation, it can occur at supersonic speed.

Regulations
The hazard potential of acetylene means it must be handled with special caution. With IGC Document 123/13/D[2], the "European Industrial Gases Association" (EIGA) has published the "Acetylene Code of Practice – Best Practice Guide for the safe handling of acetylenes" as a guide to the safety requirements to be met during the production, bottling and handling of acetylene.
The document also sets out the requirements for piping used to distribute acetylene. One such regulation addresses the deflagration and/or detonation of acetylene. Various operating ranges have been defined for the combination of absolute pressure $\boldsymbol{p}_{abs}$ and inside pipe diameter $\boldsymbol{d}_i$, see Fig. 145:

- **Operating range I**
  Below the limit pressure for a deflagration (Line A), the risk of acetylene decomposing is low.

[1] Explosion that occurs at subsonic speed
[2] The fixed reference number of the document is "123", with "13" denoting the current version (at the time of this document being printed). The letter "D" stands for the German translation. The English original is available as "123/13/E".

- **Operating range II**
  On Line A and below the limit pressure for a detonation (Line B), acetylene can decompose by deflagrating when combusted.
- **Operating range III**
  On and above Line B, acetylene decomposition starts as deflagration on combustion and can develop into detonation in sufficiently long pipes.

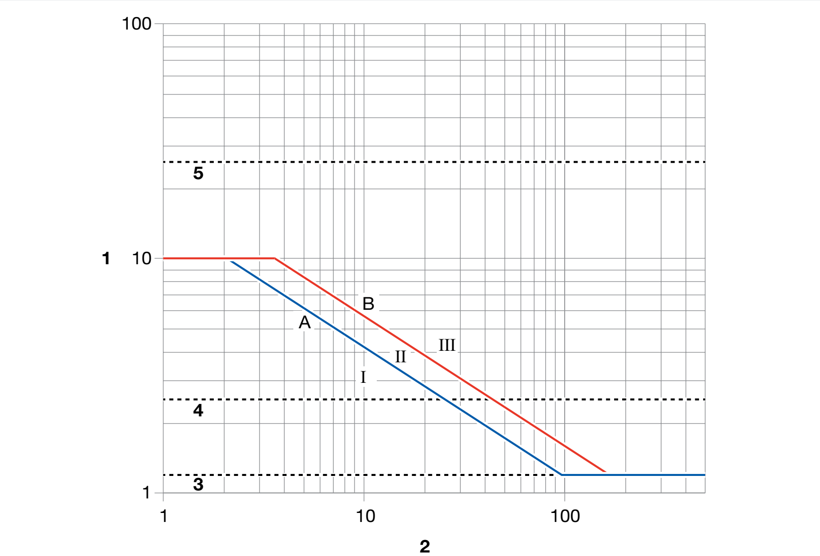


Fig. 145: Operating ranges according to the hazard in case of acetylene decomposition (Source: EIGA IGC Document 123/13/D)

1 Pressure [bar_{abs}]
2 Pipe dimension [mm]
3 Low pressure (< 0.2 bar_{abs})
4 Mid-range pressure (< 2.5 bar_{abs})
5 High pressure (< 26 bar_{abs})

Material selection

Copper piping

CAUTION!
Danger of explosion
Acetylene reacts with copper to form acetylides – compounds which are highly sensitive to energy input through shocks and friction and which can react by exploding.
- Shocks and friction must be avoided.

Copper is a prohibited material for the construction and maintenance of acetylene installations. Certain copper alloys with a copper content of less than 70%, however, are allowed to be used with restrictions for certain applications.

Stainless steel piping
Stainless steels need to be able to withstand the loads generated at maximum operating pressure, but also the thermal and mechanical loads occurring when acetylene decomposes within operating ranges II and II, see Fig. 145.
The corrosion that can potentially be caused by chloride – especially in the case of austenitic stainless steels – and which is usually more severe when calcium chloride drying is used as a drying agent, must also be taken into account.

Materials for seals
The materials used for packaging, seals and membranes must be resistant to acetone and dimethylformamide (DMF), commonly used as solvents. If this condition is satisfied, any type of packaging or seal may be used.

Liquid gases

Basics
Liquid gas refers to the C3 and C4 hydrocarbons propane, propylene (propene), butane, butylene (butene) and the mixtures thereof, which are specified in DIN 51622. These gases are obtained during the production of raw oil and natural gas, and also during the processing of raw oil. In Germany, they are used primarily for heating purposes. Liquid gas can be stored under low pressure at room temperature and is transformed to the gaseous phase for use in liquid gas systems.

Safety
Since gases take up only a fraction of their normal volume when in the liquid state, considerable amounts of energy are stored in liquid gas tanks. Because liquid gas is heavier than air, leaks can lead to dangerous concentrations at ground level, in recesses and in basements.

Biological hazard
Although liquid gas is non-toxic, it does have a narcotic effect because it displaces the oxygen in inhaled air and starves the brain of oxygen. Further down the line, it can lead to unconsciousness and, at higher concentrations, even respiratory arrest. For this reason, an odorant is added to the colourless and almost odourless gas so that a gas leak is perceptible at early stage.

Risk of fire and explosion
Liquid gas is combustible and, in the presence of air, forms explosive mixtures (ignition range approx. 1.7–9.5 volume percent) which can be made to explode by even a small spark. The indicated ignition range and also the spontaneous ignition temperature of over 365°C may vary depending on the composition of the gas. These values can be found in the safety data sheets issued by the manufacturer.

Liquid gas systems

Regulations

The planning, installation and testing of liquid gas systems are governed by the "Technische Regeln Flüssiggas 2021" (Technical Rules for Liquid Gas 2021), published by Deutscher Verband Flüssiggas e.V. (DVFG-TRF 2021).

In addition to DVFG-TRF 2021, compliance is required with the following:

- Landesbauordnung (State building regulations)
- Feuerungsverordnung (Ordinance on firing installations)
- Rules of the Employer's Liability Insurance Associations

Components

A liquid gas system consists of a supply system and a consumption system. A supply system includes:

- Liquid gas cylinders or liquid gas tanks – for storage
- Regulating equipment – pressure/volume flow control for transport and usage
- Piping

Liquid gas cylinders

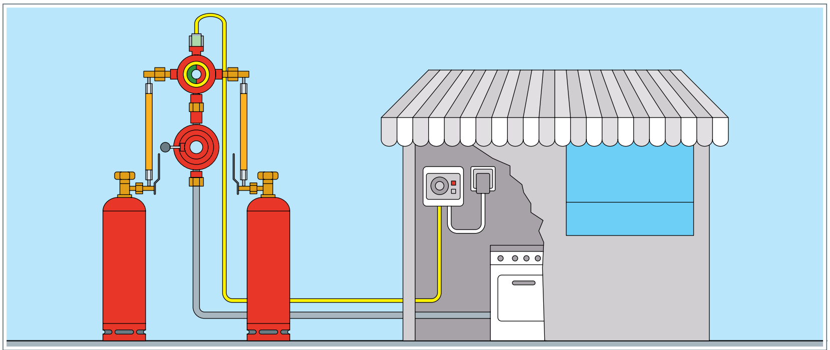


Fig. 146: Liquid gas cylinders

Fig. 147: Secured liquid gas cylinders

Secure liquid gas cylinders to prevent tipping over and damage.

A liquid gas cylinder is a pressure vessel that is not filled in situ. Consumers with a small liquid gas requirement, such as individual apartments, single-family homes or industrial applications supply their building or workplace by replacing liquid gas cylinders, see Fig. 146. These cylinders have to be stored in a secure manner to prevent damage by tipping over or other external influences, see Fig. 147.

Liquid gas tanks

Liquid gas tanks are permanently installed, cylindrical steel vessels that are filled from tankers. The tank dimensioning depends on consumption. A gas reserve sufficient for at least six months is recommended.

Fig. 148: Liquid gas tanks

The piping is connected to the tank at the top; underground tanks are accessible through a cylindrical top – the manhole. Geopress K or Geopress G adapters in combination with the Profipress G press connector system ensure a fast and reliable connection to the tank. The Geopress K or Geopress G adapters connect the underground PE pipe to copper pipe, allowing the tank to be continuously connected via press connecting technology.

Liquid gas tanks are mainly erected outdoors because the safety requirements and hence the costs are lower than those for indoor installations. The following installation variants are possible:

- **Overground**
  The tank is fastened to a concrete base plate.
- **Half-overground**
  The tank is below ground up to the centreline.
- **Underground**
  The tank is embedded in sand on all sides and covered with at least 50 cm of earth. The manhole is accessible only through a cover embedded in the ground.

It is important that the installation site has road access for the tanker to allow direct connection of the hose (25 m).

The expression "island supply" is used when several buildings are supplied centrally from one tank. This is done by laying a ring system around the area to be supplied and hooking up each building to a connection line. The Geopress G tapping valve is the ideal solution for producing the connection line.

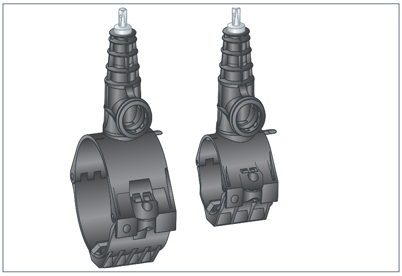


Fig. 149: Viega Geopress G tapping valve

Liquid gases as refrigerants

Liquid gases are naturally occurring refrigerants. They play a key role in refrigeration plants where they are used for heat transmission and for cooling at the same time. Their use for this purpose is nothing new. In the 1990s, they were the standard solution for domestic refrigerators until such time as they were replaced by non-combustible chlorofluorocarbons (CFC). However, once the harmful effects of CFCs on the environment and ozone layer had become increasingly apparent, they were largely replaced over the course of time with liquid gases, which also contribute less to the overall greenhouse effect than other possible substitutes (e.g. fluorinated hydrocarbons).

Refrigerant	Identifier
Ethane	R-170
Propene (propylene)	R-1270
Propane	R-290
n-Butane	R-600
2-Methylpropane (isobutane)	R-600a

Tab. 59: Examples of liquid gases as coolants

Viega solutions

> When selecting materials for fittings, pipes and sealing elements, the special operating and installation conditions, as well as other system requirements, must be considered on a case-by-case basis.
>
> Send your detailed enquiries to the Viega Service Center using the "Enquiry for material durability" form. You can find the form for this on the Viega website *viega.com* by entering "material durability" as the search term.

For fuel gases and liquid gases in the gaseous phase, Viega uses press connector systems with special sealing elements:

Parameter	**HNBR**	**NBR**
Operating temperature[1]	-20 °C – +70°C	-20 °C – +40°C
Max. operating pressure[1]	0.5 MPa (5 bar)	1.0 MPa (10 bar)
Press connector system	Profipress G[2] Sanpress Inox G[3] Megapress G[3]	Geopress G[4] [5] Geopress K
Max. operating pressure[1] **HTB**		Not applicable
GT 1[2] Press connector system	0.1 MPa (1 bar) Profipress G	
GT 5[3] Press connector system	0.5 MPa (5 bar) Sanpress Inox G Megapress G	

1) The maximum operating pressure and the maximum operating temperature depend on the type of pipe used and the specific application.
2) GT 1 in accordance with DIN 3537-1
3) GT 5 in accordance with DIN 3537-1
4) Use of the support sleeve made of gunmetal/silicon bronze (model 9605) required.
5) NBR for the transition from copper pipes to metal pipes.

Tab. 60: Viega press connector systems with sealing elements for fuel gases and liquid gases – Technical data

Press connector systems for metal piping

The Profipress G, Sanpress Inox G and Megapress G press connector systems indicated in Tab. 60 are suitable as inseparable pipe connections for metal gas supply lines (carrying gases in accordance with DVGW Worksheet G 260) and certified in accordance with DVGW Worksheet G 5614 or G 5614-B1.

Use is possible in the gas installations described below:

- Gas installations
  - Low pressure range ≤ 100 hPa (100 mbar)
  - Medium pressure range from 100 hPa (100 mbar) up to 0.1 MPa (1 bar)
  - Industrial, commercial and technical processing systems with the corresponding directives and technical regulations up to 0.5 MPa (5 bar)

- Liquid gas installations
  - With liquid gas tank in medium pressure range downstream of the pressure regulating valve, 1st level on the liquid gas tank > 100 hPa (100 mbar) up to a permitted operating pressure of 0.5 MPa (5 bar)
  - With liquid gas tank in the low pressure range ≤ 100 hPa (100 mbar) behind the pressure regulating valve, 2nd level
  - With liquid gas pressure container (liquid gas cylinders) < 16 kg downstream of the small cylinder pressure regulating valve
  - With liquid gas tank (liquid gas cylinder) ≥ 16 kg downstream of the large cylinder pressure regulating device

The press connector systems mentioned are suitable for the media listed below:
- Natural gases
- Liquid gases, only in the gaseous state for domestic and commercial applications

Press connector systems for underground PE-HD and PE-X pipes
The Geopress G and Geopress K press connector systems indicated in Tab. 60 are suitable for underground PE-HD and PE-X pipes in accordance with the regulations in Tab. 61.

Scope / Notice	Regulations applicable in Germany
Permitted use with piping materials in gas installations (PE-HD)	DIN 8074/75
Permitted types of pipes (PE) – gas supply	DVGW worksheet GW 335-A2
Types of PE pipes – gas supply	DIN EN 1555
Permitted types of pipes (PE-X) – gas supply	DIN 16893
Types of pipe (PE-X) – gas supply	DVGW worksheet GW 335-A3

Tab. 61: Suitability for underground PE pipes of press connector systems

Specifically, only the plastic pipes listed in Tab. 62 may be used for Geopress G and Geopress K. The code **SDR**[1] is the ratio between external diameter d_a and wall thickness s of a pipe SDR = $\frac{d_a}{s}$ and MOP[2] is the maximum operating pressure.

Type of pipe	Pipe series SDR	MOP
PE 80	17.0[1) 2)]	0.1 MPa (1 bar)
PE 80	11.0	0.4 MPa (4 bar)
PE 100	17.0[1) 2)]	0.5 MPa (5 bar)
PE 100	11.0	1.0 MPa (10 bar)
PE-X	11.0	0.8 MPa (8 bar)

1) Only Geopress G
2) PE 80 and PE 100 piping of pipe series SDR 17 must only be used for a nominal width of ≥ 75 mm or greater.

Tab. 62: SDR and MOP of the plastic pipes permitted for Geopress G and Geopress K

Press connector systems for acetylene
With its Sanpress Inox and Sanpress Inox stainless steel press connector systems, Viega provides PWIS-free solutions for low and medium pressures in **Operating range** I, see Fig. 145, with the parameters indicated in Tab. 63.

Acetylene	
Sanpress Inox Sanpress Inox LF	Press connector in combination with 1.4521 pipe
Dimension d	15 mm, 18 mm, 22 mm, 28 mm
Min. operating temperature T_{min} [°C]	-20
Max. operating temperature T_{max} [°C]	60
Max. Operating temperature p_{max} [MPa]	0.15
Test pressure p_{test} [MPa]	2.4

Tab. 63: Parameters for press connector systems for acetylene

[1] SDR: Standard Dimension Ratio
[2] MOP: Maximum Operating Pressure

Press connector systems for hydrogen

The properties of hydrogen are described in the corresponding section of the "Technical gases" chapter. For hydrogen, Viega provides the press connector systems listed in Tab. 64 with the parameters indicated.

Hydrogen	Profipress Profipress G	Sanpress Inox Sanpress Inox G	Megapress [1)] Megapress G[1)]
Material	Copper	Stainless steel	Steel
Dimensions	12 - 108 mm		⅜ - 2 inch
Max. operating temperature T_{max} [°C]	60		
Max. Operating temperature p_{max} [MPa]	0,5		

1) Following consultation with the Viega Service Center

Tab. 64: Parameters for press connector systems for hydrogen

Leak detection as part of the leakage test

For leak detection in gas supply lines, Viega recommends the specially developed Viega leak detection spray, see Fig. 150, which has no negative reaction with the materials of either pipe or connector. Thanks to the press connector's SC-Contur, the Viega leak detection spray shows up inadvertently unpressed connectors immediately during a dry leakage test. The formation of bubbles makes leaks apparent immediately, see Fig. 151.

Fig. 150: Viega leak detection pray

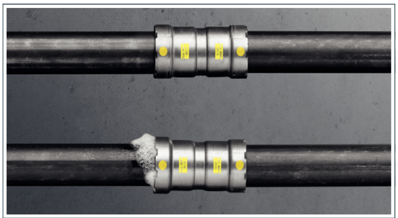


Fig. 151: Megapress G with bubble formation when the test medium escapes

The escaping test medium causes bubbles to visibly form on the SC-Contur of the unpressed press connection.

Low pressure steam

Vapour is the term used to describe water in the gaseous state. It is used for a broad range of industrial applications, primarily in the form of heating processes and for generating power in steam turbine processes.

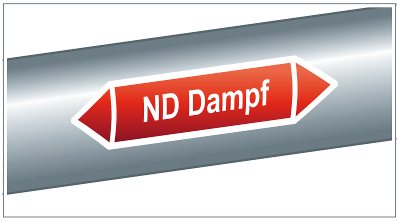


Fig. 152: Steam line with DIN 2403 marking

Vapour is used for a broad range of processes in industry, e.g. for

- Heating
- Powering turbines for power generation
- Transporting products
- Atomising
- Cleaning
- Moistening air or products

The most frequently occurring processes include

- Steam heating
- Steam cleaning
- Product moistening
- Air moistening

Steam heating

Steam systems use the physical properties of the two-phase system water/vapour. The large amount of heat provided for water evaporation (evaporation enthalpy) is released during condensation in heat exchangers and thus allows large amounts of heat to be transported.

As such, the advantages of a steam system compared to a hot water heating system essentially lie in the fact that they operate at a higher energy level. In practice this means

- Higher temperatures
- Higher thermal performance
- Greater heat transmission in heat exchangers

These properties are used in particular for systems involving high heat transformation, e.g. district heat supply systems (in buildings) and industrial processes. The disadvantages lie in the greater technical effort required to set-up and operation steam systems:

- Greater technical and safety demands
- More extensive planning, assembly, operation and maintenance
- TÜV approvals

The components used in steam systems and their installation are subjected to enormous pressures and temperatures and therefore must be planned and executed with care. Steam boilers are classified according to their area of application:

- Low pressure steam boiler up to 0.1 MPa (1 bar) and 120°C
- High-pressure steam boiler over 0.1 MPa (1 bar) and 120°C

Steam cleaning

In industry, steam is used for cleaning surfaces. Coal or oil-powered steam boilers are cleaned of soot deposits using steam soot blowers, for example. This improves the heat transition diminished by the soot deposits and hence the efficiency.

Product moistening

Steam is also used to heat up and hydrate a product at the same time. In paper production, steam is used to moisturise equipment to prevent the microscopic cracks that can occur when paper machines rotate at high speed, for instance. It is also used to provide heat and moisturise when pelleting animal feed.

Air moistening

Many industrial building complexes, especially in colder climates, are heated by steam at low pressure as a primary heat source. Air heaters are used in combination with steam humidifiers to treat suctioned air to create a pleasant room climate and a favourable atmosphere for storing books or files, and also for disinfecting air. As air is heated up, its relative humidity drops. Saturated steam is used to compensate this loss, see „Basics“ on page 232.

Basics

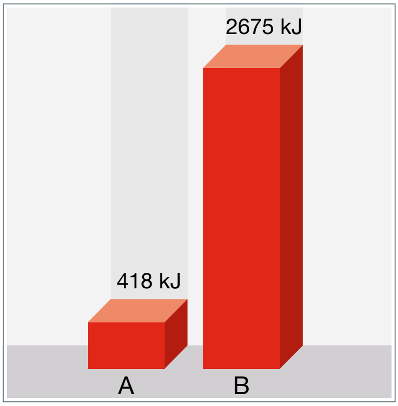
Steam states

Superheated steam is steam at a temperature above boiling point. The steam is dry and contains no droplets. In steam boilers, the generated steam is charged to this state by means of superheater.
When steam flows into a colder environment, some of the gaseous water condenses to form the finest droplets. Such a composition is referred to as **wet steam**, as can be observed when water is boiled, for example.
The transition between wet steam and superheated steam is called **saturated steam**. The process that occurs at temperatures from 10 to 20°C above the saturated steam temperature is referred to as superheating.

Heat transmission

Water in liquid form has the highest thermal capacity of all inorganic substances. This is approx. 4.18 kJ/(kg * K). Therefore, approx. 418 kJ are required to heat up 1 kg water from 0 to 100°C. To vaporise the water at 100°C, 2257 kJ/kg of evaporation enthalpy is required. This is more than five times the amount of heat required to heat it up from 0°C to 100°C.

Hence the significant advantage of steam as an energy source. The amount of heat released again during the condensation process in heat exchangers can be moved with around of a fifth of the mass.



A Heat capacity of water
B Heat capacity of vapour

Fig. 153: Heat capacity of water and vapour per 1 kg at 100°C by comparison

The evaporation enthalpy of steam makes it suitable for numerous purposes, depending on its state. Superheated steam has a lower heat transmission capacity, and is therefore the better medium for transporting heat in long piping sections for example. Saturated steam, on the other hand, has an excellent heat transmission capacity and is therefore the better medium for transmitting heat. Saturated steam should therefore be used for heating purposes.

Steam quality
Steam circuits are continuously fed with fresh water. This so-called boiler feed water is stored in feed water tanks. To avoid corrosion in the steam generator and in the installation, only treated feedwater should be used. Effective ventilation prevents harmful oxygen, which promotes corrosion, from getting into the pipes.

Risk of water hammer in steam pipelines
Water hammer in steam pipes should be avoided at all costs, since this presents a great danger to both pipes and fittings. If the condensate is not discharged from the steam pipe, it collects and forms pools. The flow velocity of steam is typically 25 m/s (90 km/h). The fast-flowing steam causes ripples on the surface of these pools, which ultimately entrains water droplets and drives them through the line at the velocity of the steam. If, at the same time, a water droplet arriving with this kinetic energy is suddenly decelerated by an obstacle, the pipeline develops water hammer which can lead to local pressures of several thousand bar. Temperature controls, pressure reducing valves or pipe bends can be destroyed or even completely ruptured. Numerous accidents, some involving fatal injuries, underline the importance of these procedures.

Piping systems
Installations in steam systems must be designed so that the condensate which forms in the piping during cooling is effectively separated from the steam phase, see Fig. 154 to Fig. 157. The removal of condensate is aided by laying steam pipelines in the direction of flow at a gradient of at least 1% and guiding them to the lowest points of the installation in separate condensate pipelines for removal of the condensate. "Condensate loops" are included at the connection points between condensate drainers and steam lines, these fill with condensate and prevent steam from entering the condensate drainer. The arrangement and planning of these "condensate drainers" is described in EN 26704.

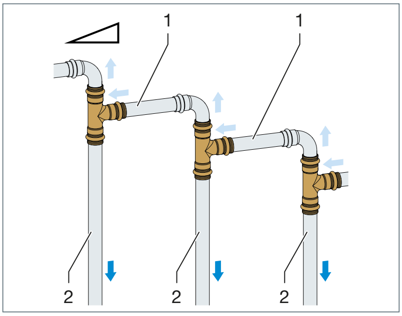


Fig. 154: Condensate discharge downwards

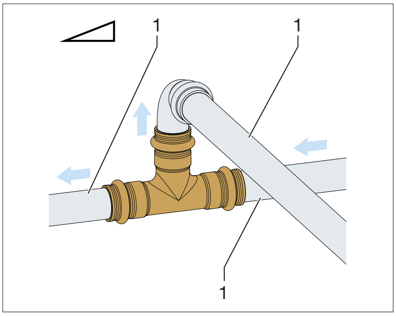


Fig. 155: Steam branch-off on the top of the pipe

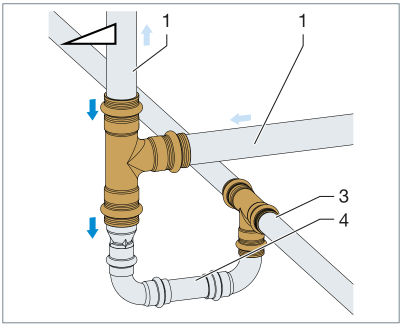


Fig. 156: Condensate loop – separation of steam and condensate

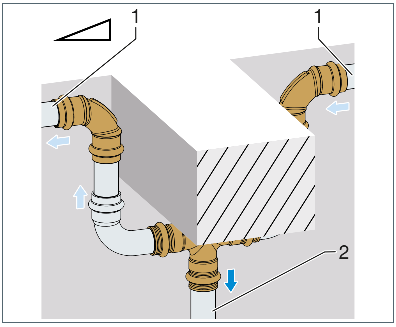


Fig. 157: Bypass around an obstacle

1 Steam/condensate
2 Drain pipeline
3 Condensate pipeline
4 Condensate loop

Viega solutions

> When selecting materials for fittings, pipes and sealing elements, the special operating and installation conditions, as well as other system requirements, must be considered on a case-by-case basis.
>
> Send your detailed enquiries to the Viega Service Center using the "Enquiry for material durability" form. You can find the form for this on the Viega website *viega.com* by entering "material durability" as the search term.

Viega piping systems for low pressure steam can be used for an operating pressure of up to max. 0.1 MPa (1 bar) and a temperature of up to max. 120°C. Steel, copper and stainless steel are very suitable materials for connectors and pipes. The pipe connector must be made using FKM sealing elements, see also chapter „Media list“ on page 295. The medium being pumped must be free of additives.

The following Viega piping systems can be used for low pressure steam processes, for details see „Media list“ on page 295:

- Profipress S
- Megapress S
- Viega piping systems – with on-site replacement of sealing elements with FKM sealing elements in accordance with „Media list“ on page 295

Oils and diesel fuels

Oils

The word "oil" is a collective term for liquids that are carbon-based and cannot be mixed with water. The term originates from 'oleum', Latin for the vegetable oil obtained from olives that has been known for over 8000 years. A liquid "oil" that solidifies is referred to as "fat".

Fig. 158 shows a classification of fats and various oils. Examples of oils and their applications are also provided. Oils are classified in various groups, each with their specific properties:

- Mineral oils
- Fatty oils
- Essential oils
- Silicone oils

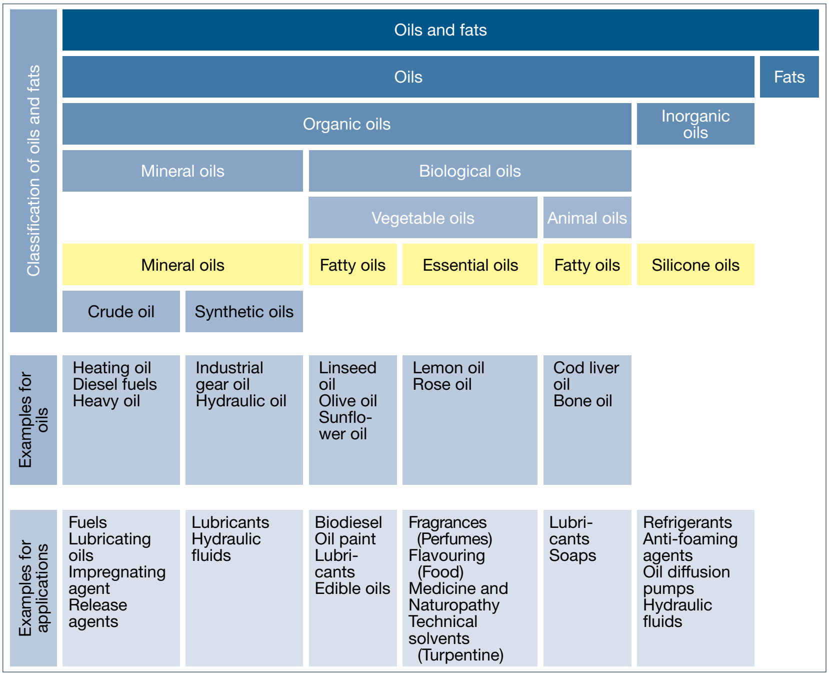


Fig. 158: Classification of oils and typical applications

Mineral oils

Crude oil

The name "mineral oil" is often used for crude oil in order to distinguish it from biological oils.
In the stricter sense, therefore, the expression also covers the heavier intermediates (base oils) produced during the distillation of raw oil (Fig. 159) or the liquefaction of coal. These intermediates can be further processed to form end products such as engine oils, cooling lubricants or lubricating greases.

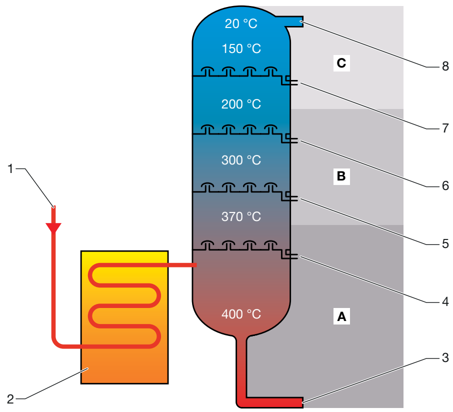


Fig. 159: Diagram of a distillation column for crude oil

1 Raw oil
2 Tube furnaces
3 Lubricating oils, paraffins, waxes, bitumen/tar, coke
4 Heavy oils
5 Diesel, heating oil
6 Kerosene, petroleum
7 Benzine
8 Liquid gas
A Base oils
B Oily fuels
C Light liquid fuels

Fig. 160: Distillation column in a crude oil refinery

Synthetic oil

"Synthetic oils" are likewise based on raw oil or carbon, but contain added synthetic hydrocarbons with molecular structures that do not occur in the two raw materials in this form.

However, the expression "synthetic oil" is not used consistently around the world. In Germany, there is a clear definition based on the oils and additives used. Oils that do not match this definition are often referred to as "high-performance oil" or "premium oil".

The performance of oils is not in their name, but rather in the chemical and physical properties defined in the SAE J357 standard of the Society of Automotive Engineers (SAE).

Heating oil

"Heating oil" is a liquid fuel that is recovered from the middle part of a distillation column when mineral oil and mineral oil products are processed, see Fig. 159. It is a mixture of various products from the distillation process and special additives.

In Germany, DIN 51603 specifies the composition of heating oil, drawing a distinction between various grades and qualities.

Heating oil grades	Properties	Comments	Regulations
EL, standard	Extra-light	■ Small, dwindling market share ■ Mixture of kerosine, gas oil fractions and additives	DIN 51603-1
EL, low-sulphur	Extra-light, sulphur content ≤ 50 mg/kg	■ Standard in Germany ■ Significantly lower harmful substance emissions than EL ■ For condensing systems ■ For private households and the trades	
EL, low-sulphur, low nitrogen	Extra-light, sulphur content ≤ 50 mg/kg, Nitrogen content ≤ 140 mg/kg	■ Rarely used today ■ Previously used for large-scale central heating firing systems	
EL A Bio	Bio heating oil	■ EL heating oil with admixtures of biodiesel, see „Biodiesel“ on page 245	DIN SPEC 51603-6
S	Viscous	■ Used in firing systems with pre-heating equipment for transport, storage and combustion ■ Fuel for large diesel motors ■ Highly viscous at room temperature ■ Pumpable at approx. 40-50°C ■ Injection temperature for the combustion chamber approx. 130-140°C	DIN 51603-3
SA	Viscous, low-sulphur	-	DIN 51603-5
SA-LW	Viscous, low-sulphur low wear	■ LW refers to low aluminium and silicon content	DIN 51603-7
R	From the processing of aromatic mineral oil fractions from refining, sulphur content for: R-LS ≤ 0.5% R-TS ≤ 1.0%	■ In re-refined heating oils, the content of the harmful substances must be respected to prevent the emission thresholds specified by the relevant legislation being exceeded.	DIN 51603-4

Tab. 65: Heating oil grades in accordance with DIN 51603

The quality of a heating oil is determined by
- its density
- its ash and sulphur content
- the ratio of carbon (C) to hydrogen (H)

Technically speaking, the heating oil used primarily in firing systems is similar to the diesel fuel („Diesel“ on page 244) that powers diesel motors. However, because heating oil and diesel fuel are taxed differently within the EU, a red pigment and the "Solvent Yellow 124" marker are mixed with the heating oil to make identification easier.

Fatty oils

"Fatty oils" are biological by nature. They are the fats obtained from plants and animals that are liquid at room temperature. In chemical terms, they are esters of glycerin with unbranched aliphatic monocarboxylic acids.

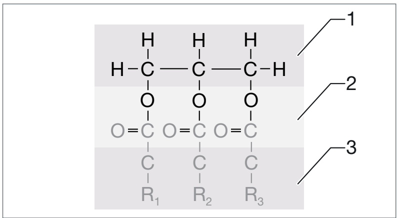


Fig. 161: Schematic representation of the structure of biological fats

1 Glycerine fraction of the fat
2 Ester group (COO)
3 Aliphatic monocarboxyl acids with different structures (R_1 to R_3)

Animal fatty oils are often processed to make soaps, surfactants for the laundry detergent industry and biogenic lubricants.
Vegetable fatty oils are likewise processed into lubricants and biodiesel or are often used directly as edible oils, e.g.
- Palm oil
- Soy oil
- Sunflower oil
- Olive oil
- Rapeseed oil

Since fatty oils are biological products, they are used in the food industry, for example, as food-safe lubricating oils and as a biodegradable substitute for lubricants made of mineral oils.

Essential oils

"Essential oils" are also biological in nature and obtained from plants. Each plant species gives the oil its characteristic aroma, which can sometimes be very powerful.

Essential oils are mixtures of numerous different chemical substances. Unlike the fatty oils produced from plants, they contain no fat and therefore evaporate completely. They are soluble in fats and oils, but not in water. In water, they usually form oil droplets because their density is lower.

Essential oils are used primarily in medicine and naturopathy (e.g. aromatherapy, phytotherapy, allergy control), in the cosmetics for perfumes and in the food industry for tea, spices, etc.

Fig. 162: Typical uses of essential oils

Silicone oils

Unlike mineral and biogenic oils, silicone oils are not made purely from carbon. They are instead technically polymerised, silicon-based compounds. The backbone consists of silicon and oxygen atoms to which different side groups, which can also contain carbon atoms and determine the properties of the silicone oil concerned, attach.

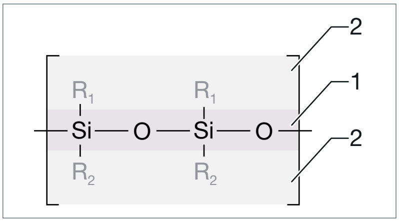


Fig. 163: Schematic representation of the structure of silicone oils

1 Backbone with silicon and oxygen atoms (Si and O)
2 Characteristic side groups (R_1 and R_2)

Under atmospheric conditions, silicone oils are transparent, colourless, water-repellant liquids. They are odourless, tasteless and non-toxic because they undergo barely any chemical reaction.
They are temperature resistant and, in a broad temperature range, have very good lubrication properties.

Because of their properties, they are used in numerous technical applications, including:

- as heat transfer media in oil baths
- as refrigerants in refrigeration technology
- in Visco couplings
- as hydraulic fluids
- as hydrophobing agents ("water repellents")
- as anti-foaming agents in medical and food technology (food additive E900)

Technical use of oils

Of the numerous possible uses of the various oils, besides combustion and heat recovery („Heating oil" on page 238), only a few selected examples are discussed here.

Cooling lubricants

"Cooling lubricants" are mixtures of numerous components and are used in chip forming metalworking processes. They perform three tasks:

1. **Cooling** the workpiece being machined
2. **Lubrication** of the contact surfaces of workpiece and tool to reduce the amount of friction
3. **Flushing** of the machining point to remove the metal chips produced

Fig. 164: Application of a cooling lubricant

Cooling lubricants have to meet numerous different requirements. These depend on the machining method and processing parameters concerned, including cutting speed, material hardness, machining temperature and so on.

To be able to meet the requirements placed on them, cooling lubricants have three major constituents (primary substances).

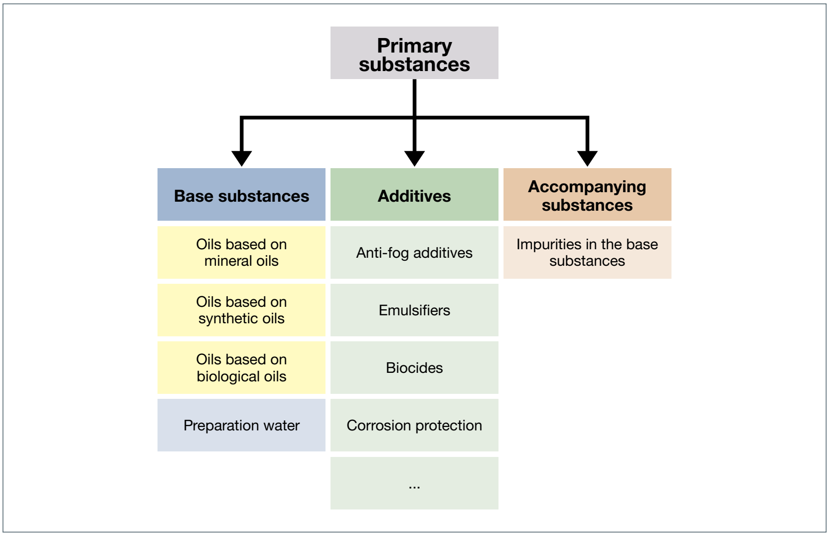


Fig. 165: Primary substances of the cooling lubricants (CL)

Since there is no obligation to label the constituents, the composition must be gleaned from the safety data sheet or, in particular cases, requested from the manufacturer. General notes on the constituents used can also be found in the VKIS-VSI-IGM-BGHM list of substances. This contains specific requirements in accordance with DIN 51385 for water-miscible, water-mixed and water-immiscible cooling lubricants (Fig. 166), as well as additives, and is published and maintained by four groups of stakeholders:

- German group for users of industrial lubricants (VKIS)
- Verband Schmierstoffindustrie e.V. (VSI) (German Lubricant Industry Association)
- Industriegewerkschaft Metall (IGM) (Metalworkers' union in Germany)
- Berufsgenossenschaft Holz und Metall (BGHM) (German Social Accident Insurance Institution for the woodworking and metalworking industries)

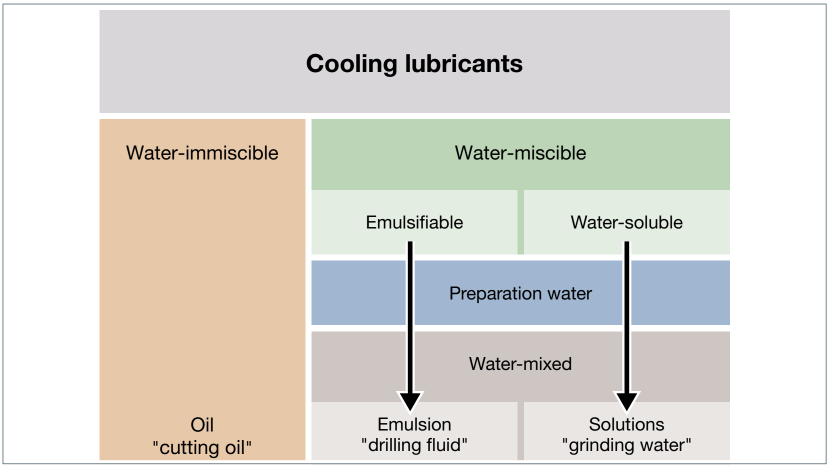


Fig. 166: Types of cooling lubricant (CL)

Fig. 167: Use of "cutting oil"

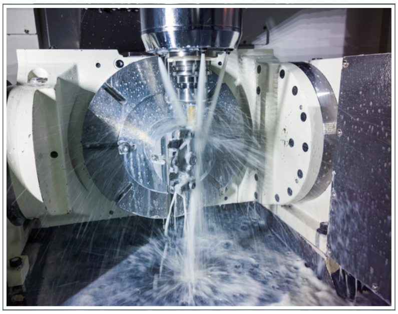


Fig. 168: Use of "drilling fluid"

Diesel fuels

Diesel

"Diesel", also called diesel fuel or formerly diesel oil, is a mixture of various hydrocarbons that are obtained from the middle fraction during the distillation of crude oil, see Fig. 159 on page 237. Technically speaking, it is suitable as a fuel for operating combustion engines in accordance with the diesel principle (diesel engine). Legally, the diesel fuels used for this purpose pursuant to Section 4 of the 10th Federal Emission Control Act (BImSchV) have to meet the requirements of DIN EN 590.
The properties of the diesel can be set to suit a broad range of specifications by varying the mixture ratios of the hydrocarbons in combination with various additives.

Fig. 169: Truck diesel engine

Fig. 170: Diesel-operated emergency generator

Marine diesel

"Marine diesel" is similar to this diesel, but has a higher density. Its composition is specified in ISO 8217. It is used in smaller marine diesel engines, for example. Larger diesel engines for ocean-going vessels powered by so-called marine fuel, a mixture of heavy oil (Fig. 159 on page 237) and diesel.

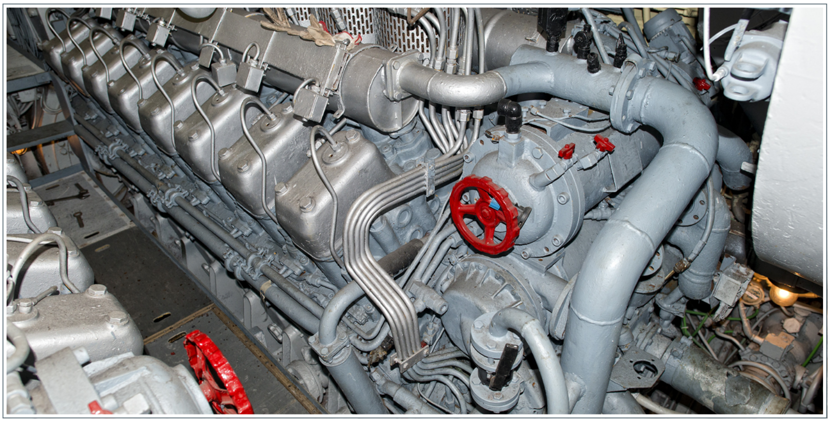


Fig. 171: Marine diesel engine

Biodiesel

"Biodiesel" is a fuel that has similar uses to mineral diesel.
Biodiesel, however, is biological in nature and obtained through the transesterification of animal or vegetable oils and fats with methanol. This combination of a fatty acid and methanol is called fatty acid methyl ester (FAME).
Biodiesel can be mixed with mineral oil-based diesel in any ratio and its properties easily set within broad ranges. The minimum requirements for biodiesel are described in DIN EN 14214.

Viega solutions

> When selecting materials for fittings, pipes and sealing elements, the special operating and installation conditions, as well as other system requirements, must be considered on a case-by-case basis.
>
> Send your detailed enquiries to the Viega Service Center using the "Enquiry for material durability" form. You can find the form for this on the Viega website *viega.com* by entering "material durability" as the search term.

Mineral oils and diesel fuels

For the transport of mineral oils and diesel fuels, Viega offers press connector systems with special sealing elements made of HNBR[1]. These systems are certified by the German Institute for Structural Engineering (DIBt):

- Profipress G
- Sanpress Inox G
- Megapress G

Besides its suitability for transporting media, Megapress G is also the ideal solution for producing suction, pressure, filling, aeration and ventilation lines in systems used for storing heating oil in accordance with DIN 51603-1 and diesel fuel in accordance with DIN EN 590.

Fig. 172: Filling plant for diesel fuel

[1] cf.„Sealing elements“ on page 12

The operating conditions in Tab. 66 and regulations concerning the media apply for the uses of the press connector systems.

Medium	Regulations	Operating pressure [MPa]	Operating temperature [°C]	Profipress G	Sanpress Inox G	Megapress G	Megapress S
Mineral oils SAE	SAE J357	≤ 1.6	≤ 70	✗	✓	✓	✓
Heating oil	DIN 51603-1	≤ 0.5	≤ 40	✓	✓	✓	✗
Diesel	DIN EN 590						
Bio-diesel	DIN EN 14214	see Tab. 67					

Tab. 66: Operating parameters of Viega press connector systems for mineral oils and diesel fuels

Biogenic oils and diesel fuels

Viega offers press connector systems with special sealing elements made of HNBR or FKM[1] for transporting biogenic oils and diesel fuels:

- Sanpress Inox G
- Sanpress Inox - when EPDM sealing elements are replaced with FKM
- Megapress G
- Megapress S

The operating conditions in Tab. 66 and regulations concerning the media apply for the uses of the press connector systems.

[1] cf.„Sealing elements“ on page 12

Medium	Regu-lations	Operating pressure [MPa]	Operating tempe-rature [°C]	Sanpress Inox G	Sanpress Inox	Megapress G	Megapress S
Biodiesel	DIN EN 14214	≤ 1.0	≤ 70	✗	✓ 1)	✗	✓
Rapeseed oil	DIN W 51805			✓	✗	✓ 2)	✓ 2)
Palm oil Soy oil Sunflower oil	-						

1) EPDM sealing elements have to be replaced with FKM
2) Following consultation with the Viega Service Center

Tab. 67: Operating parameters of Viega press connector systems for biogenic oils and diesel fuels

Cooling lubricants (CL)

Essentially, the following Viega press connector systems are also suitable for cooling lubricants (CL):

- Profipress G
- Sanpress Inox G
- Megapress G

Given the diversity of cooling lubricants and their compositions, the use of Viega press connector systems must be carefully checked on a case-by-case basis.

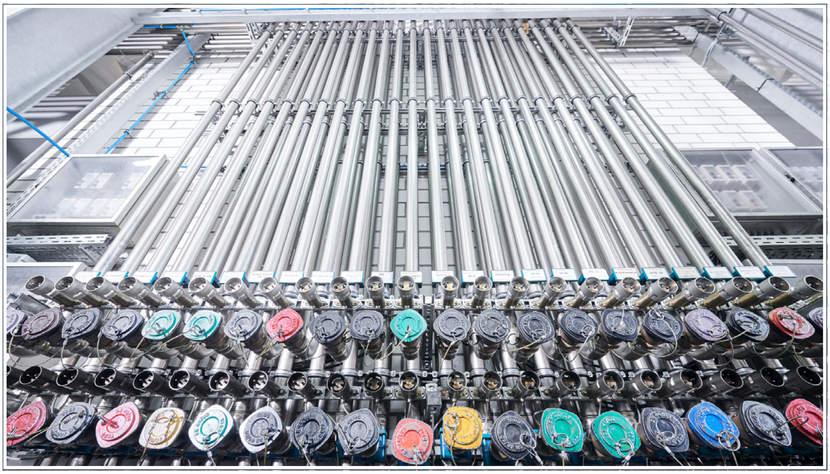


Fig. 173: High number of cooling lubricants managed using Viega Sanpress Inox G

Fig. 174: Cooling lubricant tanks filled and emptied using Viega Sanpress Inox G

PRODUCTS

Metal piping systems

General information

Instructions for use
Use of the systems for areas of application and media other than those described must be agreed in consultation with Viega. Detailed information about applications, restrictions and national standards and directives can be found in the product information, either printed or on the Viega website.

Press connector with SC-Contur
Viega press connectors are equipped with the SC-Contur. This ensures that the press connector is guaranteed to leak in an unpressed state.

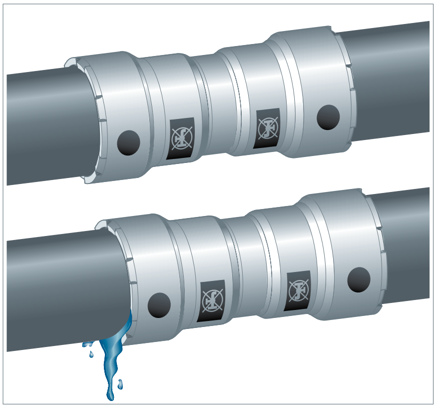


Fig. 175: SC-Contur using the Megapress as an example

Profipress / Profipress S / Prestabo / Megapress / Megapress S / Sanpress Inox / Sanpress
Inadvertently unpressed connections are noticed immediately during a leakage test. Viega guarantees the detection of unpressed connections in the following pressure ranges using water, compressed air or inert gases:

- min. water pressure: 0.1 MPa/1 bar/14.5 PSI
- max. water pressure: 0.65 MPa/6.5 bar/94.3 PSI
- min. air pressure: 22 hPa/22 mbar/0.3 PSI
- max. air pressure: 0.3 MPa/3 bar/43.5 PSI

Profipress G / Megapress G / Sanpress Inox G
Inadvertently unpressed connections are noticed immediately during a leakage test. Viega guarantees the detection of unpressed connections in the following pressure ranges using compressed air or inert gases:

- min. air pressure: 22 hPa/22 mbar/0.3 PSI
- max. air pressure: 0.3 MPa/3 bar/43.5 PSI

Raxinox
Inadvertently unpressed connections are noticed immediately during a leakage test. Viega guarantees the detection of unpressed connections in the following pressure ranges using compressed air or inert gases:

- min. water pressure: 0.1 MPa/1 bar/14.5 PSI
- max. water pressure: 0.65 MPa/6.5 bar/94.3 PSI
- min. air pressure: 22 hPa/22 mbar/0.3 PSI
- max. air pressure: 0.3 MPa/3 bar/43.5 PSI

Profipress

Flow-optimised press connector system made of copper (99.9% Cu-DHP), gunmetal or silicon bronze for copper pipes. Press connector for protecting the sealing element equipped with cylindrical pipe guide. Press connector from d 64.0 with stainless steel compression ring to ensure the mechanical strength of the connection. The pressing force is located before and behind the sealing element seat. Suitable for wall-mounted and concealed installations of manifolds and riser pipes, as well as for floor installations.

Overview

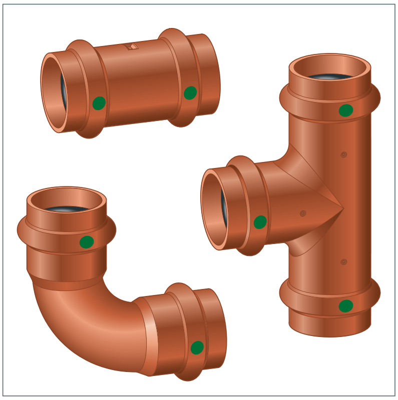


Fig. 176: Profipress product selection

Sealing elements

- EPDM (Ethylene propylene diene rubber); polished black; premounted

Dimensions

Standard sizes: d 12; 15; 18; 22; 28; 35; 42; 54
XL sizes: d 64.0; 76.1; 88.9; 108.0
Size availability in accordance with the national regulations

Areas of application

- Potable water
- Heating and cooling systems
- Rainwater
- Compressed air, inert gas
- Industrial and plant engineering
- Fire extinguisher and sprinkler systems
- Technical gases

Limitations of use for potable water

Given the possibility of the limit value for copper ions according to the Potable Water Ordinance (TrinkW) being exceeded, pipes and press connectors made of copper may be used only if the pH value is ≥ 7.4 or the total volume of organic carbon does not exceed TOC = 1.5 mg/l at values of between pH 7.0 and 7.4.

Press connector materials
- Copper: 99.9% Cu-DHP
- Gunmetal: CC 499K
- Silicon bronze: CC 246E/CuSi4Zn9MnP

Further information

For more information, see:

- „Sealing elements“ on page 12
- „Potable water“ on page 70
- „Potable water in first aid facilities“ on page 116
- „Process water“ on page 121
- „Firefighting water“ on page 147
- „Compressed air“ on page 173
- „Technical gases“ on page 197
- „Media list“ on page 295

This QR code will take you to the Viega online catalogue.

Profipress G

Flow-optimised press connector system made of copper (99.9% Cu-DHP), gunmetal or silicon bronze for copper pipes. Press connector for protecting the sealing element equipped with cylindrical pipe guide.
Press connector in d64.0 with stainless steel compression ring to ensure the mechanical strength of the connection. The pressing force is located before and behind the sealing element seat. Suitable for pre-wall and concealed installations of riser pipes and floor installations.

Overview

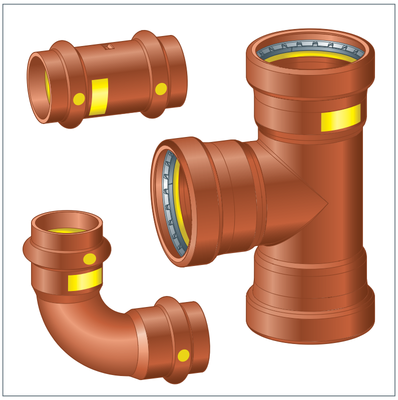


Fig. 177: Profipress G product selection

Sealing elements

- HNBR (hydrogenated NBR), yellow, pre-assembled

Dimensions

Standard sizes: d 12; 15; 18; 22; 28; 35; 42; 54
XL sizes: d 64.0
Size availability in accordance with the national regulations

Areas of application

- Natural gas/liquid gas
- Heating oil/diesel fuel (d 12–54)
- Compressed air systems

Press connector materials

- Copper: 99.9% Cu-DHP
- Gunmetal: CC499K
- Silicon bronze: CC246E / CuSi4Zn9MnP

Further information

For more information, see:

- „Sealing elements“ on page 12
- „Oils and diesel fuels“ on page 236
- „Compressed air“ on page 173
- „Technical gases“ on page 197

- „Media list“ on page 295

This QR code will take you to the Viega online catalogue.

Profipress S

Flow-optimised press connector system made of copper (99.9% Cu-DHP), gunmetal or silicon bronze for copper pipes. Press connector for protecting the sealing element equipped with cylindrical pipe guide. The pressing force is located before and behind the sealing element seat. Suitable for pre-wall and concealed installations of riser pipes and floor installations.

Overview

Fig. 178: Profipress S product selection

Sealing elements

- FKM (fluorocarbon rubber), matt black, pre-assembled

> **NOTE!**
> The use of Profipress S and Profipress connectors with FKM sealing elements in potable water and gas installations is not permitted!

Dimensions

Standard sizes: d 12; 15; 18; 22; 28; 35
Size availability in accordance with the national regulations

Areas of application

- Solar installations (flat/vacuum collectors)
- District heat supply systems
- Low pressure steam systems
- Compressed air systems
- Water for process heat

Usage for systems with additives (e.g. anti-corrosion agents or anti-freeze) in heating water or for areas of application other than those described must be agreed in consultation with Viega.

Press connector materials

- Copper: 99.9% Cu-DHP
- Gunmetal: CC499K
- Silicon bronze: CC246E / CuSi4Zn9MnP

Further information

For more information, see:

- „Sealing elements“ on page 12
- „Water for heat transmission“ on page 140
- „Compressed air“ on page 173
- „Low pressure steam“ on page 230
- „Media list“ on page 295

This QR code will take you to the Viega online catalogue.

Prestabo

Flow-optimised press connector system with press connectors made of non-alloy steel 1.0308. Galvanised (blue chromated) on the outside. Press connector for protecting the sealing element equipped with cylindrical pipe guide. Press connector from d64.0 with stainless steel compression ring to ensure the mechanical strength of the connection. Pipes are equipped with plugs for protection. The pressing force is located before and behind the sealing element seat. Suitable for pre-wall and concealed installations of riser pipes and floor installations.

Overview

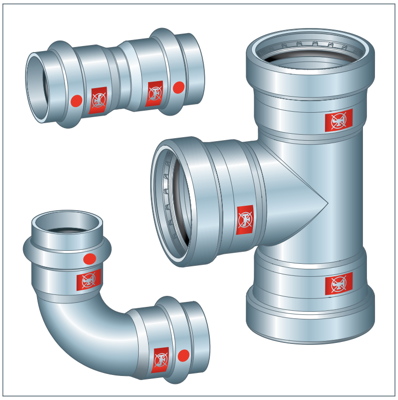


Fig. 179: Prestabo product selection

System pipe made of non-alloy steel 1.0308 (E235)
- Galvanised (blue chromated) on the outside.
- Suitable for heating, solar and cooling systems.

System pipe made of non-alloy steel 1.0308 (E235)
- Galvanised (blue chromated) on the outside.
- Covered on the outside with a polypropylene (PP) plastic coating in white (RAL 9001).
- Suitable for heating, solar and cooling systems.

System pipe made of non-alloy steel 1.0215 (E220)
- Hot dip galvanised on the inside and outside.
- Suitable for fire extinguishing, sprinkler and compressed air systems.

Sealing elements
- EPDM (ethylene propylene diene rubber), black, pre-assembled

Dimensions

Standard sizes: d 12; 15; 18; 22; 28; 35; 42; 54
XL sizes: d 64.0; 76.1; 88.9; 108.0
Size availability in accordance with the national regulations

Areas of application

- Heating and cooling systems
- Industrial and plant engineering
- Fire extinguishing and sprinkler systems (hot dip galvanised pipe)
- Compressed air systems (hot dip galvanised pipe)
- Solar installations (flat collectors)
- Solar installations (vacuum pipe collectors, only with FKM sealing element)

Press connector materials

1.0308 steel

Note – storage and transport

To guarantee the impeccable quality of Prestabo pipes, observe the following points during transport and storage:

- Packing and protective foil (only with PP-coated pipes) should not be removed until immediately before use.
- The pipe ends must be closed with protective caps when delivered.
- Do not store the pipes directly on the bare floor.
- Do not stick any protective foils or plastics to the pipe surfaces.
- When loading and unloading, do not pull the pipes over the truck sill.

Note – protection against external corrosion

Prestabo pipes and press connectors are protected by external galvanisation. In case of contact with dampness (condensation, precipitation during the construction phase, plaster and splash water etc.) or corrosive building materials (surfacer, levelling screed etc.), however this layer of zinc cannot provide permanent protection against external corrosion.
Viega recommends taking the following protective measures:

- Use of closed-cell insulating tubes with professional sealing of all abutting and cut edges using a suitable filler.
- Damp-proofing of the laid piping through separating foil in the floor construction.
- Installing piping outside areas at risk of moisture.
- Visible radiator connections rising from the floors should be avoided if floors are to be frequently cleaned with water and/or cleaning agents/ disinfectants, for example in retirement homes and care facilities, as well as hospitals. Wall connections make cleaning easier and also exclude any additional risk of corrosion.
- If the radiator connections do come from the floor, professional corrosion protection and professional sealing of the joints must be ensured. If not, there is a risk of the cleaning water penetrating, which will moisten the insulation and could cause corrosion.

If the measures in the examples above are unable to provide permanent protection against dampness or the areas of application have to meet special requirements, e.g. in cooling circuits, complete external corrosion protection, which reliably prevents influences that lead to corrosion, must be applied.

Further information

For more information, see:

- „Sealing elements“ on page 12
- „Process water“ on page 121
- „Firefighting water“ on page 147
- „Compressed air“ on page 173
- „Media list“ on page 295

This QR code will take you to the Viega online catalogue.

Prestabo LF

Flow-optimised press connector system with press connectors made of non-alloy steel 1.0308. Galvanised (blue chromated) on the outside. Free of paint-wetting impairment substances (PWIS-free), such as silicon, grease or oil. Especially suitable for the use of pipeline installations in paint shops. Press connector for protecting the sealing element equipped with cylindrical pipe guide. Press connector from d64.0 with stainless steel compression ring to ensure the mechanical strength of the connection. Pipes are equipped with plugs for protection. The pressing force is located before and behind the sealing element seat. Suitable for pre-wall and concealed installations of riser pipes and floor installations.

Overview

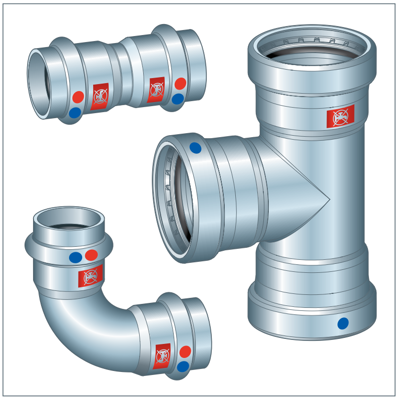


Abb. 180: Prestabo LF product selection

System pipe made of non-alloy steel 1.0308 (E235)

- Galvanised (blue chromated) on the outside.
- Suitable for heating, solar and cooling systems.

System pipe made of non-alloy steel 1.0215 (E220)

- Hot dip galvanised on the inside and outside.
- Suitable for fire extinguishing, sprinkler and compressed air systems.

Sealing elements

- EPDM (ethylene propylene diene rubber), black, pre-assembled

Dimensions

Standard sizes: d 12; 15; 18; 22; 28; 35; 42; 54
XL sizes: d 64.0; 76.1; 88.9; 108.0
Size availability in accordance with the national regulations

Areas of application
- Heating and cooling systems
- Industrial and plant engineering
- Fire extinguishing and sprinkler systems (hot dip galvanised pipe)
- Compressed air systems (hot dip galvanised pipe)
- Solar installations (flat collectors)

Press connector materials
- 1.0308 steel

Note – storage and transport
To guarantee the impeccable quality of Prestabo pipes, observe the following points during transport and storage:
- Packing and protective foil (only with PP-coated pipes) should not be removed until immediately before use.
- The pipe ends must be closed with protective caps when delivered.
- Do not store the pipes directly on the bare floor.
- Do not stick any protective foils or plastics to the pipe surfaces.
- When loading and unloading, do not pull the pipes over the truck sill.

Note – protection against external corrosion
Prestabo pipes and press connectors are protected by external galvanisation. In case of contact with dampness (condensation, precipitation during the construction phase, plaster and splash water etc.) or corrosive building materials (surfacer, levelling screed etc.), however this layer of zinc cannot provide permanent protection against external corrosion.
Viega recommends taking the following protective measures:
- Use of closed-cell insulating tubes with professional sealing of all abutting and cut edges using a suitable filler.
- Damp-proofing of the laid piping through separating foil in the floor construction.
- Installing piping outside areas at risk of moisture.
- Visible radiator connections rising from the floors should be avoided if floors are to be frequently cleaned with water and/or cleaning agents/ disinfectants, for example in retirement homes and care facilities, as well as hospitals. Wall connections make cleaning easier and also exclude any additional risk of corrosion.
- If the radiator connections do come from the floor, professional corrosion protection and professional sealing of the joints must be ensured. If not, there is a risk of the cleaning water penetrating, which will moisten the insulation and could cause corrosion.

If the measures in the examples above are unable to provide permanent protection against dampness or the areas of application have to meet special requirements, e.g. in cooling circuits, complete external corrosion protection, which reliably prevents influences that lead to corrosion, must be applied.

Further information

For more information, see:

- „Sealing elements“ on page 12
- „PWIS conformity“ on page 169
- „Media list“ on page 295

This QR code will take you to the Viega online catalogue.

Megapress

Flow-optimised press connector system made of non-alloy steel 1.0308 with an externally galvanised zinc-nickel coating for black, galvanised, industrially painted and powder-coated steel pipes. Press connector with stainless steel compression ring to ensure the mechanical strength of the connection. Suitable for pre-wall and concealed installations of riser pipes and floor installations.

Overview

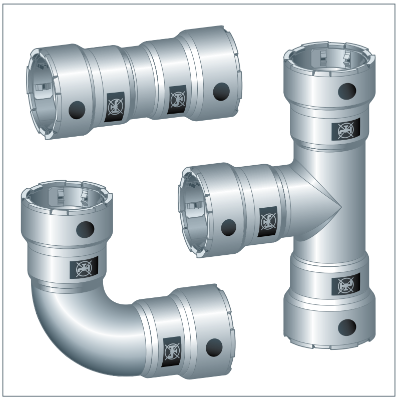


Fig. 181: Megapress product selection

Sealing elements

- EPDM (ethylene propylene diene rubber), profile sealing element, black, pre-assembled

NOTE!
Not suitable for fuel gases in accordance with DVGW Worksheet G 260 and potable water installations, as well as other open systems!

Dimensions

D⅜ (DN10); D½ (DN15); D¾ (DN20); D1 (DN25); D1¼ (DN32); D1½ (DN40); D2 (DN50);
External diameter 38.0 (DN32); 44.5 (DN40); 57.0 (DN50)
Size availability in accordance with the national regulations

Areas of application

- Industrial and plant engineering
- Closed cooling and heating systems
- Compressed air systems
- Fire extinguishing and sprinkler systems (the required minimum and maximum wall thickness have to be observed)
- Technical gases (request required)

Press connector materials
- 1.0308 steel
- Silicon bronze: CC246E / CuSi4Zn9MnP

Note – protection against external corrosion
A zinc-nickel coating provides the press connectors with optimum protection against corrosion – e.g. when condensation water forms in cooling systems. The pipe used must have suitable corrosion protection – refer to the manufacturer's information.
Pipes and pipe connectors must be insulated in the same way in accordance with the generally recognised rules of engineering.

Further information
For more information, see:

- „Sealing elements" on page 12
- „Process water" on page 121
- „Firefighting water" on page 147
- „Compressed air" on page 173
- „Technical gases" on page 197
- „Media list" on page 295

This QR code will take you to the Viega online catalogue.

Megapress G

Flow-optimised press connector system made of non-alloy steel 1.0308 with an externally galvanised zinc-nickel coating for black and galvanised steel pipes in accordance with DIN EN 10255, DIN EN 10220/10216-1 and DIN EN 10220/10217-1. Press connector with stainless steel compression ring to ensure the mechanical strength of the connection. Suitable for wall-mounted and concealed installations of manifolds and riser pipes, as well as for floor installations.

Overview

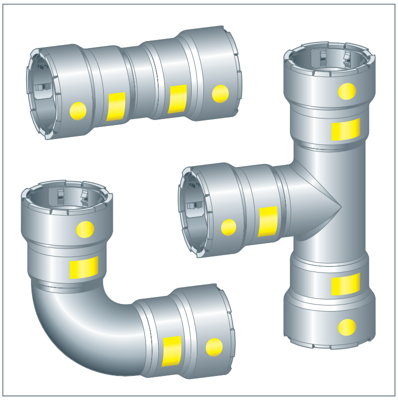


Fig. 182: Megapress G product selection

Sealing elements

- HNBR (NBR), profile sealing element, yellow, pre-assembled

Dimensions

D½ (DN15); D¾ (DN20); D1 (DN25); D1¼ (DN32); D1½ (DN40); D2 (DN50)
size availability in accordance with national regulations

Areas of application

- Natural gas/liquid gas
- Heating oil/diesel fuel
- Compressed air systems
- Technical gases (request required)

Press connector materials

- 1.0308 steel

Further information

For more information, see:

- „Sealing elements“ on page 12
- „Oils and diesel fuels“ on page 236
- „Compressed air“ on page 173
- „Technical gases“ on page 197
- „Media list“ on page 295

This QR code will take you to the Viega online catalogue.

Megapress S

Flow-optimised press connector system made of non-alloy steel 1.0308 with an externally galvanised zinc-nickel coating for black, galvanised, industrially painted and powder-coated steel pipes. Press connector with stainless steel compression ring to ensure the mechanical strength of the connection. Suitable for pre-wall and concealed installations of riser pipes and floor installations.

Overview

Fig. 183: Megapress S product selection

Sealing elements

- FKM (fluorocarbon rubber), matt black, pre-assembled

> **NOTE!**
> Not suitable for fuel gases in accordance with DVGW Worksheet G 260 and potable water installations, as well as other open systems!

Dimensions

D⅜ (DN10); D½ (DN15); D¾ (DN20); D1 (DN25); D1¼ (DN32); D1½ (DN40); D2 (DN50); D2½ (DN65); D3 (DN80); D4 (DN100)
Size availability in accordance with the national regulations

Areas of application

- Industrial and plant engineering
- Local and district heat systems in accordance with AGFW FW 524 (after entry into the building, ≤ DN50)
- Closed cooling and heating systems
- Compressed air systems
- Fire extinguishing and sprinkler systems (the required minimum and maximum wall thickness have to be observed)
- Technical gases (request required)
- Low pressure steam systems
- Water for process heat

Press connector materials
- 1.0308 steel

Note – protection against external corrosion
A zinc-nickel coating provides the press connectors with optimum protection against corrosion – e.g. when condensation water forms in cooling systems. The pipe used must have suitable corrosion protection – refer to the manufacturer's information.
Pipes and pipe connectors must be insulated in the same way in accordance with the generally recognised rules of engineering.

Further information
For more information, see:
- „Sealing elements“ on page 12
- „Water for heat transmission“ on page 140
- „Firefighting water“ on page 147
- „Compressed air“ on page 173
- „Low pressure steam“ on page 230
- „Media list“ on page 295

This QR code will take you to the Viega online catalogue.

Sanpress Inox

Flow-optimised press connector system with press connectors made of 1.4401 stainless steel and pipes from 1.4401 and 1.4521 stainless steel. Press connector for protecting the sealing element equipped with cylindrical pipe guide. Press connector from d64.0 with stainless steel compression ring to ensure the mechanical strength of the connection. Pipes are equipped with plugs for protection. The pressing force is located before and behind the sealing element seat. Suitable for pre-wall and concealed installations of riser pipes and floor installations.

Overview

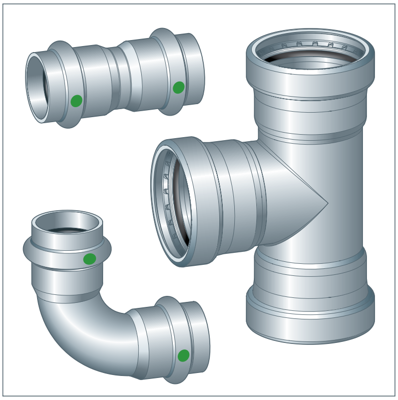


Fig. 184: Sanpress Inox product selection

Sealing elements

- EPDM (ethylene propylene diene rubber), black, pre-assembled

Dimensions

Standard sizes: d 15; 18; 22; 28; 35; 42; 54
XL sizes: d 64.0; 76.1; 88.9; 108.0
Size availability in accordance with the national regulations

Areas of application

- Potable water
- Heating and cooling systems
- Rainwater
- Agriculture
- Compressed air, inert gas
- Industrial and plant engineering
- Fire extinguisher and sprinkler systems
- Technical gases

Press connector materials

- Stainless steel 1.4401

Further information

For more information, see:

- „Sealing elements“ on page 12
- „Potable water“ on page 70
- „Potable water in first aid facilities“ on page 116
- „Process water“ on page 121
- „Firefighting water“ on page 147
- „Compressed air“ on page 173
- „Technical gases“ on page 197
- „Media list“ on page 295

This QR code will take you to the Viega online catalogue.

Sanpress Inox LF

Flow-optimised press connector system with press connectors made of 1.4401 stainless steel and pipes from 1.4401 and 1.4521 stainless steel. Free of paint-wetting impairment substances (PWIS-free), such as silicon, grease or oil. Especially suitable for the use of pipeline installations in paint shops. Press connector for protecting the sealing element equipped with cylindrical pipe guide. Press connector from d64.0 with stainless steel compression ring to ensure the mechanical strength of the connection. Pipes are equipped with plugs for protection. The pressing force is located before and behind the sealing element seat. Suitable for pre-wall and concealed installations of riser pipes and floor installations.

Overview

Abb. 185: Sanpress Inox LF product selection

Sealing elements

- EPDM (ethylene propylene diene rubber), black, pre-assembled

Dimensions

Standard sizes: d 15; 18; 22; 28; 35; 42; 54
XL sizes: d 64.0; 76.1; 88.9; 108.0
Size availability in accordance with the national regulations

Areas of application

- Potable water
- Heating and cooling systems
- Rainwater
- Agriculture
- Compressed air, inert gas
- Industrial and plant engineering
- Technical gases

Press connector materials

- Stainless steel 1.4401

Further information

For more information, see:

- „Sealing elements“ on page 12
- „PWIS conformity“ on page 169
- „Media list“ on page 295

This QR code will take you to the Viega online catalogue.

Sanpress Inox G

Flow-optimised press connector system with press connectors and pipes made of 1.4401 stainless steel. Press connector for protecting the sealing element equipped with cylindrical pipe guide. Press connector from d64.0 with stainless steel compression ring to ensure the mechanical strength of the connection. Pipes are equipped with plugs for protection. The pressing force is located before and behind the sealing element seat. Suitable for pre-wall and concealed installations of riser pipes and floor installations.

Overview

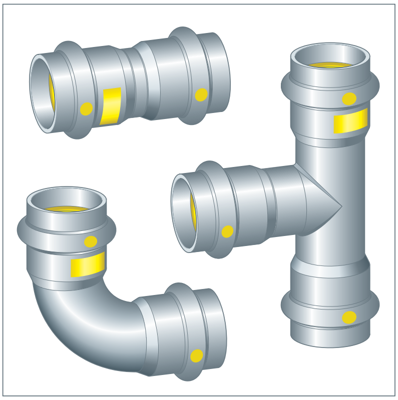


Fig. 186: Sanpress Inox G product selection

Sealing elements

- HNBR (hydrogenated NBR), yellow, pre-assembled

Dimensions

Standard sizes: d 15; 18; 22; 28; 35; 42; 54
XL sizes: d 64.0; 76.1; 88.9; 108.0
Size availability in accordance with the national regulations

Areas of application

- Natural gas/liquid gas
- Heating oil/diesel fuel
- Compressed air systems
- Technical gases

Press connector materials

- Stainless steel 1.4401

Further information

For more information, see:

- „Sealing elements" on page 12
- „Oils and diesel fuels" on page 236
- „Compressed air" on page 173
- „Technical gases" on page 197
- „Media list" on page 295

This QR code will take you to the Viega online catalogue.

Sanpress

Flow-optimised press connector system with press connectors made of gunmetal or silicon bronze and pipes made of 1.4401 and 1.4521 stainless steel. Press connector for protecting the sealing element equipped with cylindrical pipe guide. Press connector from d64.0 with stainless steel compression ring to ensure the mechanical strength of the connection. Pipes are equipped with plugs for protection. The pressing force is located before and behind the sealing element seat. Suitable for pre-wall and concealed installations of riser pipes and floor installations.

Overview

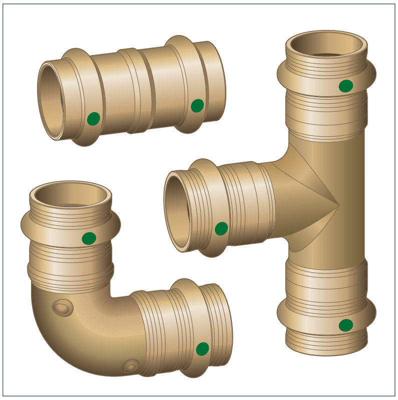


Fig. 187: Sanpress product selection

Sealing elements

- EPDM (ethylene propylene diene rubber), black, pre-assembled

Dimensions

Standard sizes: d 12; 15; 18; 22; 28; 35; 42; 54
XL sizes: d 76.1; 88.9; 108.0
Size availability in accordance with the national regulations

Areas of application

- Potable water
- Heating and cooling systems
- Rainwater
- Agriculture
- Compressed air, inert gas
- Industrial and plant engineering
- Fire extinguisher and sprinkler systems
- Technical gases

Press connector materials

- Copper: 99.9% Cu-DHP
- Gunmetal: CC499K
- Silicon bronze: CC246E / CuSi4Zn9MnP

Further information

For more information, see:

- „Sealing elements“ on page 12
- „Potable water“ on page 70
- „Potable water in first aid facilities“ on page 116
- „Process water“ on page 121
- „Compressed air“ on page 173
- „Media list“ on page 295

This QR code will take you to the Viega online catalogue.

Sanpress LF

Flow-optimised press connector system with press connectors made of gunmetal or silicon bronze and pipes made of 1.4401 and 1.4521 stainless steel. Free of paint-wetting impairment substances (PWIS-free), such as: silicon, grease or oil. Especially suitable for the use of pipeline installations in paint shops. Press connector for protecting the sealing element equipped with cylindrical pipe guide. Press connector from d64.0 with stainless steel compression ring to ensure the mechanical strength of the connection. Pipes are equipped with plugs for protection. The pressing force is located before and behind the sealing element seat. Suitable for wall-mounted and concealed installations of riser pipes, as well as for floor installations.

Overview

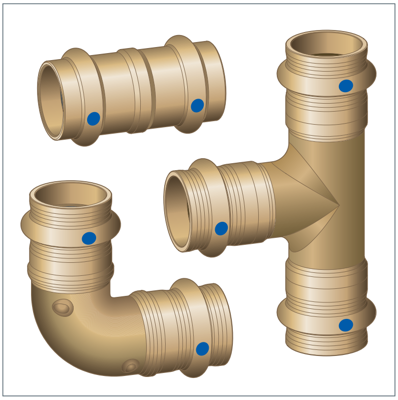


Fig. 188: Sanpress LF product selection

Sealing elements

- EPDM (ethylene propylene diene rubber), black, pre-assembled

Dimensions

Standard sizes: d 12; 15; 18; 22; 28; 35; 42; 54
XL sizes: d 76.1; 88.9; 108.0
Size availability in accordance with the national regulations

Areas of application

- Potable water
- Heating and cooling systems
- Rainwater
- Agriculture
- Compressed air, inert gas
- Industrial and plant engineering
- Technical gases

Press connector materials
- Copper: 99.9% Cu-DHP
- Gunmetal: CC499K
- Silicon bronze: CC246E / CuSi4Zn9MnP

Further information

For more information, see:
- „Sealing elements“ on page 12
- „PWIS conformity“ on page 169
- „Media list“ on page 295

This QR code will take you to the Viega online catalogue.

Viega 1.4520 stainless steel pipe

System pipes made of 1.4520 stainless steel for industrial applications. In combination with Profipress, Sanpress, Sanpress XL, Sanpress Inox and Sanpress Inox XL press connectors. Press connector for protecting the sealing element equipped with cylindrical pipe guide. Press connector from d64.0 with stainless steel compression ring to ensure the mechanical strength of the connection. Pipes are equipped with plugs for protection. The pressing force is located before and behind the sealing element seat. Suitable for pre-wall and concealed installations of riser pipes and floor installations.

Overview

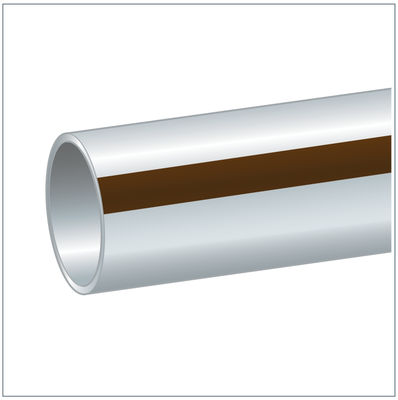


Fig. 189: Industrial Pipe Inox 1.4520

Marking

- Two copper-coloured lines
- Copper-coloured pipe plugs
- Copper-coloured symbol "Not approved for potable water installations"

Dimensions

Standard sizes: d 15; 18; 22; 28; 35; 42; 54
XL sizes: d 64.0; 76.1; 88.9; 108.0
Size availability in accordance with the national regulations

Areas of application

- Industrial and plant engineering
- Closed heating and cooling systems
- Compressed air systems
- Solar installations (flat/vacuum collectors)

Note – protection against external corrosion
In areas of application in which the possibility of condensate formation cannot be ruled out, such as in closed cooling circuits or in humid environments for instance, Viega recommends the use of Sanpress and Sanpress Inox press connectors.
When using copper Profipress press connectors in the aforementioned areas of application, the connection points between the 1.4520 stainless steel pipe and the copper Profipress press connectors must be additionally protected by a corrosion protection agent.
It is necessary to use closed-cell insulation hoses on which all abutting and cutting edges have been sealed by a suitable adhesive.

Further information
For more information, see:
- „Media list“ on page 295

This QR code will take you to the Viega online catalogue.

Seapress

Flow-optimised press connector system made of CuNiFe alloy for CuNiFe pipes. Especially suitable for applications involving seawater. Press connector for protecting the sealing element equipped with cylindrical pipe guide. Press connector from d76.1 with stainless steel compression ring to ensure the mechanical strength of the connection. The pressing force is located before and behind the sealing element seat. Suitable for installations of manifolds and riser pipes.

Overview

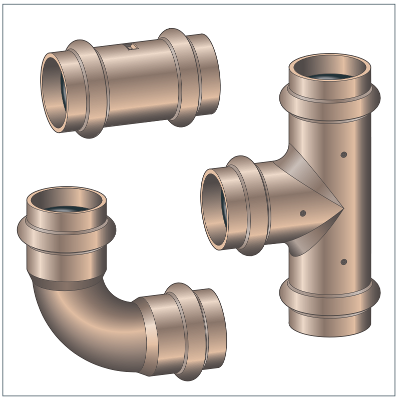


Fig. 190: Seapress product selection

Sealing elements

- EPDM (ethylene propylene diene rubber), black, pre-assembled

Dimensions

Standard sizes: d 15; 22; 28; 35; 42; 54
XL sizes: d 76.1; 88.9; 108.0
Size availability in accordance with the national regulations

Areas of application in the shipbuilding industry

- Fire extinguisher and sprinkler systems
- Seawater cooling
- Bilge and ballast systems
- Seawater desalination systems
- Compressed air systems

NOTE!
Before installation, refer to the relevant valid certificate for verification of suitability and approval, or contact the appropriate certification body.

Press connector materials

- CuNiFe1.6 Mn

Further information

For more information, see:

- „Sealing elements“ on page 12
- „Firefighting water“ on page 147
- „Compressed air“ on page 173
- „Media list“ on page 295

This QR code will take you to the Viega online catalogue.

Plastic piping systems

General information

Instructions for use

Use of the systems for areas of application and media other than those described must be agreed in consultation with Viega! Detailed information about applications, restrictions and national standards and directives can be found in the product information, either printed or on the Viega website.

Press connector with SC-Contur

Viega press connectors are equipped with the SC-Contur. This ensures that the press connector is guaranteed to leak in an unpressed state.

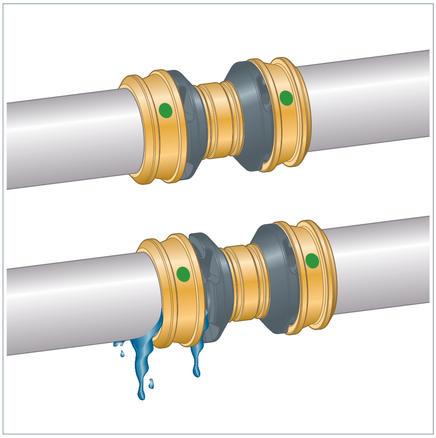


Fig. 191: SC-Contur using the Raxofix as an example

Raxofix / Geopress K

Inadvertently unpressed connections are noticed immediately during a leakage test.
Viega guarantees the detection of unpressed connections in the following pressure ranges with water, compressed air or inert gases:

- min. water pressure: 0.1 MPa/1 bar/14.5 PSI
- max. water pressure: 0.65 MPa/6.5 bar/94.3 PSI
- min. air pressure: 22 hPa/22 mbar/0.3 PSI
- max. air pressure: 0.3 MPa/3 bar/43.5 PSI

Geopress G

Inadvertently unpressed connections are noticed immediately during a leakage test. Viega guarantees the detection of unpressed connections in the following pressure ranges using compressed air or inert gases:

- min. air pressure: 22 hPa/22 mbar/0.3 PSI
- max. air pressure: 0.3 MPa/3 bar/43.5 PSI

Raxofix

Flow-optimised press connector system with press connectors made of silicon bronze and multi-layer pipes and solid plastic pipes. Multi-layer pipe, dimensionally stable, oxygen-proof, colour: grey. Press connector with PPSU support body to ensure the leak tightness and mechanical strength of the connection. Safe and fast connection without widening or calibration of the pipe ends through seal ring-free press connection technology in all pipe dimensions. Pipes are equipped with plugs for protection. Solid plastic pipe, flexible. Suitable for pre-wall and concealed installations of riser pipes and floor installations.

Overview

Fig. 192: Raxofix product selection

Dimensions

Solid plastic pipe:
d 10
Multi-layer pipe:
d 16; 20; 25; 32; 40; 50; 63
Size availability in accordance with the national regulations

Area of applications: solid plastic pipe

- Potable water
- Rainwater

Areas of applications: multi-layer pipe

- Potable water
- Rainwater
- Heating installations
- Compressed air systems

Press connector materials

- Silicon bronze: CC246E / CuSi4Zn9MnP with PPSU support body

Further information

For more information, see:

- „Potable water“ on page 70
- „Potable water in first aid facilities“ on page 116
- „Compressed air“ on page 173

This QR code will take you to the Viega online catalogue.

Raxinox

Flow-optimised press connector system with press connectors made of 1.4408/5/1 stainless steel and flexible stainless steel composite pipes made of 1.4435 stainless steel and high-quality plastic coating. Press connector made of stainless steel with PPSU support body to ensure the leak tightness and the mechanical strength of the connection. Pipes are equipped with plugs for protection. Safe and fast connection through seal ring-free press connection technology in all pipe dimensions. Suitable for wall-mounted and concealed floor installations.

Overview

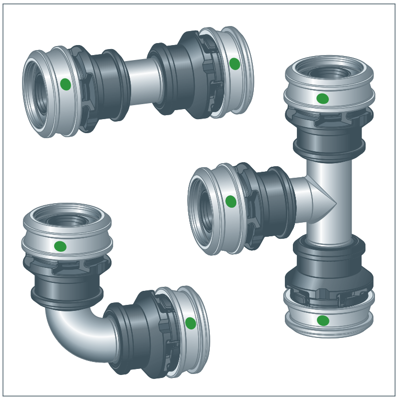


Fig. 193: Raxinox product selection

Dimensions

d 16; 20

Size availability in accordance with the national regulations

Areas of application

- Potable water

Press connector materials

- 1.4408/5/1 stainless steel with PPSU support body

Pipe materials

- Stainless steel 1.4435
  - With a high-quality plastic coating
  - Exterior colour grey with black line
  - Suitable for potable water installations

Further information

For more information, see:

- „Potable water“ on page 70

This QR code will take you to the Viega online catalogue.

Geopress K

Press connector system made of fibre-glass reinforced polyamide. Permitted pipe types PE 80/100/100RC and PE-X. Internally sealed without sealing element. Support sleeve function integrated into the press connector. Suitable for underground, municipal supply lines.

Overview

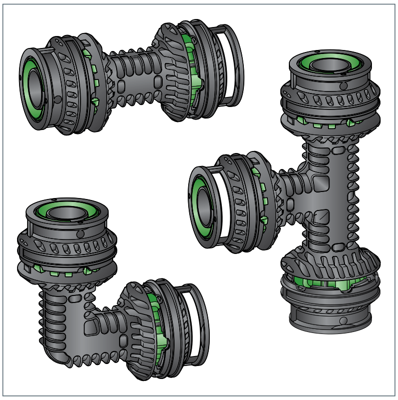


Fig. 194: Geopress K product selection

Dimensions

d 25; 32; 40; 50; 63
Tapping valves: d 63; 90; 110; 125; 140; 160; 180; 200; 225
Size availability in accordance with the national regulations

Areas of application

- Potable water
- Gas
- Liquid gas in the gaseous phase

Press connector materials

- Fibre-glass reinforced polyamide GF-PA / POM / CuSi4Zn9MnP

Further information

For more information, see:

- „Oils and diesel fuels“ on page 236

This QR code will take you to the Viega online catalogue.

Geopress G

Press connector system made of gunmetal for plastic pipes. Permitted pipe types PE 80/100/100RC and PE-X. Suitable for underground, municipal gas supply lines and underground liquid gas lines (only in conjunction with gunmetal support sleeves).

Overview

Fig. 195: Geopress G product selection

Sealing elements

- NBR (acrylonitrile butadiene rubber), black, pre-assembled

Dimension

d 32; 40; 50; 63

Tapping valves: d 63; 90; 110; 125; 140; 160; 180; 200; 225

Size availability in accordance with the national regulations

Areas of application

- Gas
- Liquid gas in the gaseous phase

Press connector materials

- Gunmetal: CC499K

Further information

For more information, see:

- „Oils and diesel fuels“ on page 236

This QR code will take you to the Viega online catalogue.

Flushing systems for maintaining potable water quality

To maintain potable water hygiene in industry, Viega offers flushing stations and the universal flush valve. The systems can be combined with numerous Viega press connector systems directly.

Flushing stations

With Viega Hygiene function for potable water cold (PWC) and potable water cold and hot (PWC/PWH), automatic flushing system for supporting operation as intended in case of foreseeable usage interruptions. Each section is freely configurable as PWC or PWH. For use in ring systems and pipes in series, wall and concealed mounting, installation in wet and dry construction and pre-wall systems. Time-based flush actuation of the flushing process via freely definable time intervals, freely selectable flush volume with and without temperature testing.
Use-based actuation of the flushing process via freely definable time intervals depending on a presettable time for usage interruption, check of the water exchange via a sensor in the piping, freely selectable flush volume with and without temperature testing. Temperature-based flush actuation of the flushing process via a sensor in the piping, check of impermissible stagnation temperature at freely-definable time intervals, freely selectable flush volume with and without temperature monitoring.
Communication over browser-based software via Ethernet or WLAN.
Connections to existing building automation systems via Ethernet connection.

Overview

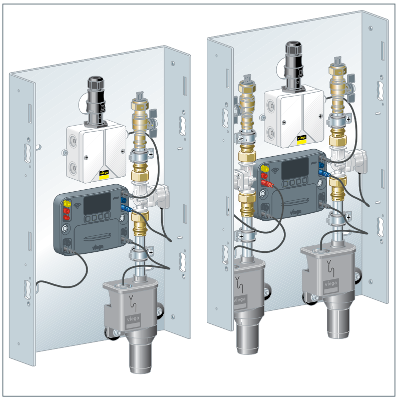


Fig. 196: Flushing stations

Product comparison

Both flushing stations suitable for:

- Potable water cold or hot (PWC or PWH)
- Use in ring systems and pipe in series, wall-mounted and concealed mounting
- Installation in wet and dry as well as pre-wall systems

Technical data for the two flushing stations:

- Flush volume 4.2 l/min (0.1 to 0.3 MPa)
- Operating pressure max. 1.0 MPa
- Operating temperature: max. 75°C,
- Minimum flow pressure: 1000 hPa
- Mains voltage: 100–240 V AC / 50–60 Hz

Model	For one flushing section	For two flushing sections
2241.10	✓	
2241.20		✓

Tab. 68: Product comparison of flushing stations

Compatible components

Model	Name	Features
2241.81	Flow meter fitting	■ For precise calculation of volumetric flows, function test for magnet valves ■ Plug connections reverse-polarity protected and watertight ■ Measuring range 1–10 l/min
2241.62	External sensor	■ With light and acoustic signal: DC 12 V / 200 mA, with light signal: DC 12 V / 90 mA ■ Optical light signal alert in case of malfunction, optionally with additional acoustic signal ■ Operating temperature range: 0 – 40°C ■ Sound pressure at 1 meter: 95 dB
2241.68	BMS module binary	■ Eight inputs (signals for building automation, potential-free) ■ 12 outputs (signals for building automation, relay contact max. 24 V/100 mA)
2241.90	Protective cover, concealed	■ For concealed mounting ■ Depth-adjustable from 12.5 to 50 mm

Model	Name	Features
2241.89	Wall-mounted protective cover	For wall-mounted assembly
2241.53	Blue multi-functional sensor	■ Brass screw-in piece ■ Screw-in sensor with G-thread ■ Blue plug connector for media marking
2241.54	Red multi-functional sensor	■ Brass screw-in piece ■ Screw-in sensor with G-thread ■ Red plug connector for media marking
2241.60	Screw-in sensor, blue	■ Adapter ring for transition from Rp¼ to Rp½ ■ Connection cable ■ Reverse-polarity protected and waterproof plug contacts
2241.61	Screw-in sensor, red	
2241.95	Extension cable PWC	■ Blue plug connector for media marking ■ Reverse-polarity protected and waterproof plug contacts
2241.96	PWH extension cable	■ Red plug connector for media marking ■ Reverse-polarity protected and waterproof plug contacts

Tab. 69: Compatible components for flushing stations

This QR code will take you to the Viega online catalogue.

Flush valve universal PWH/PWC

With Viega Hygiene function for potable water cold (PWC), or potable water hot (PWH), automatic flushing system for supporting operation as intended in case of foreseeable usage interruptions. For use in ring systems and pipes in series, wall and concealed mounting, installation in wet and dry construction and pre-wall systems. Volume-controlled actuation of the flushing process via (max. four settings) via freely-defined flush volumes. Connection to the Building Management System via potential-free contacts and analogue incoming signals 0–20 mA.

Overview

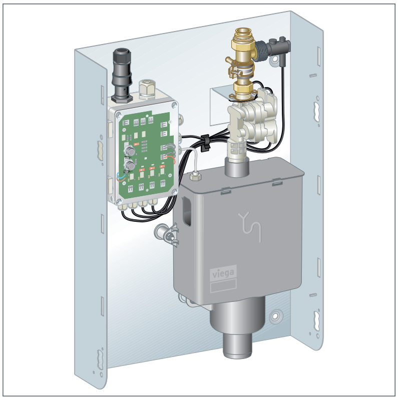


Fig. 197: Flush valve PWH/PWC (model 2243.10)

Model	Features
2243.10	■ For potable water cold or hot (PWC or PWH) ■ Use in ring systems and pipe in series, wall-mounted and concealed mounting ■ Installation in wet and dry as well as pre-wall systems Technical data: ■ Up to DN80 max. 45 l/m ■ Operating pressure max. 1.0 MPa ■ Operating temperature max. 75°C ■ Minimum flow pressure 1000 hPa ■ Mains voltage 100–240 V AC/50–60 Hz

Tab. 70: Product overview of flush valve model 2243.10

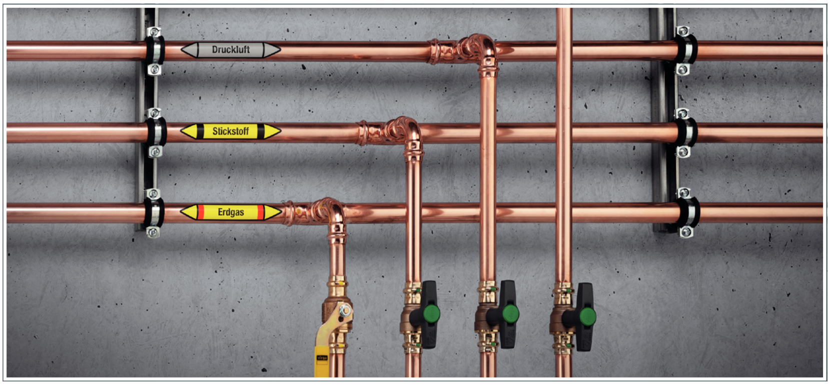
Compatible components

Model	Name	Features
2243.11	Protective cover	■ For concealed mounting ■ Depth-adjustable from 12.5 to 50 mm
2243.12	Protective cover	For wall-mounted assembly

Tab. 71: Compatible components, flush valve

This QR code will take you to the Viega online catalogue.

MEDIA LIST



For many years, Viega press connecting technology with the Sanpress, Sanpress Inox, Prestabo and Profipress systems has proved its worth for use in potable water and building services installations. Increasingly often, it is now used in industrial systems with special operating conditions in terms of pressure, temperature, and concentration of the transported media, requiring careful selection of the pipe and sealing materials.
This chapter makes it easier to select the materials. In special cases, please contact our Service Center to discuss whether your application is in compliance with the intended use of a system. For enquiries via fax, please use the attached checklist.

> Check the use of Viega press systems in the pharmaceutical and food industries on a case-by-case basis.
>
> Send your detailed enquiries to the Viega Service Center using the "Enquiry for material durability" form.
>
> You can find the form for this on the Viega website *viega.com* by entering "material durability" as the search term.

Sealing elements – Technical data

Sealing element short name	Technical designation	Viega press connector system application	Colour
EPDM	Ethylene propylene diene rubber	Sanpress Inox / Sanpress / Profipress / Megapress	Black polished
HNBR	Acrylonitrile butadiene rubber	Sanpress Inox G / Profipress G / Megapress G	Yellow
FKM	Fluor rubber	Sanpress Inox / Sanpress / Profipress / Megapress S	Black matt

Tab. 72: Technical data

Pipes and press connectors – transported media

Waters, frost and corrosion protection, heat transfer media

Waters

System name				Profipress		Profipress S		Sanpress					Prestabo		Mega-press	Mega-press S	Sea-press
Pipe material				copper	stainless steel 1.4520	copper	stainless steel 1.4520	stainless steel 1.4521	stainless steel 1.4520	stainless steel 1.4401	stainless steel 1.4521	stainless steel 1.4401	steel galvanised	steel hot dip galvanised	steel thick-walled	steel thick-walled	CuNiFe
Connector material				copper gunmetal Silicon bronze		copper gunmetal Silicon bronze		stainless steel			gunmetal Silicon bronze		galvanised steel		steel zinc-nickel plated		CuNiFe
Sealing element				EPDM		FKM		EPDM					EPDM		EPDM	FKM	EPDM
Medium	**Comment**	**p_{max} [MPa]**	**T_{max} [°C]**														
Drinking water	Requirement according to DWO, DIN 50 930-6	1.6	110	✓				✓		✓	✓	✓			✓ 9)		
Treated water (no drinking water)	Fully desalinated, deionised, demineralised, distilled (open system)							✓ 17)		✓ 17)							
Cooling water, closed circuit	Open systems available on request		≥ -25	✓	✓ 11)	✓ 10)	✓ 10) 11)	✓	✓	✓	✓	✓	✓ 3)	✓ 2) 3)	✓ 7)	✓ 7) 10)	✓
Vapour	Low pressure steam units	≤ 0.1	120	✓ 1)	✓ 1) 2)	✓	✓ 2)	✓ 1) 2)	✓ 1) 2)	✓ 1) 2)	✓ 1) 2)	✓ 1) 2)				✓ 8)	✓ 1) 2)
Well water	Requirements in acc. with DWO	1.6	110	✓				✓		✓	✓	✓					
Pump hot water heating systems	in acc. with DIN EN 12 828		105	✓	✓	✓ 10)	✓ 10)	✓	✓	✓	✓	✓	✓		✓	✓ 10)	✓

Anti-freeze / corrosion protection / cold and heat carrier

Medium	Product/manufacturer	p_{max} [MPa]	T_{max} [°C]	Profipress copper	Profipress stainless steel 1.4520	Profipress S copper	Profipress S stainless steel 1.4520	Sanpress 1.4521	Sanpress 1.4520	Sanpress 1.4401	Sanpress 1.4521 (gunmetal)	Sanpress 1.4401 (gunmetal)	Prestabo galvanised	Prestabo hot dip galvanised	Mega-press	Mega-press S	Sea-press
Anti-freeze, cooling brines concentration of 50%	Antifrogen N / Clariant	1.6	-25 to 110	✓	✓ 11)	✓ 10)	✓ 10) 11)	✓	✓	✓	✓	✓	✓ 3)		✓ 7)	✓ 7) 10)	✓
	Antifrogen L / Clariant			✓	✓ 11	✓ 10)	✓ 10) 11)	✓	✓	✓	✓	✓	✓ 3)		✓ 7)	✓ 7) 10)	✓
	Antifrogen Sol (solar installations) / Clariant			✓	✓ 11	✓ 10)	✓ 10) 11)	✓	✓	✓	✓	✓	✓ 3)		✓ 7)	✓ 7) 10)	✓
	Ethylene glycol (Ethan-1.2-diol)			✓	✓ 11	✓ 10)	✓ 10) 11)	✓	✓	✓	✓	✓	✓ 3)		✓ 7)	✓ 7) 10)	✓
	Propylene glycol (1.2-Propandiol)			✓	✓ 11	✓ 10)	✓ 10) 11)	✓	✓	✓	✓	✓	✓ 3)		✓ 7)	✓ 7) 10)	✓
	Tyfoxit / Tyforop-Chemie			✓	✓ 11	✓ 10)	✓ 10) 11)	✓	✓	✓	✓	✓	✓ 3)		✓ 7)	✓ 7) 10)	✓
	Tyfocor / Tyforop-Chemie			✓	✓ 11	✓ 10)	✓ 10) 11)	✓	✓	✓	✓	✓	✓ 3)		✓ 7)	✓ 7) 10)	✓
Potassium Acetate/-formiat brine	TEMPER® Antifrogen KF / Clariant Glysofor KF / Wittig							✓	✓	✓							

1) sealing elements replaced for FKM
2) without additives
3) corrosion protection acc. to AGI Q151
7) corrosion protection for the pipes acc. to AGI Q151; thanks to their zinc-nickel coating, the Megapress connectors do not require any corrosion protection
8) following coordination with the Attendorn factory
9) only applicable for Megapress silicon bronze adapter, model 4213.2
10) for operating temperatures of -5 °C to +140 °C
11) The use of Sanpress and Sanpress Inox press connectors is recommended. When using Profipress press connectors made of copper the connection points between pipe and press connector have to be protected with a corrosion prevention agent.
17) Resistance < 1 MΩ · cm (at 25 °C)

Oils

System name				Profipress	Sanpress						Profipress G	Sanpress Inox G	Prestabo	Megapress	Megapress S	Megapress G	Seapress
Pipe material				copper	stainless steel 1.4521	stainless steel 1.4520	stainless steel 1.4401	stainless steel 1.4521	stainless steel 1.4520	stainless steel 1.4401	copper	stainless steel	steel galvanised	steel thick-walled			CuNiFe
Connector material				copper gunmetal Silicon bronze	stainless steel			gunmetal Silicon bronze			copper gunmetal Silicon bronze	stainless steel	steel galvanised	steel zinc-nickel plated			CuNiFe
Sealing element				EPDM	EPDM						HNBR	HNBR	EPDM	EPDM	FKM	HNBR	EPDM
Medium	Comment	p_{max} [MPa]	T_{max} [°C]														
Mineral oils SAE	15–108 mm / ⅜–4 inch	1.6	70									✓ 4)			✓	✓	
Fuel oil acc. to DIN 51603-1 Diesel acc. to DIN EN 590	according to TRbF (German Technical Regulations for Flammable Liquids) 12–54 mm / ½–2 inch	0.5	40								✓	✓				✓	
Palm oil		1.0	70									✓ 4)			✓ 8)	✓ 8)	
Rapeseed oil	DIN W 51805	1.0	70									✓ 4)			✓ 8)	✓ 8)	
Soy oil		1.0	70									✓ 4)			✓ 8)	✓ 8)	
Sunflower oil		1.0	70									✓ 4)			✓ 8)	✓ 8)	
Biodiesel	EN 14214	1.0	70		✓ 1)	✓ 1)	✓ 1)								✓		
Palm oil heating		1.0	90		✓ 1)	✓ 1)	✓ 1)										

1) sealing elements replaced for FKM

4) in connection with Viega stainless steel pipe 1.4521, 1.4520 and 1.4401

8) following coordination with the Attendorn factory

Compressed air
assigned to the purity classes in accordance with ISO 8573-1:2010-04

system name	pipe material	Sealing element[12]	p_{max} [MPa]	T_{max} [°C]	Solid particles class[13]									Residual moisture content class											Oil content class					
					0	1	2	3	4	5	6	7	X	0	1	2	3	4	5	6	7	8	9	X	0	1	2	3	4	X
Profipress	Copper pipe acc. to DIN EN 1057	EPDM	1,6	60	O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✗
Profipress S	Copper pipe acc. to DIN EN 1057	FKM	1,6	60	O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓
Profipress G	Copper pipe acc. to DIN EN 1057	HNBR	1,6	60	O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓
Sanpress	1.4401 model 2203/2203XL	EPDM	1,6	60	O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✗
Sanpress	1.4401 model 2203/2203XL	FKM[15]	1,6	60	O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓
Sanpress	1.4521 model 2205/2205XL	EPDM	1,6	60	O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✗
Sanpress	1.4521 model 2205/2205XL	FKM[15]	1,6	60	O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓
Sanpress	1.4520 model 2204/2204XL	EPDM	1,6	60	O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✗
Sanpress	1.4520 model 2204/2204XL	FKM[15]	1,6	60	O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓
Sanpress Inox	1.4401 model 2203/2203XL	EPDM	1,6	60	O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✗
Sanpress Inox	1.4401 model 2203/2203XL	FKM[15]	1,6	60	O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓
Sanpress Inox	1.4521 model 2205/2205XL	EPDM	1,6	60	O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✗
Sanpress Inox	1.4521 model 2205/2205XL	FKM[15]	1,6	60	O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓
Sanpress Inox	1.4520 model 2204/2204XL	EPDM	1,6	60	O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✗
Sanpress Inox	1.4520 model 2204/2204XL	FKM[15]	1,6	60	O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓
Sanpress Inox G	1.4401 model 2203/2203XL	HNBR	1,6	60	O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓
Sanpress Inox LF	1.4401 model 2203/2203XL	EPDM	1,6	60	O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✗
Sanpress Inox LF	1.4521 model 2205/2205XL	EPDM	1,6	60	O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✗
Sanpress Inox LF	1.4520 model 2204/2204XL	EPDM	1,6	60	O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✗

[12] EPDM sealing element for oil concentrations < 25 mg/m³
[13] Recommendation for classes 1 to 3: Flush the line before commissioning
[15] The EPDM factory-fitted sealing element can be exchanged for a FKM sealing element on-site

✓ = For use
✗ = Not for use
O = Conditional use, consultation with the Service Center required

system name	pipe material	Sealing element[12]	p_{max} [MPa]	T_{max} [°C]	Solid particles[13] class									Residual moisture content class											Oil content class					
					0	1	2	3	4	5	6	7	X	0	1	2	3	4	5	6	7	8	9	X	0	1	2	3	4	X
Seapress	Copper nickel wrought alloy to DIN 86019 WL 2.1972.11 or WL 2.1972.22	EPDM	1.6	60	O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✗
		FKM[15]			O	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓
Prestabo	Externally galvanised model 1103/1103XL	EPDM			✗	✗	✗	✗	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✗
		FKM[15]			✗	✗	✗	✗	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓
	PP coated model 1104	EPDM			✗	✗	✗	✗	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✗
		FKM[15]			✗	✗	✗	✗	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓
	Externally and internally galvanised model 1106/1106XL	EPDM			✗	✗	✗	✗	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✗
		FKM[15]			✗	✗	✗	✗	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓
Prestabo LF	Externally galvanised model 1103/1103XL	EPDM			✗	✗	✗	✗	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✗
	PP coated model 1104	EPDM			✗	✗	✗	✗	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✗
	Externally and internally galvanised model 1106/1106XL	EPDM			✗	✗	✗	✗	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✗
Megapress	Steel pipes according to DIN EN 10255 DIN EN 10220 DIN EN 10216-1 DIN EN 10217-1	EPDM			✗	✗	✗	✗	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✗
Megapress S		FKM			✗	✗	✗	✗	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓
Megapress G		HNBR			✗	✗	✗	✗	✓	✓	✓	✓	✓	O	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓

[12] EPDM sealing element for oil concentrations < 25 mg/m^3

[13] Recommendation for classes 1 to 3: Flush the line before commissioning

[15] The EPDM factory-fitted sealing element can be exchanged for a FKM sealing element on-site

✓ = For use

✗ = Not for use

O = Conditional use, consultation with the Service Center required

Gases

Gases*

Medium	Comment	p_{max} [MPa]	T_{max} [°C]	Profipress		Profipress S		Sanpress					Profipress G	Sanpress Inox G	Prestabo		Megapress	Megapress S	Megapress G	Seapress
Pipe material				copper	stainless steel 1.4520	copper	stainless steel 1.4520	stainless steel 1.4521	stainless steel 1.4520	stainless steel 1.4401	stainless steel 1.4521	stainless steel 1.4401	copper	stainless steel	steel galvanised	steel hot dip galvanised	steel thick-walled			CuNi-Fe
Connector material				copper gunmetal Silicon bronze				stainless steel			gunmetal Silicon bronze		copper gunmetal Silicon bronze	stainless steel	galvanised steel		steel zinc-nickel plated			CuNi-Fe
Sealing element				EPDM		FKM		EPDM					HNBR	HNBR	EPDM		EPDM	FKM	HNBR	EPDM
Natural gas	according to G 260	0.5											✓ 5)	✓					✓	
Liquid gases, propane, butane, methane													✓ 5)	✓					✓	
Acetylene	Test pressure 2.4 MPa 15–28 mm	0.15						✓ 16)												
Argon	12–54 mm / ⅜–2 inch	1.6		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	
	64–108 mm / 2½–4 inch	1.0																		
Carbogen	$CO_2 + O_2$ dry 12–54 mm / ⅜–2 inch	1.6		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	
	64–108 mm / 2½–4 inch	1.0																		
Oxygen – O_2	Keep free of oil and grease 12–54 mm / ⅜–2 inch	1.0	60	✓ 14)				✓ 14)									✓ 7)			
Nitrogen – N_2	Downstream of the vaporiser 12–54 mm / ⅜–2 inch	1.6		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	
	64–108 mm / 2½–4 inch	1.0																		
Hydrogen – H_2	12–108 mm / ⅜–2 inch	0.5		✓	✓			✓	✓	✓	✓	✓	✓	✓			✓ 8)		✓ 8)	
Carbon dioxide – CO_2	dry 12–54 mm	1.6		✓	✓			✓	✓	✓	✓	✓	✓	✓						
	64–108 mm	1.0																		
Carbon monoxide – CO	Stainless steel parts not permitted 12–54 mm	1.6		✓									✓							
	64–108 mm	1.0																		

* Purity requirements acc. to DIN EN 437 available on request

1) sealing elements replaced for FKM

4) in connection with Viega stainless steel pipe 1.4521, 1.4520 and 1.4401

5) in case of HTR (higher thermal resistance) requirement, max. permitted operating pressure p_{max} = 0.1 MPa

7) BAM certified

8) following coordination with the Attendorn factory

14) TÜV certified

16) ≤ DN 25 / also applies for Sanpress Inox LF (labs-free)

Gases*

System name				Profipress		Profipress S		Sanpress					Profipress G	Sanpress Inox G	Prestabo		Megapress	Megapress S	Megapress G	Seapress
pipe material				copper	stainless steel 1.4520	copper	stainless steel 1.4520	stainless steel 1.4521	stainless steel 1.4520	stainless steel 1.4401	1.4521	1.4401	copper	stainless steel	steel galvanised	steel hot dip galvanised	steel thick-walled			CuNiFe
Connector material				copper gunmetal Silicon bronze				stainless steel			gunmetal Silicon bronze		copper gunmetal Silicon bronze	stainless steel	steel galvanised		steel zinc-nickel plated			CuNiFe
Sealing element				EPDM		FKM		EPDM					HNBR	HNBR	EPDM		EPDM	FKM	HNBR	EPDM
Medium	**Comment**	**p_{max} [MPa]**	**T_{max} [°C]**																	
Coarse vacuum	P_{abs} = 1hPa		70	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
Forming gas, dry/inert gas	Ar + CO_2 (e.g. corgon) 15–54 mm/⅜–2 inch	1.6	60	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	
	64–108 mm/2½–4 inch	1.0																		
Nitrous oxide (laughing gas)	12–54 mm	1.6						✓	✓	✓										
	64–108 mm	1.0																		
Ethane	12–54 mm	1.6												✓						
	64–108 mm	1.0																		
Ethene (ethylene)	12–54 mm	1.6												✓						
	64–108 mm	1.0																		
Helium	12–54 mm	1.6											✓	✓						
	64–108 mm	1.0																		
Krypton	15–54 mm	1.6		✓	✓			✓	✓	✓	✓	✓	✓	✓						
	64–108 mm	1.0																		
Neon	15–54 mm	1.6		✓	✓			✓	✓	✓	✓	✓	✓	✓						
	64–108 mm	1.0																		
Propene (propylene)	15–54 mm	1.6								✓ 1)										
	64–108 mm	1.0																		
Xenon	15–54 mm	1.6		✓	✓			✓	✓	✓	✓	✓	✓	✓						
	64–108 mm	1.0																		
Synthetic air	12–54 mm	1.6		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓						✓
	64–108 mm	1.0																		

* Purity requirements acc. to DIN EN 437 available on request

1) sealing elements replaced for FKM

Special media - Examined and approved

Special media*

System name				Profipress		Sanpress					Profipress G	Sanpress Inox G	Prestabo	Megapress	Megapress S	Megapress G	Seapress
pipe material				copper	stainless steel 1.4520	stainless steel 1.4521	stainless steel 1.4520	stainless steel 1.4401	stainless steel 1.4521	stainless steel 1.4401	copper	Stainless steel 1.4401	steel galvanised	steel thick-walled	steel thick-walled	steel thick-walled	CuNiFe
Press connector material				copper gunmetal Silicon bronze	copper gunmetal Silicon bronze	stainless steel	stainless steel	stainless steel	gunmetal Silicon bronze	gunmetal Silicon bronze	copper gunmetal Silicon bronze	stainless steel	steel galvanised	steel zinc-nickel plated	steel zinc-nickel plated	steel zinc-nickel plated	CuNiFe
Sealing element				EPDM	EPDM	EPDM	EPDM	EPDM	EPDM	EPDM	HNBR	HNBR	EPDM	EPDM	FKM	HNBR	EPDM
Medium	**Comment**	p_{max} [MPa]	T_{max} [°C]														
Urea solution	Max. concentration 40 %	1.0	40			✓	✓	✓									
Ethanol		1.6	25	✓	✓	✓	✓	✓	✓	✓							
Methanol	Caution: toxic!	1.6	25			✓	✓	✓									
Condensate	from gas-powered calorific value devices, not from oil-powered calorific value devices!	1.6	110			✓	✓	✓									
Condensate	of vapour	1.6	110	✓ 6)	✓ 6)	✓	✓	✓	✓ 6)	✓ 6)				✓ 8)	✓ 8)		✓
Glycerine triacetate		0.1	20			✓	✓	✓									
Caustic soda	30 % aqueous solution	1.0	20			✓		✓									
Caustic soda	50 % aqueous solution	1.0	60					✓									
Acetone	liquid	0.5	-10 to 40	✓	✓	✓	✓	✓	✓	✓							
Ammoniac	Medium free from CO_2 + H_2O Caution: toxic!	0.2	25			✓	✓	✓									
Biogas – before biogas treatment	45–70 % CH_4 / 20–45 % CO_2 / H_2S < 30 mg/m³	0.5	70									✓					
Biogas – after biogas treatment	according to G260 and G262	0.5	70								✓ 5)	✓				✓	
Fermenter heating	Substrate temperature 65 °C	1.0	105					✓									

* Purity requirements acc. to DIN EN 437 available on request

5) in case of HTR (higher thermal resistance) requirement, max. permitted operating pressure p_{max} = 0.1 MPa

6) without contamination

8) following coordination with the Attendorn factory

Valves – transported media

Waters, frost and corrosion protection, heat carriers

Waters

Product name				Easytop ball valve		Free-flow valve	Easytop Inox ball valve	Profipress G gas ball valve	Gas ball valve
Model no.				2270, 2270.4, 2270.10, 2275, 2275.3, 2275.4	2270.1, 2270.2, 2275.1, 2275.2, 2275.5, 2275.6	2242, 2278	2370	2670, 2670.4, 2671, 2671.3	G2101
Press connector material				gunmetal Silicon bronze			stainless steel	gunmetal Silicon bronze	brass
Seal				EPDM		EPDM	EPDM	HNBR	
Medium	**Comment**	**p_{max} [MPa]**	**T_{max} [°C]**						
Drinking water	Requirement acc. to DWO, DIN 50 930-6	1.6	110	✓	✓	✓	✓		
Treated water (no drinking water)	Fully desalinated, deionised, demineralised, distilled (open system)						✓		
Cooling water, closed circuit	Open systems available on request		≥ -25	✓	✓	✓	✓		
Well water	Requirements in acc. with DWO		110	✓	✓	✓	✓		
Pump hot water heating systems	in acc. with DIN EN 12 828		105	✓	✓	✓	✓		

Anti-freeze / corrosion protection / cold and heat carrier

Medium	Product/manufacturer	p_{max} [MPa]	T_{max} [°C]	Easytop ball valve (2270, 2270.4, 2270.10, 2275, 2275.3, 2275.4)	Easytop ball valve (2270.1, 2270.2, 2275.1, 2275.2, 2275.5, 2275.6)	Free-flow valve	Easytop Inox ball valve	Profipress G gas ball valve	Gas ball valve
Anti-freeze, cooling brines concentration of 50%	Antifrogen N / Clariant	1.6	-25 to 110	✓	✓	✓	✓		
	Antifrogen L / Clariant			✓	✓	✓	✓		
	Antifrogen Sol (solar installations) / Clariant			✓	✓	✓	✓		
	Ethylene glycol (Ethan-1.2-diol)			✓	✓	✓	✓		
	Propylene glycol (1.2-Propandiol)			✓	✓	✓	✓		
	Tyfoxit / Tyforop-Chemie			✓	✓	✓	✓		
	Tyfocor / Tyforop-Chemie			✓	✓	✓	✓		
Potassium Acetate/-formiat brine	TEMPER® Antifrogen KF/Clariant Glysofor KF/Wittig						✓		

Oils

Medium	Comment	p_{max} [MPa]	T_{max} [°C]	Easytop ball valve		Free-flow valve	Easytop Inox ball valve	Profipress G gas ball valve	Gas ball valve
			Model no.	2270, 2270.4, 2270.10, 2275, 2275.3, 2275.4	2270.1, 2270.2, 2275.1, 2275.2, 2275.5, 2275.6	2242, 2278	2370	2670, 2670.4, 2671, 2671.3	G2101
			Press connector material	gunmetal Silicon bronze			stainless steel	gunmetal Silicon bronze	brass
			Seal	EPDM		EPDM	EPDM	HNBR	
Mineral oils SAE		1.6						✓	✓
Palm oil								✓	✓
Rapeseed oil	DIN W51805		70					✓	✓
Soy oil		1.0						✓	✓
Sunflower oil								✓	✓
Palm oil heating	Valves not in palm oil		90	✓	✓	✓	✓		

Gases

Gases*

Product name					Easytop ball valve		Free-flow valve	Easytop Inox ball valve	Profipress G gas ball valve	Gas ball valve
Model no.					2270, 2270.4, 2270.10, 2275, 2275.3, 2275.4	2270.1, 2270.2, 2275.1, 2275.2, 2275.5, 2275.6	2242, 2278	2370	2670, 2670.4, 2671, 2671.3	G2101
Press connector material					gunmetal Silicon bronze			stainless steel	gunmetal Silicon bronze	brass
Seal					EPDM		EPDM	EPDM	HNBR	
Medium	**Comment**		**p_{max} [MPa]**	**T_{max} [°C]**						
Compressed air	Oil concentration ≤ 25 mg/m³	12–54 mm	1.6	60	✓	✓		✓	✓	✓
		64–108 mm								
	Oil concentration ≥ 25 mg/m³	12–54 mm							✓	✓
		64–108 mm								
Natural gas	according to G 260		0.5						✓ 5)	✓ 5)
Liquid gases, propane, butane, methane									✓ 5)	✓ 5)
Argon		12–54 mm	1.6		✓	✓		✓	✓	✓
		64–108 mm	1.0							
Carbogen	CO_2 + O_2 dry	12–54 mm	1.6		✓	✓		✓	✓	✓
		64–108 mm	1.0							
Nitrogen – N_2	Downstream of the vaporiser	12–54 mm	1.6		✓	✓		✓	✓	✓
		64–108 mm	1.0							
Hydrogen – H_2		12–108 mm	0.5		✓	✓		✓	✓	✓
Carbon dioxide – CO_2	dry	12–54 mm	1.6		✓	✓		✓	✓	✓
		64–108 mm	1.0							
Carbon monoxide – CO	Stainless steel parts not permitted	12–54 mm	1.6		✓	✓			✓	✓
		64–108 mm	1.0							

* Purity requirements acc. to DIN EN 437 available on request

5) in case of HTR (higher thermal resistance) requirement, max. permitted operating pressure p_{max} = 0.1 MPa

Gases*

Medium	Comment	p_{max} [MPa]	T_{max} [°C]	Easytop ball valve	Easytop ball valve	Free-flow valve	Easytop Inox ball valve	Profipress G gas ball valve	Gas ball valve
Model no.				2270, 2270.4, 2270.10, 2275, 2275.3, 2275.4	2270.1, 2270.2, 2275.1, 2275.2, 2275.5, 2275.6	2242, 2278	2370	2670, 2670.4, 2671, 2671.3	G2101
Press connector material				gunmetal Silicon bronze	gunmetal Silicon bronze	gunmetal Silicon bronze	stainless steel	gunmetal Silicon bronze	brass
Seal				EPDM		EPDM	EPDM	HNBR	
Coarse vacuum	P_{abs} = 1hPa		70	✓			✓	✓	✓
Forming gas, dry/inert gas	Ar + CO_2 (e.g. corgon) 15–54 mm	1.6	60	✓	✓		✓	✓	✓
	64–108 mm	1.0	60						
Nitrous oxide (laughing gas)	12–54 mm	1.6	60				✓		
	64–108 mm	1.0	60						
Ethane	12–54 mm	1.6	60					✓	✓
	64–108 mm	1.0	60						
Ethene (ethylene)	12–54 mm	1.6	60					✓	✓
	64–108 mm	1.0	60						
Helium	15–54 mm	1.6	60					✓	✓
	64–108 mm	1.0	60						
Krypton	15–54 mm	1.6	60	✓	✓		✓		
	64–108 mm	1.0	60						
Neon	15–54 mm	1.6	60	✓	✓		✓		
	64–108 mm	1.0	60						
Xenon	15–54 mm	1.6	60	✓	✓		✓		
	64–108 mm	1.0	60						
Synthetic air	12–54 mm	1.6	60	✓	✓		✓	✓	✓
	64–108 mm	1.0	60						

* Purity requirements acc. to DIN EN 437 available on request

Special media – Examined and approved

Special media*

Medium	Comment	p_{max} [MPa]	T_{max} [°C]	Easytop ball valve		Free-flow valve	Easytop Inox ball valve	Profipress G gas ball valve	Gas ball valve
			Model no.	2270, 2270.4, 2270.10, 2275, 2275.3, 2275.4	2270.1, 2270.2, 2275.1, 2275.2, 2275.5, 2275.6	2242, 2278	2370	2670, 2670.4, 2671, 2671.3	G2101
			Press connector material	gunmetal Silicon bronze			stainless steel	gunmetal Silicon bronze	brass
			Seal	EPDM		EPDM	EPDM	HNBR	
Urea solution	Max. concentration 40 %	1.0	40				✓		
Ethanol		1.6	25	✓	✓	✓	✓		
Methanol	Caution: toxic!						✓		
Condensate	from gas-powered calorific value devices, not from oil-powered calorific value devices!		110				✓		
Condensate	of vapour			✓ 6)	✓ 6)	✓ 6)	✓		
Caustic soda	50 % aqueous solution	1.0	60				✓		
Acetone	liquid	0.5	-10 to 40	✓	✓	✓	✓		
Biogas – after biogas treatment	according to G260 and G262		70					✓ 5)	✓ 5)
Fermenter heating	Substrate temperature 65 °C outside of the fermenter	1.0	105	✓	✓		✓		

* Purity requirements acc. to DIN EN 437 available on request

5) in case of HTR (higher thermal resistance) requirement, max. permitted operating pressure p_{max} = 0.1 MPa

6) without contamination

Form

Inquiry regarding material durability

Inquiry regarding material durability

Global Service & Consulting-Team Application
Phone +49 (0) 2722 61 5666
material-request@viega.com

Customer		**Building project**	
Customer no.			
Customer/company*		Customer/company*	
Contact persons*		Contact persons	
Street*		Street	
Postal code/town*		Postal code/town	
Country*		Country	
Phone*		Phone	
Email*		Email	
		Potential*	

Information about the installation system	
Planned system*	
Dimension*	

Information about the medium			
Supplier/manufacturer*			
Trade name/designation*			
Application/function*			
Concentration of the medium*			
Other components			
		Time interval (Sec.)	Duration of the condition
max. temp.*			
min. temp.*			
max. pressure*			
min. pressure*			
max. pH value			
min. pH value			

Information about the system				
Function of the complete system				
Installation site*	☐ Indoor		☐ Outdoor	
Type of installation*	☐ open		☐ closed	
Stagnation*	☐ yes		☐ no	
Ambient conditions*	☐ Interior spaces	☐ Country air	☐ City air	☐ Sea air
	☐ Industrial air	☐ Other:		
desired service life*	☐ < 1 year	☐ 1–5 years	☐ 5–10 years	☐ > 10 years

Free text field	

*) Mandatory fields

GLOSSARY / LIST OF ABBREVIATIONS

AD
Arbeitsgemeinschaft Druckbehälter (Working Group for Pressure Vessels)

AGFW
Energieeffizienzverband für Wärme, Kälte und KWK e.V. (German Energy Efficiency Association for Heating, Cooling and CHP)

ANSI
American National Standards Institute

ASTM
American Society for Testing and Materials

AVBWasserV
Verordnung über allgemeinene Bedingungen für die Versorgung mit Wasser (Ordinance on the general conditions for the supply of water)

BAuA
Bundesanstalt für Arbeitsschutz und Arbeitsmedizin (Federal Institute for Occupational Safety and Health)

BImSchV
Bundesimmissionsschutzverordnung (BImSchV) (Federal Emission Control Act)

BTGA
Bundesindustrieverband Technische Gebäudeausrüstung e. V. (Federal Industrial Association for Building Services Engineering)

CFU
Colony Forming Unit

DEKRA
Deutscher Kraftfahrzeug-Überwachungs-Verein (European vehicle inspection company)

DGUV
Deutsche Gesetzliche Unfallversicherung e. V. (German Social Accident Insurance)

DIN
Deutsches Institut für Normung (German Institute for Standardisation)

DN
Nominal width (diamètre nominal)

DVFG
Deutscher Verband Flüssiggas e.V. (German Liquefied Natural Gas Association)

DVGW
Deutscher Verein des Gas- und Wasserfaches e.V. (German Technical and Scientific Association for Gas and Water)

EDI
Electro-deionisation

EIGA
European Industrial Gases Association

EN
European standard

EnEV
Energy Saving Ordinance
EPDM
Ethylene propylene diene rubber
figawa
Bundesvereinigung der Firmen im Gas- und Wasserfach e. V.
(Association of Companies for Gas and Water Technologies)
FKM
Fluorocarbon rubber
HNBR
Hydrogenated acryl nitrile butadiene rubber
HTR
Higher thermal resistance
IfSG
The Act on the Prevention and Control of Infectious Diseases in Humans
("Protection Against Infection Act" (IfSG)
IHPH
Institute for Hygiene and Public Health
ISO
International Organisation for Standardisation
KTW
Plastics in contact with potable water
MAG
Metal Active Gas Welding
MHHR
High-rise building model guideline
MOP
Maximum Operation Pressure
MPA
Materialprüfungsamt (Material Testing Institute)
NBR
Acrylonitrile butadiene rubber
Operators
Natural or legal persons who, during the operation of a building, deliver the “operation” partial performance of the Facility Manager as part of the building management strategy
PE
Polyethylene
PE-X
Cross-linked polyethylene
PN
Pressure nominal
PPSU
Polyphenylsulfone
PWC
Potable Water Cold
PWC-C
Potable Water Cold-Circulation

PWH
Potable Water Hot
PWH-C
Potable Water Hot-Circulation
PWIS
Paint-wetting impairment substances
RKI
Robert Koch Institute
SDR
Standard Dimension Ratio
TOC
Total Organic Carbon
TRF
Technical rules for liquid gas (publisher: DVFG)
TRGI
Technical rules for gas installations (publisher: DVGW)
TRGS
Technical rules for hazardous substances
TrinkwV
Ordinance on the quality of water for human consumption (Potable Water Ordinance)
TÜV
German technical inspection association
TWE
Potable water heater
UBA
German Environment Agency
UFC
Ultrafiltration Control
UsI
Contractor and other owners
UVV
German Accident Prevention Regulation
VDI
Verein Deutscher Ingenieure e. V. (Association of German Engineers)
VDMA
Verband Deutscher Maschinen und Anlagenbau e. V. (German Mechanical Engineering Industry Association)
VdS
Verband für Sachversicherer (Property Insurers' Association)
VdTÜV
Verband der TÜV e.V. (TÜV Association)
WVU
Water supply company
ZVSHK
Zentralverband Sanitär Heizung Klima (Central association for plumbing, heating and conditioning)

INDEX

A

B

C

D

Viega GmbH & Co. KG
Viega Platz 1
57439 Attendorn
Germany

Phone +49 (0) 2722 61-0

viega.com

817 572 · 2022-08 · V1 · VPN200258