TECHNICAL GUIDELINES

PIPE SYSTEMS

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References to standards and installation recommendations are based on standards and building regulations currently applicable in Germany. Different or supplementary regulations may apply in other countries. Observe all local regulations.

TECEflex
Technical Guidelines

TECE
Intelligente Haustechnik

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Description of the system

TECEflex is the universal installation system for potable water, heating, compressed air and gas installation. All-plastic pipes and composite pipes are available. The pipes are connected using axial pressure sleeve technology, without the use of O-rings.

TECEflex offers:

- Connection without O-rings
- Connections with low pressure loss through the use of expansion technology
- High resistance to pressure and temperature
- Hygienically clean
- Fault-tolerant and therefore extremely safe system
- Flush mounting possible
- Rigid composite pipes, stable towards bending
- One fitting for three pipe types – therefore no danger of using the wrong fitting, considerably lower storage requirements
- Axial pressing connector with low cross-section narrowing

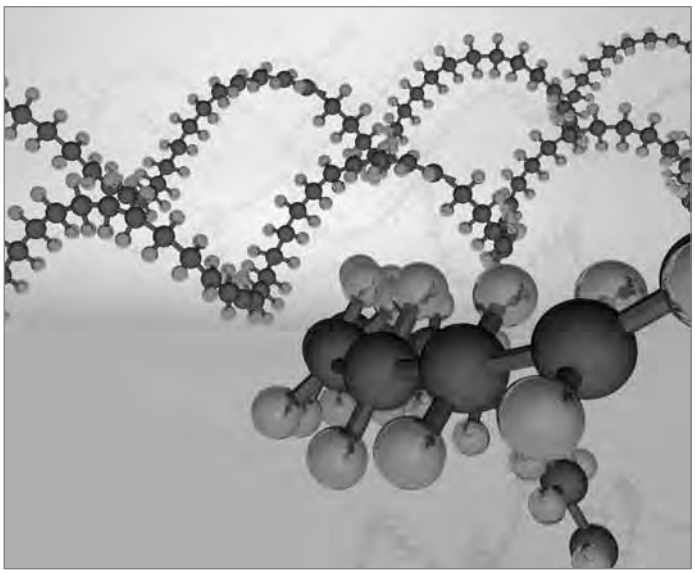
Types of pipe

The TECEflex system offers the right pipe for every installation application:

- Composite pipe for potable water, heating and compressed air applications
- Composite pipe – in yellow – for indoor gas installations
- PE-Xc five-layer pipe for potable water, heating and compressed air applications (with inner diffusion block)
- PE-MDXc five-layer pipe for floor heating (with inner diffusion block)

Electron beam cross-linking

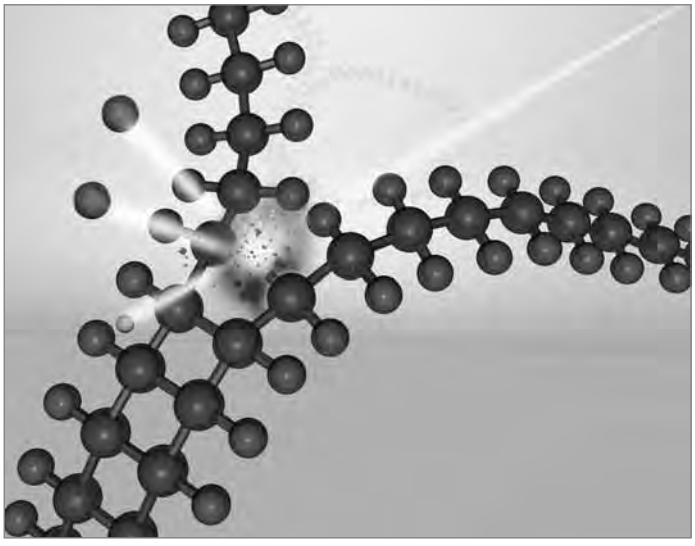
Potable water, heating, compressed air and gas installation place high demands on the pipe material. In addition to being pressure- and temperature-resistant, a pipe must be resistant to chemicals and have a life of at least 50 years. Plastic pipes made of polyethylene are cross-linked in order to improve their mechanical properties.
The cross-linking of polyethylene involves linking the long, loosely adjacent polyethylene molecules to form a large, three-dimensional macromolecule. Polyethylene molecules are very long chains of hydrocarbons.
These chains are loosely adjacent, and the chains are not linked. Only low forces of attraction keep them together. This two-dimensional structure is the reason why polyethylene melts. If the plastic is heated, the chains start to vibrate and as soon as these vibrations are so strong that the forces of attraction are no longer enough, the plastic becomes liquid.



Unlinked PE molecules

The cross-linked macromolecule, on the other hand, has a three-dimensional structure. The long polyethylene chains are firmly linked to each other by fixed bonds. This molecular structure gives the cross-linked polyethylene its excellent properties. The three-dimensional grid prevents the plastic from melting. As a result, cross-linked pipes cannot be welded.

All TECEflex pipes are electron beam cross-linked polyethylene pipes and have proven their worth over many years. They meet the requirements of the DVGW (German Technical and Scientific Association for Gas and Water) for potable water and gas installations and the DIN CERTCO requirements for heating installations. A TÜV type approval certificate is available for use in compressed air installation. The pipes are externally monitored by recognized testing institutes and have the most important European approvals and certificates.



Molecular structure of cross-linked polyethylene

TECEflex pipes are cross-linked by means of a high-energy electron beam. This method is a purely physical process. Electron beam cross-linked pipes have the designation PE-Xc. "PE" stands for the material polyethylene, "X" stands for cross-linked and "c" refers to the cross-linking procedure.

Memory effect

Cross-linked pipes have a memory effect. This means the plastic tries to return to its original geometry after being deformed. As a result of the memory effect, it is possible to repair kinks in a PE-Xc pipe with an industrial blower, for example. Non-cross-linked pipes would melt. The memory effect prevents the plastic from yielding under pressure. This represents a huge safety advantage for the connection technique. The cross-linked plastic of a PE-Xc pipe stays in place even under tension. The memory effect is what makes the O-ring-free connection technique of the TECEflex systems possible in the first place.

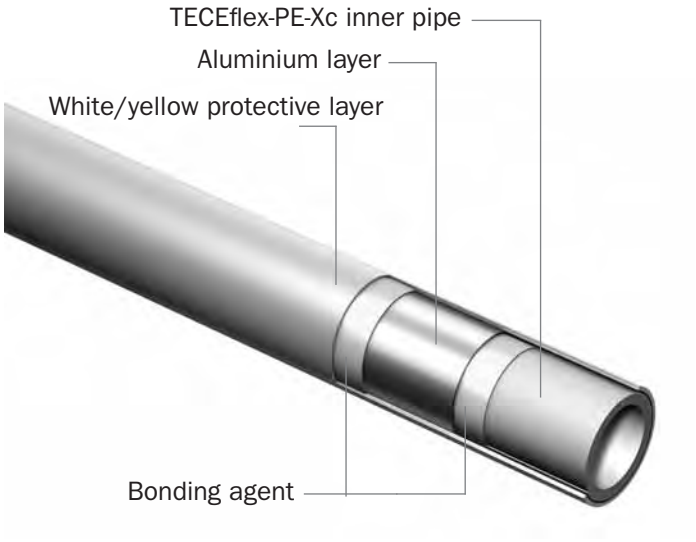
The advantages of electron beam cross-linked PE-Xc pipes

The increased mechanical strength of the electron beam cross-linked TECEflex pipes gives the following properties:

- Very good long-term behaviour during constant internal pressure testing, even at high temperatures
- Good thermal ageing stability so that no damage caused by thermo-oxidative changes is to be expected, when used as intended
- High resistance to the formation of stress cracks
- Good resistance to chemicals, which means the pipes are also resistant to heating system additives such as inhibitors
- Can be laid cold, without any heat treatment
- Can be laid with small bending radii
- High resistance to corrosion
- Smooth pipe walls, which means low pressure drop and low tendency towards incrustation
- Good abrasion resistance and resistance to tear propagation
- Impact-resistant at low temperatures
- No creep behaviour of the plastic material
- Suitable for every potable water quality according to the German Ordinance on Potable Water (TrinkwV 2001)
- Odourless and tasteless
- Construction site quality for rough day-to-day installation work

TECEflex PE-Xc/AL/PE composite pipe

The TECEflex composite pipe has a particularly strong inner pipe of PE-Xc. This inner pipe would already meet all pressure- and temperature-resistance requirements on its own. The aluminium layer and the PE outer layer provide additional mechanical safety. This special construction feature of the TECEflex composite pipe gives it its unique buckling resistance so the pipe can be bent and processed by hand without using flexible springs.
Only the yellow composite pipes are permitted for use in gas installations. The pipes are identified with W/G 100. They are permitted for indoor gas installation up to 100 mbar.



Structure of the TECEflex composite pipe

The PE-Xc/AL/PE composite pipe is a pipe with a butt-welded aluminium layer. The material combination reduces the thermal linear deformation and makes the pipe rigid and resistant to bending at the same time.

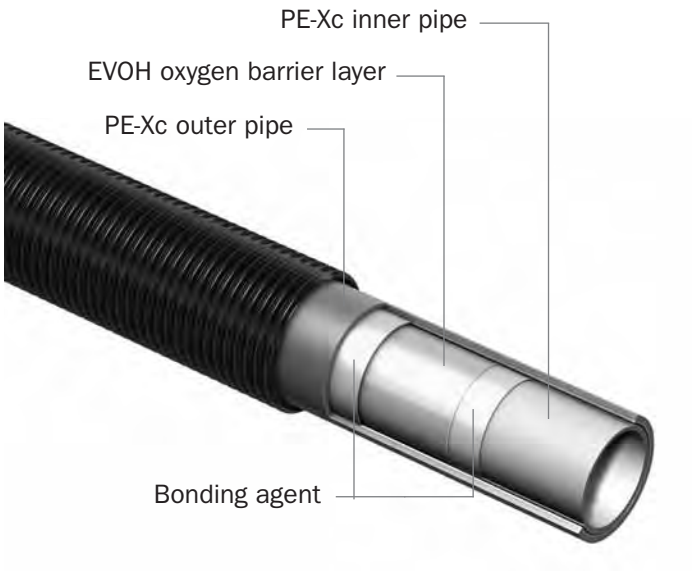
TECEflex composite pipes can be used as follows:

- for storey and apartment distribution,
- in cellar, riser and surface-mounted areas,
- in concealed areas in the insulation,
- in radiator connection areas, including from the skirting board,
- as floor and wall heating etc.

Versions supplied:

- Dimensions from 14–63 mm (14/16/20/25/32/40/50/63 mm)
- As rolls (up to 25 mm) or ready-cut pipes
- In corrugated pipe sheathing or
- As pre-insulated variants
- Yellow for gas installation

Advantages of the TECEflex composite pipe:
- Universal pipe for sanitation, heating, compressed air and gas = one pipe for all areas of application
- Linear expansion similar to a metal pipe
- Optically appealing white or yellow covering layer
- Easy to lay as the pipes are stable towards bending and consistent in shape
- Corrosion-resistant
- Resistant to heating system inhibitors
- Third-party and own monitoring
- Excellent creep rupture strength
- DVGW, TÜV and DIN CERTCO certified
- Suitable for potable water installation for application class 2 and 10 bar according to ISO 10508 for hot water applications*
- Suitable for heating installation for application class 5 and 10 bar according to ISO 10508 for high temperature applications*
- Suitable for heating installation for application class 5 and 6 bar according to ISO 10508 for high temperature applications*



Structure of the TECEflex PE-Xc five-layer pipe

TECEflex-PE-Xc five-layer pipe

TECEflex five-layer all-plastic pipes are equipped with an internal diffusion block. They are therefore ideally protected against unfavourable construction site conditions. Because of the position of the oxygen barrier layer in the middle of the pipe wall, TECEflex five-layer pipes are insensitive to external moisture such as condensation. The silver-coloured PE-Xc five-layer pipes are suitable for potable water, heating and compressed air installation.

PE-Xc pipes have enjoyed over 25 years of use in housing technology applications. They stand out in particular on account of their high pressure, temperature and corrosion resistance. The patented TECEflex pressure sleeve technology permits connections without the use of an O-ring while allowing for large inner diameters.
TECEflex PE-Xc five-layer pipes must not be used for gas installation.

Versions supplied:
- Dimensions 16 and 20 mm
- As rolls
- In black corrugated pipe sheathing

Advantages of TECEflex five-layer pipe:
- Particularly flexible
- Oxygen barrier layer effectively protected by five-layer technology
- Oxygen-tight in keeping with German standard DIN 4726
- Third-party and own monitoring
- Suitable for potable water installation for application class 2 and 10 bar according to ISO 10508 for hot water applications*

TECEflex PE-MDXc five-layer floor heating pipe

The PE-MDXc five-layer floor heating pipe – in accordance with German standard DIN 16894/95 – is a further development of the PE-Xc pipe with special properties for use in floor heating. It is electron beam cross-linked like a PE-Xc pipe, but has a higher flexibility thanks to the use of MD-PE. The PE-MDXc heating pipe is constructed using the five-layer technology. The oxygen barrier layer is in the middle of the pipe sheathing and is therefore effectively protected against damage.

Areas of application:
Floor heating and heating installation

Versions supplied:
- Dimensions 16 and 20 mm
- As rolls of 200 and 600 m

Advantages of PE-MDXc five-layer pipe:
- Particularly flexible
- Oxygen barrier layer effectively protected by five-layer technology
- Oxygen-tight in keeping with German standard DIN 4726
- Third-party and own monitoring
- Suitable for heating installation for application class 5 and 4 bar according to ISO 10508 for high temperature applications*

* Application classes according to ISO 10508 see page 13

Fittings

Fittings made of brass and polyphenylsulphone (PPSU) are available for installation.
Properties and characteristic features of the TECEflex fittings:

- Same fittings for all TECEflex composite pipes and TECEflex-PE-Xc pipes
- One fitting for potable water, heating, compressed air and gas installation (only brass fittings for gas)
- No sensitive O-rings or additional sealing rings
- Open cross section
- Fittings comply with DVGW Worksheet W 534
- National and international certificates

Brass fittings

The brass fittings are manufactured from a special brass with a low level of dezincification as recommended by the DVGW (German Technical and Scientific Association for Gas and Water) and meet the requirements of DVGW Worksheet W 534 "Pipe connectors and pipe connections" and the German Ordinance on Potable Water.
In addition they meet the TRGI [German Technical Rules for Gas Installation] requirements for gas installation and are therefore identified with W/G 100. As well as use with potable water and gas installation, the brass fittings can also be used for heating and compressed air installation.

Brass fittings for use with TECEflex pipes

PPSU plastic fittings

Lower-cost PPSU fittings can also be used as an alternative to many brass fittings. PPSU is a mechanically high load-bearing and extremely impact-resistant special plastic material recommended by the German Technical and Scientific Association for Gas and Water (DVGW).
The TECEflex PPSU fittings are corrosion resistant and hygienically clean. The use of PPSU fittings is restricted to heating, potable water and compressed air installation. Use in gas installation is not permitted.
The PPSU material is stable towards all substances in potable and heating water and towards the oils contained in compressed air. Cleaning agents, paints, foams and similar products may contain substances which can damage a PPSU fitting. For this reason, the PPSU fittings must not be glued, painted or foamed. If necessary, the chemical suitability of PPSU with respect to the standard building or plastering products can be checked in a resistance list – see appendix "PPSU resistance list".

PPSU fittings for use with TECEflex pipes

Pressure sleeves

The TECEflex composite pipe and TECEflex-PE-Xc pipes are pressed in with different pressure sleeves.

- Brass-coloured pressure sleeves for TECEflex composite pipes
- Silver-coloured pressure sleeves for TECEflex-PE-Xc or PE-MDXc five-layer pipes

Limits of application

- Suitable for potable water installation for application class 2 and 10 bar according to ISO 10508 for hot water applications*
- Suitable for heating installation for application class 5 and 10 bar according to ISO 10508 for high temperature applications*
- For gas installation up to 100 mbar inside buildings. For gases of the 2nd gas group according to DVGW worksheet G 260. Use for liquid gas installations is not permitted. The regulations of TRGI 2008 (= DVGW worksheet G 600) apply.

For short periods, the system can withstand 95 °C, but at no time may the TECEflex components be subject to a temperature of more than 100 °C. Naked flames are not allowed. For soldered transitions to copper pipes, the soldered joints must be created first. It is necessary to wait until the fitting has cooled before connecting the TECEflex system pipe.

The table below lists the detailed technical data for the TECEflex pipes.

TECEflex system pipes	**Composite pipes**							
Pipe designation	PE-Xc/AL/PE	PE-Xc/AL/PE	PE-Xc/AL/PE	PE-Xc/AL/PE	PE-Xc/AL/PE	PE-Xc/AL/PE	PE-Xc/AL/PE	PE-Xc/AL/PE
Dimension	14	16	20	25	32	40	50	63
Delivery length – roll (m)	120	100	100	50	-	-	-	-
Ready-cut pipes (m) (5 m/length)	-	100	70	45	30	15	15	5
Field of application*	HKA, FBH, DLA	TWA, HKA, FBH, DLA	TWA, HKA, FBH, DLA	TWA, HKA, DLA	TWA, HKA, DLA	TWA, HKA, DLA	TWA, HKA, DLA	TWA, HKA, DLA
Application class/operating pressure	2 / 10 bar 5 / 10 bar	2 / 10 bar 5 / 10 bar	2 / 10 bar 5 / 10 bar	2 / 10 bar 5 / 10 bar	2 / 10 bar 5 / 10 bar	2 / 10 bar 5 / 10 bar	2 / 10 bar 5 / 10 bar	2 / 10 bar 5 / 10 bar
Approval	DIN CERTCO	DIN CERTCO DVGW	DIN CERTCO DVGW	DIN CERTCO DVGW	DIN CERTCO DVGW	DIN CERTCO DVGW	DIN CERTCO, DVGW	DIN CERTCO DVGW
Colour	white	white yellow	white yellow	white yellow	white yellow	white yellow	white yellow	white yellow
Outside diameter (mm)	15	17	21	26	32	40	50	63
Wall thickness (mm)	2.6	2.7	3.4	4	4	4	4.5	6
Inside diameter (mm)	9.8	11.6	14.2	18	24	32	41	51
Available in corrugated pipe sheathing	Yes	Yes	Yes	Yes	-	-	-	-
Available with 9 mm insulation λ = 0.040 W/(mK)	-	Yes	Yes	-	-	-	-	-
Available with 13 mm insulation λ = 0.040 W/(mK)	-	Yes	Yes	-	-	-	-	-
Pipe weight empty (kg/m)	0.09	0.11	0.17	0.25	0.32	0.42	0.59	0.99
Internal volume (dm^3/m)	0.08	0.11	0.16	0.25	0.45	0.80	1.32	2.04
Pipe roughness (mm)	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
Thermal conductivity uninsulated (W/m^2K)	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Coefficient of thermal expansion (mm/mK)	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026
Minimum bending radius (mm) (5 x dimension)	70	80	100 (80)**	125	160	200	250	315

* TWA - potable water systems; HKA - radiator connection; FBH - floor heating; DLA - compressed air systems
The grading of the application classes corresponds to the definitions in IS0 10508[4].
** Pipes with the 20 mm dimension can also be bent to 4 times the dimension.

Technical pipe data TECEflex – part 1

TECEflex system pipes	PE-MDXc five-layer heating pipes to DIN 4724		PE-Xc five-layer heating pipes to DIN EN ISO 15875	
Pipe designation	PE-MDXc 5S	PE-MDXc 5S	PE-Xc	PE-Xc
Dimension	16	20	16	20
Delivery length – roll (m)	200/600	200/600	200	120
Ready-cut pipes (m) (5 m/length)	-	-	-	-
Field of application*	FBH, HKA	FBH, HKA	FBH, HKA	FBH, HKA
Application class/operating pressure	5 / 4 bar	5 / 4 bar	2 / 10 bar 5 / 6 bar	2 / 10 bar 5 / 6 bar
Approval	DIN CERTCO	DIN CERTCO	DIN CERTCO	DIN CERTCO
Colour	pearly-white	pearly-white	silver	silver
Outside diameter (mm)	16.2	20	16	20
Wall thickness (mm)	2.1	2.8	2.2	2.8
Inside diameter (mm)	12	14.4	11.6	14.4
Available in corrugated pipe sheathing	-	-	Yes	Yes
Available with 9 mm insulation λ = 0.040 W/(mK)	-	-	-	-
Available with 13 mm insulation λ = 0.040 W/(mK)				
Pipe weight empty (kg/m)	0.08	0.14	0.09	0.14
Internal volume (dm^3/m)	0.11	0.16	0.11	0.16
Pipe roughness (mm)	0.007	0.007	0.007	0.007
Thermal conductivity uninsulated (W/m^2K)	0.35	0.35	0.35	0.35
Coefficient of thermal expansion (mm/mK)	0.2	0.2	0.2	0.2
Minimum bending radius (mm) (5 x dimension)	80	100	80	100

* TWA - potable water systems; HKA - radiator connection; FBH - floor heating; DLA - compressed air systems
The grading of the application classes corresponds to the definitions in ISO 10508[4].

Technical pipe data TECEflex – part 2

Application class	Calculation temperature T_D °C	Operating period[b] at T_D years[a]	T_{max} °C	Operating period at T_{max} years	T_{mal} °C	Operating period at T_{mal} hours	Typical application range
1 [a]	60	49	80	1	95	100	Hot water supply (60 °C)
2 [a]	70	49	80	1	95	100	Hot water supply (70 °C)
3 [c]	20	0.5	50	4.5	65	100	Low temperature floor heating
	30	20					
	40	25					
4 [b]	20	2.5	70	2.5	100	100	Floor heating and low temperature radiator connection
	40	20					
	60	25					
5 [b]	20	14	90	1	100	100	High temperature radiator connection
	60	25					
	80	10					

T_D = Temperature for which the pipe is designed. T_{max} = Maximum temperature which may occur for a short period

T_{mal} = Highest possible "one-off" temperature which may occur during a malfunction (maximum 100 hours in 50 years)

[a] Depending on its national regulations, a country may choose either class 1 or class 2.

[b] For an application class, if more than one calculated temperature results for the operating period and its temperature, the associated times for the operating period should be added. "Plus cumulative" in the table implies a temperature group for the temperature given for an operating period (e.g. the temperature group for a period of 50 years for class 5 is made up as follows: 20 °C for 14 years, followed by 60 °C for 25 years, followed by 80 °C for 10 years, followed by 90 °C for 1 year, followed by 100 °C for 100 h).

[c] Only allowed if the malfunction event temperature cannot rise above 65 °C.

Application classes and classification of the operating conditions (according to ISO 10508)

Application areas

Potable water installation

Potable water places special demands on a plumbing system. It is a foodstuff and must not be affected by the materials of the plumbing system.
The planning, implementation and operation of a potable water installation must be in accordance with DIN 1988, DIN EN 806, DIN EN 1717/A1 and VDI 6023. The plumber must satisfy himself that he is installing a pipework system which complies with the valid recognised technical regulations. The TECEflex system has been certified by the DVGW (German Technical and Scientific Association for Gas and Water) and is demonstrably suitable for use in potable water installations. DVGW certification includes:

- Technical test of the components
- A test according to the guidelines of the "Plastics and Potable Water" working group of the German Federal Health Office
- Certification in accordance with Worksheet DVGW W270

Field of application

The TECEflex system is suitable for all potable water qualities according to DIN 50930 part 6, which correspond to the current potable water regulation (TrinkwV 2011).
It cannot be used if the water drops below the following limiting values:

- pH value lower than 6.5 or
- Total hardness less than 5 °dH (German hardness).

The following component parts are available for potable water systems:

- Plastic fittings made of PPSU
- Metal fittings made of DR brass with a low level of zincification
- Composite pipe with PE-Xc liner
- Entirely plastic pipe made of PE-Xc

All materials are recommended by the DVGW (German Technical and Scientific Association for Gas and Water), and are recognised all over Europe.

Material selection

The implementer has done his duty of care when he

- is in receipt of the potable water analysis according to DIN 50930-6 for the supply area from the responsible building authority and has checked the suitability of the TECEflex system,
- has assured himself of the experience of the supplier,
- has received an approval for TECEflex from TECE where applicable.

Installation of TECEflex brass adapters in stainless steel installations

Under certain conditions, contact corrosion may occur between brass and stainless steel. Technically relevant contact corrosion only occurs, however, if the water-wetted brass surface is very low in relation to the water-wetted stainless steel surface.
No contact corrosion is to be expected if the ratio of areas of copper, red brass and brass on the one side and stainless steel on the other is not below about 2–3 : 100. The sequence of the different materials is arbitrary in this case. A flow rule need not be observed. In heating systems this does not apply because no corrosion is to be expected here.
Unprofessional use of hemp on a TECEflex external thread adapter can lead to corrosion in brass, if the fittings are screwed into stainless steel threads. If hemp is used as a seal, then it must be protected against drying out by the use of a suitable paste. The paste must meet the requirements of DIN EN 751-2 and DIN 30660.
For potable water and gas installations, the paste must be DVGW certificated. Excessive tightening torques can also start a corrosion process in brass and must be prevented. Up to a size of 25 mm, TECE recommends adapters made of stainless steel.

Measures for Legionella prevention

Potable water installations must be planned, implemented and operated with special care according to DIN EN 806 and DIN 1988, in addition the VDI 6023 and the DVGW worksheet W551 apply.

By observing some simple rules, the risk of a Legionella contamination can be minimized:

- Unneeded and dead sections of pipe in which water could stagnate must be separated immediately at the outflow.
- Care must be taken during installation to ensure that no dirt enters the pipe system.
- The volume of stored water must be designed to be as small as possible.
- The correct pipe sizes must be chosen.
- Circulation pipelines must not be too large.
- Circulation pipelines must be hydraulically balanced.
- The temperature of the hot water boiler must be at least 60 °C.
- The circulation return must not drop below 55 °C.
- During commissioning, the system should be thoroughly flushed.
- There must be no organic material such as hemp remaining in the potable water installation.

- Uninsulated parts of the hot water pipework should be avoided.
- The correct operation and maintenance of the water treatment system and filters must be ensured.
- If the tapping points are far away or are used only rarely, a decentralized hot water supply is preferable.
- If cold water lines are located next to hot water lines or heating pipes, they have to be insulated well, so that the cold water cannot heat up.
- Pipes carrying cold water should not be laid in cavities in which circulation or heating pipes run.
- For reasons of hygiene, pressure tests must not be performed using water, but with oil-free compressed air or inert gas. Pressure tests using water are only permitted immediately before initial operation of the installation. Only hygienically clean potable water must be used for flushing and the pressure test.

Disinfection of potable water systems

The suitability of the TECEflex system for potable water has been verified by DVGW certification. The components of the TECEflex system are approved all over Europe and are made of tried-and-tested materials. A potable water installation which is planned, implemented and operated according to DIN 1988, DIN EN 806, DIN EN 1717/A1 and VDI 6023 is hygienically clean and in principle does not need any disinfection measures. Disinfection is only necessary in exceptional cases and is only then to be used when an urgent necessity exists (contamination).
It must be considered as an immediate emergency measure to return the potable water installation to a usable state. The reason for the microbial contamination (growth of microbes) must be eliminated (e.g. fault in construction or incorrect operation). Maintaining a usable state of the drinking water installation by repeated disinfection measures must be avoided. In such cases, renovation comes before disinfection measures.
Often repeated disinfection measures have an adverse affect on the lifetime of the installation.

A general distinction must be made between measures taken while the system is not operating (chemical disinfection) and measures while it is still operating (thermal disinfection and continuous chemical disinfection).

Thermal disinfection

DVGW Worksheet W552 prescribes a three-minute flushing of each tapping point with hot water at a minimum temperature of 70° C. In practice, a proven method is to heat the hot water storage tank to 80° C to compensate for temperature losses towards the tapping points.
Before flushing the tapping points, any circulation device present must be switched on until the circulation return pipe has reached a temperature of at least 70° C.
Care must be taken to be sure that no user can be scalded during the thermal disinfection process.
All potable water installation pipes from the TECEflex system can be disinfected effectively with this method.
If thermal disinfection is often performed, a reduction in the life of the TECEflex pipes cannot be ruled out and renovation of the potable water installation should be considered.

Chemical disinfection

Chemical disinfection measures must be performed according to DVGW worksheet W 291. Care must be taken that the active substances, concentrations, application time and maximum temperatures listed there are adhered to. A combination of thermal and chemical disinfection is forbidden. The water temperature during chemical disinfection must not exceed 25 °C.

The TECEflex system can be disinfected using the disinfectants listed in the DVGW worksheet W 551.
Care must be taken that the dosages are not exceeded.
It is necessary to ensure that nobody taps any potable water during the disinfection process. After a chemical disinfection, it is vital to ensure that all the residual disinfectant is completely flushed from the network of pipes. The water containing the disinfectant must not be allowed to enter the drainage system.

Before carrying out disinfection measures using chemical agents, it must be made certain that all the components of the potable water installation are stable towards the agents. Particular attention should be paid to components made of stainless steel. The specifications of DVGW worksheet W 551 must be adhered to. The suitability of the disinfectant in conjunction with PE-Xc pipes and DR brass must be confirmed by the manufacturer of the disinfectant. The manufacturer's instructions must be observed. The disinfectant properties of the chemical disinfectant usually result from the oxidising effect of the contents. If disinfection is often performed, the agents may also attack the potable water installation.
Often repeated chemical disinfection measures have a considerable adverse affect on the lifetime of the TECEflex system. For this reason, the total number of disinfection cycles should be limited to five over the total lifetime of the pipes. Repeated disinfection measures do not correspond to the latest state of the technology.
A disinfection measure is only legitimate to return a potable water installation to a usable condition after it has become contaminated.

Continuous chemical disinfection

Disinfection of a contaminated potable water system by continuously dosing with disinfectants is not constructive according to current knowledge.
For this reason, it should only be performed in some rare situations. In doing so, the requirements of the current German Ordinance on Potable Water and the UBA list according to § 11 TVO must be met. To achieve an appropriate effect however, the specified limiting values would have to be considerably exceeded. Continuously added disinfectant can have a serious effect on the life of the potable water installation. This type of disinfection is advised against because of the possible damage to materials. We cannot accept any liability for these cases.

Heating installation

The TECEflex system is DIN CERTCO certified and authorized for heating installations.

The following components parts are available:
- Plastic fittings made of PPSU
- Metal fittings made of dezincification-resistant DR brass
- Composite pipe with PE-Xc liner
- Five-layer all-plastic pipes made of PE-Xc
- Five-layer all-plastic pipes made of PE-MDXc

All materials are impermeable to oxygen according to DIN 4724/4726.
The appropriate certificate is available to download from www.tece.com.

Compressed air installation

TECEflex fittings and connectors and the TECEflex aluminium composite pipe are suitable for use in compressed air systems. The same fittings and pipes are used for compressed air installation as are used for potable water and heating installations.
TECEflex is certificated by the Southern Germany TÜV as a compressed air system and is permitted to carry the TÜV seal. The certification also includes the TECEflex PPSU fittings.

Connections can be made across systems with valves, taps, fittings, etc. using TECEflex threaded fittings.
The TECEflex system is suitable for compressed air with the following parameters
- nominal pressure 16 bar,
- positive operating pressure 12 bar and
- maximum peak operating temperature 60 °C.

The Southern Germany TÜV certificate is available for download from www.tece.com.

Gas installation

The TECEflex system is approved for gas installation up to 100 mbar inside buildings. The approval applies to gases of the 2nd gas group according to DVGW worksheet G 260. Use for liquid gas installations is not permitted. The regulations of TRGI 2008 (= DVGW worksheet G 600) apply. In addition, the regional building regulations as well as the regional fire protection regulations have to be observed for a proper and professional installation. Furthermore, the country-specific regulations, standards and worksheets, the accident prevention regulations and the generally accepted rules of engineering also apply.

The following are available for gas installation:
- Metal fittings made of dezincification-resistant DR brass
- Yellow composite pipes with PE-Xc liner
- Brass coloured pressure sleeves
- Gas safety valves (TAE and GSK)

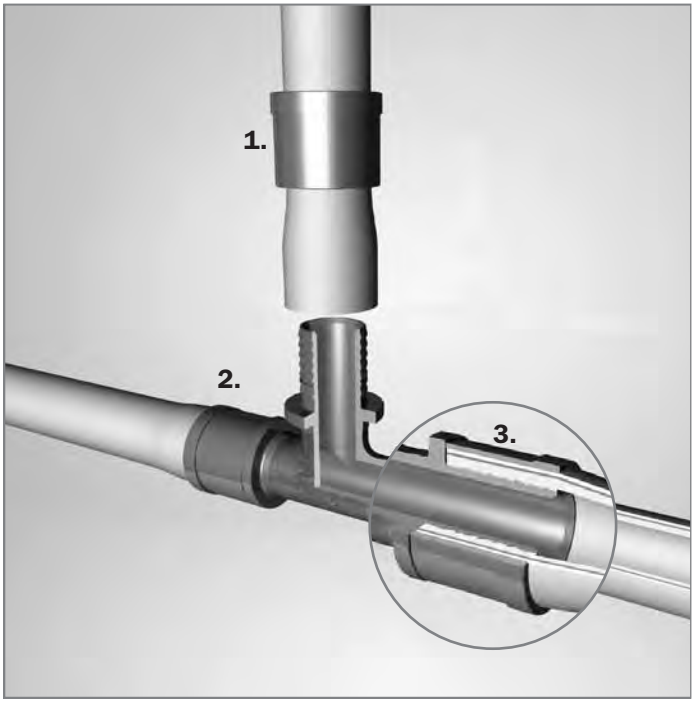
All those TECEflex components which are suitable for gas installation are identified with the marking W/G 100.

Connection technique

The patented TECEflex pressure sleeve connection is a particularly reliable connection technique that has proven its worth over many years in sanitary and heating installations. Among other things, operational safety is verified through the DVGW system registration DW8501 AQ2007.

Axial pressing technique

TECEflex connections are based on the axial pressing technique. A pressure sleeve is pushed axially over a widened pipe and fitting. Because the fittings are inserted into a widened pipe, they have a larger internal diameter compared to O-ring sealed plastic pipe connectors and feature a particularly low loss of pressure. The sealing effect is achieved solely through the pipe plastic pressed on to the fitting over the entire surface. As a result, TECEflex fittings do not require O-rings, The faults that can occur from working with O-rings are thus excluded. There are no gaps or spaces that water can penetrate into and stagnate in. This is particularly relevant because stagnant water poses a considerable risk to hygiene.

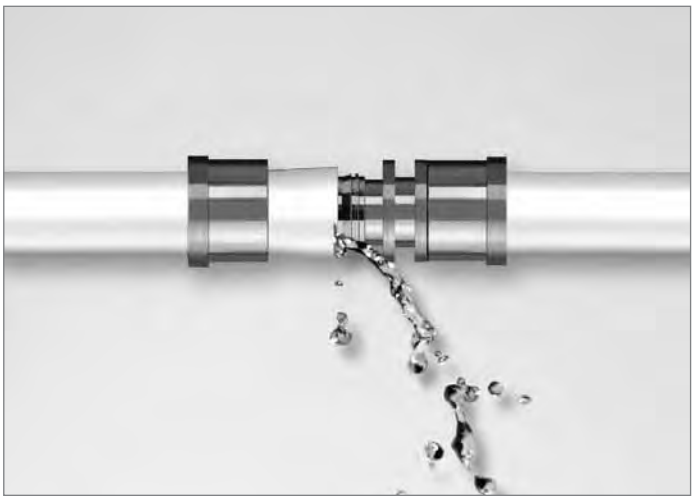


The TECEflex connection:

1. **Pressure sleeve and composite pipe prior to pressing**
2. **Pressure sleeve and composite pipe after pressing**
3. **Memory effect: After expansion, the composite pipes contract again over the fitting. During the pressing process an absolutely tight connection is produced with a hardly narrowed cross-section in the connection area itself.**

Forced leakage

The TECEflex connection technique meets the requirements of DVGW Worksheet W 534, section 12.14 for connectors with forced leakage. This means that a TECEflex connection in an unpressed state can be identified with certainty in the pressure test through leaking water. It can also be optically clearly identified as unpressed by a pressure sleeve loosely positioned on the pipe.



Forced leakage in unpressed pipes

Controlled leakage is tested and certified by DVGW. The DVGW certificate is available for download at www.tece.com.

Working instructions

Only the associated system tools may be used to work with the TECEflex system. Connection of TECEflex components to third-party pipes or fittings is forbidden. A warranty entitlement exists only for the uses represented in the system description.

Connection with TECEflex hand tools

TECEflex connections up to a dimension of 32 mm can be made with the TECEflex hand tools.

TECEflex hand tools: Expanding tool with expanding head, pipe cutter, manual jointing gripper with fork heads (from left)

The following steps are required for a correct connection:

Step 1 – Cutting the pipe to length:

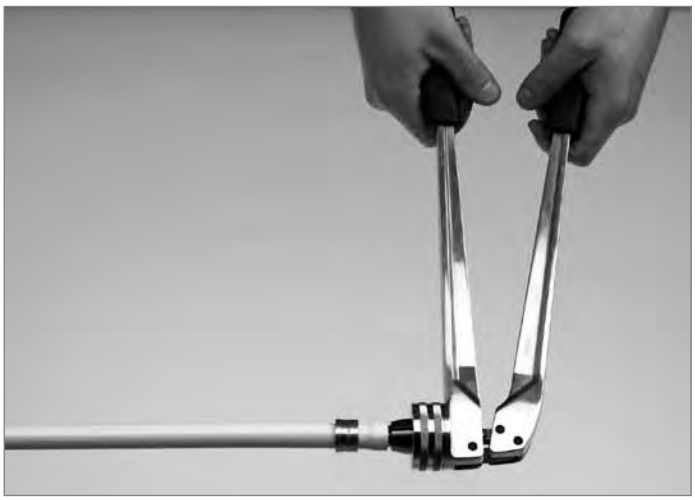
Cut the installation pipe to length at a right angle using the TECE pipe cutting pliers (Order No.: 876 00 02 or 7 200 93). From the dimension 32 mm, it is recommended to use the plastic pipe cutter (Order No.: 80042).

Note: TECEflex pipes should only be processed with a cutting tool in perfect condition. In particular, the cutting edge must be sharp and without any burrs, as otherwise the installation pipe could be damaged during expansion.

Step 2 – Sliding on the pressure sleeve:

Slide the TECEflex pressure sleeve over the end of the pipe. The smooth side of the pressure sleeve (without outer ring) must face the fitting.

Step 3 – Expanding the pipe:



Choose the right expanding head for the pipe dimension and screw it on to the expanding tool (Order No.: 7 200 56). Slide the pipe end on to the expanding head up to the stop and expand.
Important: TECEflex composite pipes can only be expanded once!

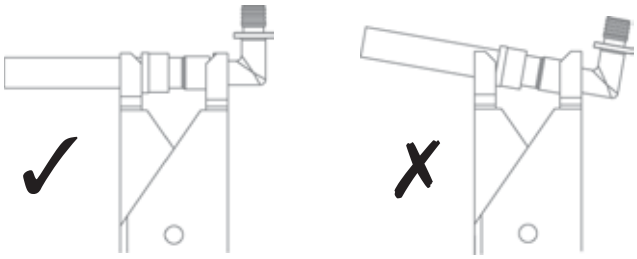
Step 4 – Sliding on the pipe:

Slide the TECEflex installation pipe on to the fitting up to the last saw tooth. It is not necessary to slide the pipe up to the stop, as the correct depth is already given as a result of expansion. It is not necessary to mark the push-in depth.

Step 5 – Creating the connection:

Select the fork heads marked with the pipe dimension and use the bolts to secure them on the manual jointing gripper (Order No.: 7 200 50). Push the pressure sleeve as far as possible towards the pipe end by hand, insert the fitting and sleeve in the fork heads. Press the pressure sleeve up to the fitting by operating the manual jointing gripper several times. A remaining gap of about 0.5 mm between the fitting and sleeve is specific to the preparation and is not important. The connection itself is then perfect if the pipe was not slid up to the press collar of the fitting.

Note: During pressing, make sure the pressing tool is in the correct position. The fitting must be completely in the pressing tool and at a right angle in order to avoid damage to the fitting collar.



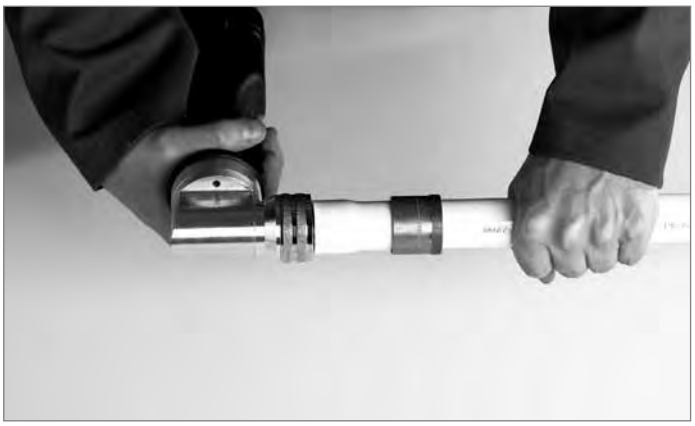
Pressing: Correct position (left) – Incorrect position (right)

Connection using the RazFaz rechargeable tool

The RazFaz tools – one each of a pressing tool, and an expanding tool – enable TECEflex connections up to dimension 32 mm to be created. The lightweight and easy-to-use battery-powered tools enable work to be carried out efficiently even in tight installation situations and permits pressing directly at the wall.

The work steps required for a correct connection are the same as those in the procedure for "Connection with TECEflex hand tools" (see previous section). Only expansion (step 3) and pressing (step 5) are carried out with the RazFaz tools.

Step 3 – Expand the pipe:

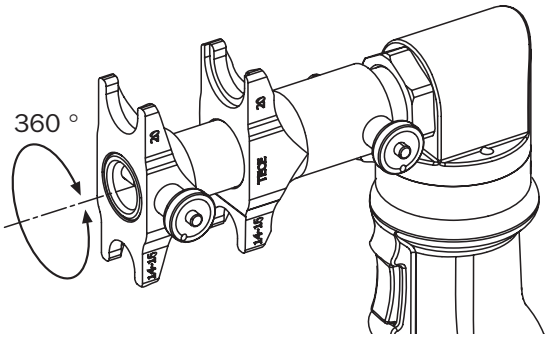


Choose the right expanding head for the pipe dimension and screw it on to the RazFaz expanding tool. Now push the expanding head into the pipe end up to the stop and activate the expansion operation on the pressing tool. The tool must be held straight in front of the pipe end.

The tool has an end control, which means the expansion operation must be carried out until the expanding head automatically returns to the starting position.

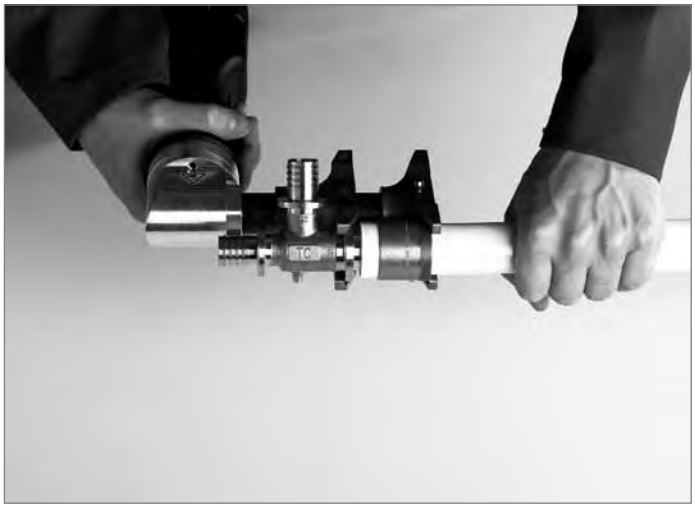
Step 5 – Creating the connection:

Screw the correct pressing forks on to the pressing tool and lock them with the securing bolts. The forks are each designed for two dimensions (14/16–20 mm and 25–32 mm) and can be continuously rotated around 360 °.



Push the pressure sleeve as far as possible towards the end of the pipe and position the pressing forks straight on the fitting.

Push the pressure sleeve up to the fitting using the pressing tool.



The pressing tool also has an end control, which means the pressing operation must be carried out until the pressing forks automatically return to the starting position.

The RazFaz tools are high-quality and technically sophisticated hydraulic units. The quality of the TECEflex connection does not depend on the state of maintenance of the RazFaz devices. Despite this, it is recommended that the devices are regularly maintained. You can obtain a service address from:

Novopress GmbH & Co. KG
Scharnhorststraße 1
D-41460 Neuss
info@novopress.de

Connection using the PMA press tool

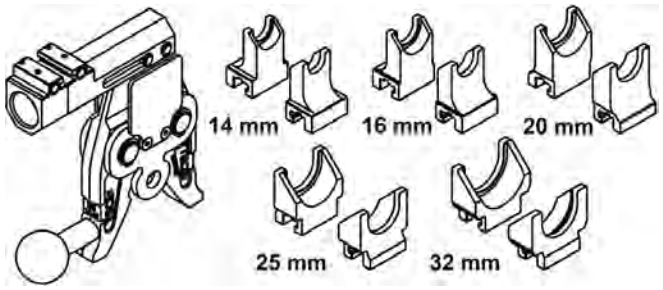
The TECEflex tools for processing dimensions 32–63 mm require a drive in the form of a conventional pressing machine with pressure of at least 32 kN, **but no more than 38 kN**. Higher pressures could potentially damage the tool. Pressing machines from manufacturers that are members of the compatibility group and which were manufactured after 1998 have sufficient drive performance.

The following machines are suitable:

Manufacturer (system provider)	**Machine type**
KLAUKE (Uponor)	UAP1 (UP63, UP75); UAP2 UAP3L; UAP4L UNP2 HPU2 UP2EL (UP50EL) UP2EL14 (UP50EL)
NOVOPRESS (Mapress) (Geberit)	EFP 2 EFP; ECO1; ACO1 ACO 201; ECO 201 ACO 202; ECO 202 AFP 202; EFP 202
NUSSBAUM (Viega)	Type 1; Type 2 Type 3; Type 4 Type 5; Type 5a Presshandy (rechargeable) Picco
REMS/ROLLER	Akkupress
ROTHENBERGER	Romax Pressliner (Eco) Romax 3000 Romax AC Eco
GEBERIT	PWH 75

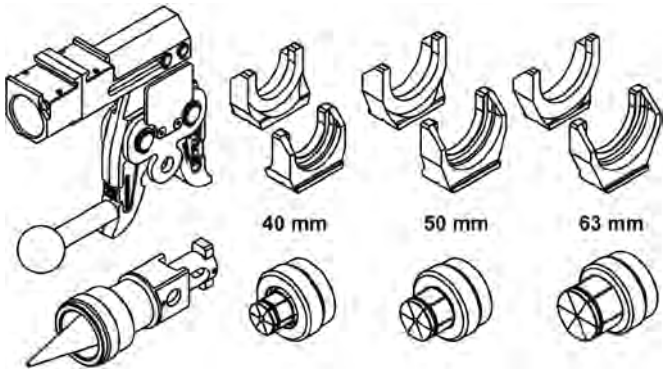
If a pressing machine is not included in the list above, its suitability should be assessed in a trial. It is necessary to check whether the TECEflex tool fits in the pressing machine holder and whether sufficient pressure is provided. Multiple pressing to close the connection is permitted, and may be required with some older machines.

Note: A connection has been pressed correctly when the pressure sleeve has been pushed up to the fitting.
A guarantee for the pressed connection therefore depends not on the state of the pressing tool, but on the position of the pressure sleeve alone.



PMA 14 40 TECEflex pressing tool

The safety instructions from the pressing machine manufacturer and those for the TECEflex tools must be read prior to use, and adhered to during use.



PMA 40 63 TECEflex pressing tool

The job steps required to make a connection – using the tool set – are the same as those for using the manual pressing tools.

The pipe is separated using the pipe cutter (Order No. 80042). The pipe cutter is fitted with a special plastic cutting wheel.

Note: TECEflex pipes should only be processed with a cutting tool in perfect condition. In particular, the cutting edge must be sharp and without any burrs, as otherwise the installation pipe could be damaged during expansion.

In the second step, the TECEflex pressure sleeve is pushed over the pipe end. The smooth side of the pressure sleeve (without outer ring) must face the fitting.

Note: Only ever change tools when the pressing machine is not connected to the electrical power!

Select the right expanding tool for the dimension, insert it in the pressing machine and fix it with the safety bolt. Push the pipe end on to the expanding head up to the stop and trigger the expansion operation on the pressing machine. The tool must be held straight and still in front of the pipe end.

Slide the pipe on to the fitting up to the last saw tooth. It is not necessary to slide the pipe up to the stop, as the correct depth is already given as a result of expansion.

The connection is then created: Insert the pressing tool attachment PMA – with the right pressing forks for the pipe dimension – into the pressing machine holder and fix it with the safety bolt.

Push the pressure sleeve as far as possible towards the pipe end by hand, place the fitting and pressure sleeve straight between the fork heads. The base body of the sliding jaw must be parallel to the pipe. Press the pressure sleeve up to the fitting by operating the pressing machine several times. A remaining gap of about 0.5 mm between the fitting and sleeve is specific to the preparation and is not important.

Reuse of pressed fittings

TECEflex fittings that have already been pressed can be reused. The fittings can be easily removed from the pipe by heating the connection to approx. 180 °C with a hot air blower.

Note the following in relation to this:

- Reuse is only possible with the metal fittings and connectors (not for PPSU fittings).
- The fitting that is to be reused must be completely separate from the pipe system so that the existing installation is not subject to temperatures of above 110 °C. In the case of fittings with several outlets (e.g. tees or elbows), all connections must be removed.
- Pressure sleeves cannot be used again.
- Allow the fitting to cool sufficiently.
- Heating must never be done with a naked flame!
- Never pull the heated pipe end from the connecting piece with your bare hands, always use tongs!

Installation regulations

The applicable technical regulations, standards and guidelines have to be observed during the installation of heating, potable water, compressed air and gas systems. Installation must only be carried out by specialists.

General instructions

When using TECEflex pipes, the following instructions have to be observed:

Threaded connections

For threaded connections, TECE recommends the use of hemp, combined with sealing paste approved for the purpose. If too much hemp is used, the inside or outside threaded component may be damaged. Please make sure that no hemp remains in the pipe system. If other thread sealants are used, warranty must be provided by the manufacturer of the sealant.

Processing temperatures

TECEflex system can be processed down to a minimum temperature of 0° C. At low temperatures, the ends of the pipes must be warmed to "hand temperature". Do NOT use a flame to do this !

Sheathing of fittings

Suitable sheathing must always be used to protect TECEflex fittings from any contact with masonry, plaster, cement, screed, rapid binders etc. Direct contact with the structural shell must be prevented because of the sound insulation requirements in accordance with German standard DIN 4109 and guideline VDI 4100.

Kinks and deformations

If a kink or a deformation is produced in a TECEflex pipe due to inexpert processing or unfavourable construction site conditions, this area must be repaired, an elbow or U fitting should be used for a tight radius.

Use in mastic asphalt

The high temperatures which may occur when applying the mastic asphalt (approx. 250° C) would immediately destroy any pipes coming into direct contact. This also applies for the use of pipe-in-pipe systems. For this reason, suitable protective measures have to be taken. The pipe-in-pipe lines laid on the bare concrete are sufficiently protected against being burned if softboard is laid before applying the asphalt over the pipes. However, the points where the pipes enter the masonry from the bare concrete, rather than the free floor surfaces, are critical. At these critical points, the lines are best protected if edge insulation strips are laid in front of the pipes in such a way that there is a certain spacing which can be filled with sand in the area of the pipes. These protective measures have to be checked once again prior to applying the mastic asphalt in order to prevent potentially irreparable damage to the pipe system. During application, the pipes should be flushed with cold water.

Prevention of air locks

Pipe runs must be laid so that no air locks are possible. At the lowest point in the system, there must also be a way of draining the pipeline.

Protection against UV irradiation

Exposure to UV irradiation over an extended period will damage the TECEflex pipes. The packaging of the pipes provides sufficient protection against ultraviolet irradiation, but it is not weatherproof. For this reason, the pipes should not be stored outdoors. On the construction site, the pipes should not be subjected to sunlight for unnecessarily long periods. If necessary, they must be protected against UV light. TECEflex pipes laid outdoors must be inside black corrugated tubing to protect them against sunshine.

Identification of pipelines

In the interests of safety, we recommend that pipelines are marked to show the substances flowing through them. Especially at complex places or where there are several pipes with different contents.
In every case, the identification must be done according to DIN 2403

Laying TECEflex pipework in the ground

Pipework made of TECEflex may be laid in the ground under the following conditions:

- The pipes must be laid in a bed of sand.
- The pipes must be covered with fine-grain sand to such an extent that there is no danger of damage to the pipe when the later fill material is applied.
- There must be no moveable loads affecting the pipes laid in the ground.
- The fittings and the the pressure sleeves must be protected against direct contact with the ground by a suitable corrosion protection agent.
- Wall bushing in the ground must be suitable for plastic pipe and the pipe must be secured against being pulled out. They must be implemented according to the current technical rules and regulations.

Laying on bitumen sheets

Prior to laying TECEflex pipes on solvent-containing bitumen sheets or coatings, these have to be completely dry. The manufacturer's setting times must be observed.

Arrangement of pipelines

If cold and hot water pipes are to be laid one above the other, the pipe carrying the hot water must be laid above the cold water pipe.

Contact with solvents

Direct contact of TECEflex components with solvents or solvent-containing varnishes, paints, greases, sprays, adhesive strips, etc. must be prevented. The solvents can attack the plastic components of the system.

Potential equalization

TECEflex composite pipes must not be used as an earthing conductor for electric plants, in accordance with the guidelines of the Association of German Engineers VDE 0100.
For this reason, the correct earthing has to be checked when replacing some metal pipes with pipes from the TECEflex range (during building restoration work, for example).

Protection against frost

Filled TECEflex pipes must be protected against frost. The TECEflex system is suitable for the following anti-freeze agents and concentrations:

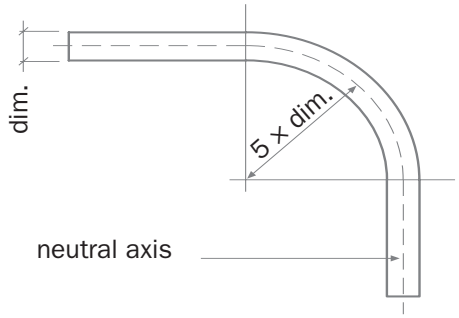
- Ethylene glycol (Antifrogen N): May be used up to a concentration of 50% maximum. TECE recommends restricting the concentration to 35%. A concentration of 50% Antifrogen N is equivalent to frost protection down to a temperature of -38 °C. A concentration of 35% Antifrogen N is equivalent to frost protection down to -22 °C. If the concentration of Antifrogen N is more than 50%, the frost protection reverses and diminishes. At temperatures below -25° Celsius, slush is produced.
- Propylene glycol: May be used up to a maximum concentration of 25%. Propylene glycol is used primarily by the food-processing industry. A concentration of 25% provides frost protection down to -10 °C.
  At higher concentrations of propylene glycol, stress cracks may occur in the material of the pipe.

Trace heating

Trace heating and self-regulating heat tapes that are approved by the manufacturers for plastic pipe systems in the sanitary area can be used for TECEflex. In order to ensure optimum heat transmission, the heat tapes are attached to the full area of the TECEflex pipes with a broad adhesive aluminium tape. The specifications of the manufacturer have to be observed.

Bending radii

The TECEflex pipes can be bent to a minimum bending radius corresponding to five times the pipe dimension.



Minimum bending radius of the TECEflex composite pipes

Note:
Pressing must not be done near a bend. Furthermore, if a bend must be directly at a fitting, the bend must be made before the pressing.

Up to dimension 20 mm, TECEflex composite pipes can be bent by hand. Flexible springs are not required. From dimension 25 mm, conventional bending tools can be used.

TECEflex pipe dimension	Minimum radius of bend (mm)
14	70
16	80
20	100 (80)*
25	125
32	160
40	200
50	250
63	315

Bending radii of the TECEflex composite pipes

* Pipes with the 20 mm dimension can also be bent to 4 times the dimension.

Thermal linear expansion

Materials expand when heated and contract again when cooling down. Due to the large differences in temperature inherent in the system, the pipes in a hot water and heating system have to be attached in such a way that extensions in length are compensated in the elbows or special expansion bends.

Calculation of the thermal linear expansion

The thermal linear expansion is calculated using the following equation:

$\Delta l = \alpha \cdot l \cdot \Delta t$

Δl thermal linear expansion of pipe (mm)
α coefficient of linear expansion of TECEflex pipe
l initial length of pipe (m)
Δt temperature difference (K)*

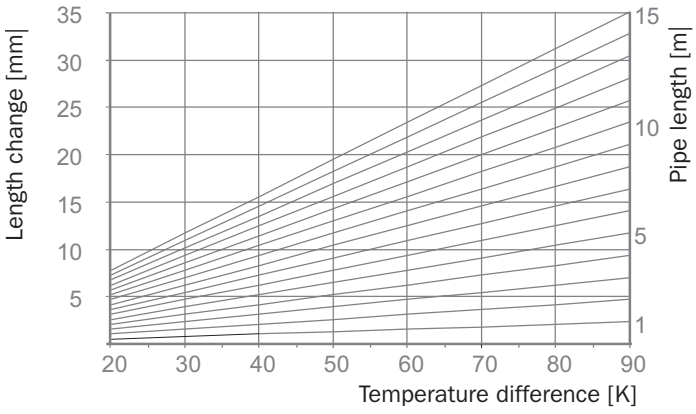
* K = Kelvin, the SI unit of temperature and relates to absolute zero.
(0 °C = 273.16 K)

Coefficient of expansion of the TECEflex pipes:
Composite pipe α = 0.026 mm/(mK)
PE-Xc pipe α = 0.2 mm/(mK)

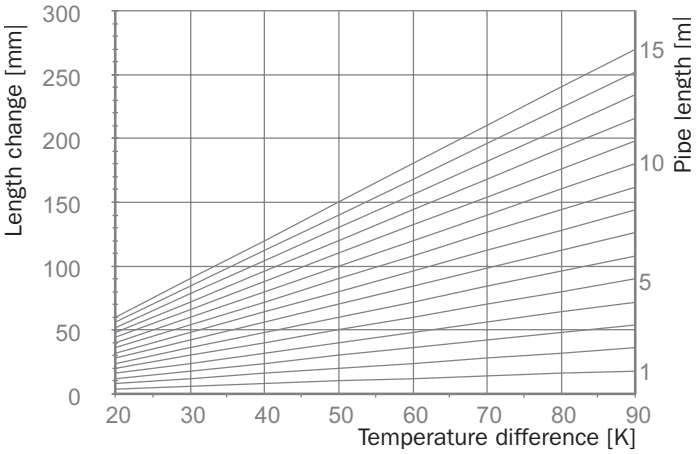
Example: A 12 metre long TECEflex gas line made of composite pipe is installed in winter at 5 °C.
Under operating conditions, 35 °C can occur.

l 12 m
Δt 35 K - 5 K = 30 K
α 0.026 mm/mK
Δl = 0.026 mm/(mK) · 12 m · 30 K = 9.36 mm

Result: The pipe will expand by about 10 mm.
The expansion has to be compensated by the structural conditions. As an alternative, the thermal linear expansion can be taken from the following charts.



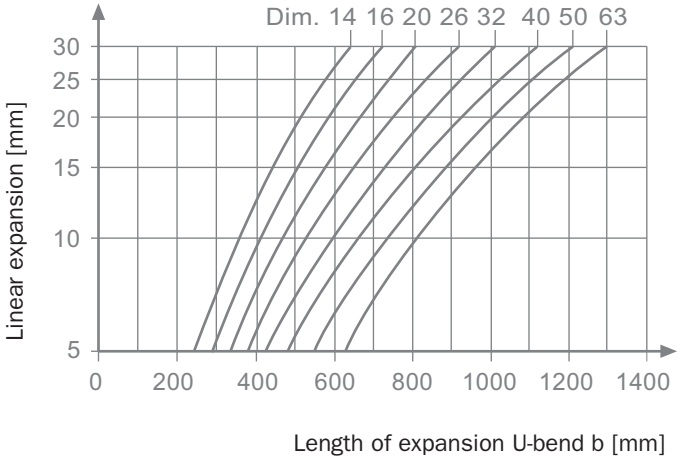
Thermal linear expansion of TECEflex composite pipes



Thermal linear expansion for TECEflex-PE-Xc or PE-MD-Xc pipes

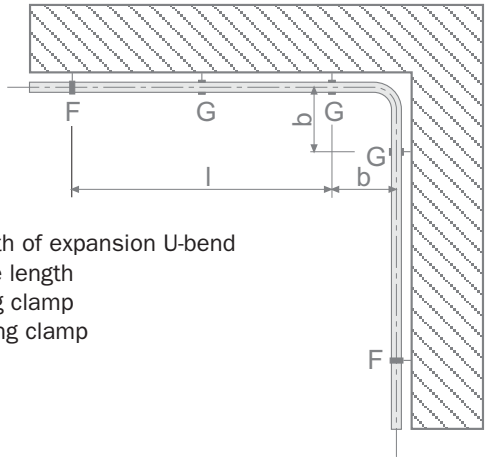
Calculation of the length of the expansion U bend

The length of the expansion U bend (b) can be taken from the following chart.



Length of the expansion U bend for TECEflex pipes

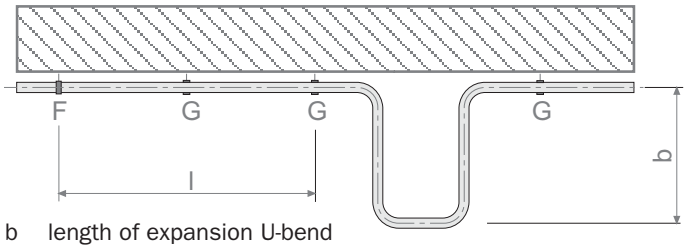
The pipe length in question may be limited by fixing and sliding clamps. The linear expansion in compressed air and gas installations can usually be compensated for by a pipe layout with directional changes.



b length of expansion U-bend
l pipe length
F fixing clamp
G sliding clamp

Compensation of the thermal linear expansion with a change of direction

In hot water or heating systems in particular, it is possible that the planned pipe layout does not permit sufficient scope for accommodating the thermal linear expansion. In this case, expansion U bends have to be planned which take the length of the expansion U bend into consideration.



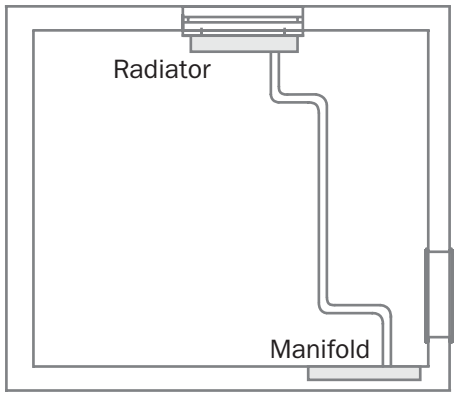
b length of expansion U-bend
l pipe length
F fixing clamp
G sliding clamp

Compensation of the thermal linear expansion with an expansion bend

Example:
The increase in length of the pipe calculated in the previous example is about 10 mm. The chart above can be used to determine the length of the expansion U bend b. For a TECEflex pipe of 20 mm dimension, a value of 470 mm is calculated. If a sliding clamp is fitted at least 470 mm in front of a bend, no additional expansion bend is required.

Special installation instructions with respect to linear expansion

- Only TECEflex composite pipe is permitted for skirting board systems.
- Make sure there is enough space to fit an expansion bend when connecting radiators to the pipes exiting from the floor or wall.
- The connection should always be made in a curve towards the radiator.



Example of laying taking account of the linear expansion.

Attaching pipes

TECEflex pipes must be attached with only those pipe clamps approved for the application purpose. Commercially available wall plugs can be used to fix the clamps, provided the components have sufficient mechanical strength. TECEflex pipes must not be used in other pipe systems.

Attaching gas lines

The use of pipe-holding devices made of combustible materials is permitted for TECEflex gas lines. Commercially available wall plugs can be used to fix the clamps, provided the components have sufficient mechanical strength. TECEflex gas lines must not be used in other pipe systems. No other pipe systems can be attached to gas lines.

Layout of TECEflex pipes carrying water

The pipe layout of TECEflex installation pipes has to comply with the recognised rules of engineering.
The quality of the potable water must not be affected by the pipe layout. To prevent the propagation of micro-organisms, the pipe layout and insulation must be selected so that the potable water does not become warmed. Especially inside ducts and curtain walls, a check must be made of whether the cold potable water pipe needs increased insulation to maintain its hygiene. The potable water must not become warmed to above 25 °C.

TECEflex surface-mounted pipework

The type of attachment and the spacing depends on the structural conditions on site. From the structural point of view, the pipework should be fixed in accordance with the recognised rules of engineering, taking into account full and insulated pipes.

TECEflex pipe dimension	Spacing of attachments (m)
14	1
16	1
20	1.15
25	1.3
32	1.5
40	1.8
50	2
63	2

Attachment spacing distances for surface-mounted TECEflex pipework.

TECEflex dimension	Pipe weight when full (kg/m)
14	0.19
16	0.24
20	0.35
25	0.54
32	0.85
40	1.35
50	2.08
63	3.31

Dimensions of TECEflex pipes

The pipes have to be laid in such a way that neither humidity nor dripping or condensate water from other installation affects them.

TECEflex concealed pipework

Depending on the wall structure or the quality of the masonry, the thermal length expansion of a concealed TECEflex composite pipe may cause damage to the wall. For this reason, TECE recommends insulating all concealed TECEflex composite pipes with a pipe insulation.
The pre-insulated TECEflex pipes are a suitable solution here.

If no insulation is required, the composite pipes can be laid in corrugated pipe sheathing as an alternative. These pipes are also part of the TECEflex range.
Suitable sheathing must always be used to protect TECEflex fittings from contact with masonry, plaster, cement, screed, rapid binders or similar. Direct contact with the structural body must be prevented on account of the sound insulation requirements in accordance with German standard DIN 4109 and guideline VDI 4100.

TECEflex pipes in concrete or screed

The pipes are firmly encapsulated in concrete or screed so that the linear expansion of the pipe material is towards the inside. In this case, special measures are not required to compensate for the thermal linear expansion.
If, however, the pipes are laid in the insulation layer between concrete and screed, they should be laid in such a way that the linear expansion to be expected is compensated for by the insulation or by a pipe layout incorporating a bend.
It is vital that the requirements relating to thermal protection and impact sound are observed. The applicable standards and guidelines must be adhered to. For this reason, it is advisable to lay the TECEflex pipes in a suitable compensation layer. The additional assembly height must be taken into account during planning.
The fittings must be protected against corrosion.

A maximum attachment distance of one metre applies for TECEflex pipes that are laid on an unfinished floor or in the concrete floor. It is necessary to ensure that the TECEflex pipes laid on the unfinished floor are not damaged by ladders, scaffolding, wheelbarrows, being permanently walked over or similar after they have been laid. The pipes must be checked immediately before the screed is laid.

TECEflex pipes passed through movement joints

If pipes are passed through expansion joints of buildings, they must be laid in corrugated sheathing. The corrugated sheathing must protrude by at least 25 cm on either side. Pipe insulation with a wall thickness of at least 6 mm may be used as an alternative to the corrugated sheathing.

Pipe runs in the floor structure

For planning and laying of pipes in floor structures, the screed laying trade body has described how pipe-runs have to be carried out, in the guidelines "Pipes, cable and cable channels on unfinished floors". "Pipes laid in the floor have to be non-intersecting, as straight as possible, and have to be laid axially parallel and parallel to the wall. During the planning, heating and potable water pipes shall be given priority over electric cables and conduits."

- The pipes in a run should be arranged as close to each other as possible.
  Caution: If hot pipes are laid directly beside cold potable water pipes, laying must be done so that cold water pipes will not be warmed above 25 °C.
- The width of runs for parallel laid pipes including insulation must be no more than 30 cm.
- A minimum distance of 20 cm must be maintained between the individual runs. The minimum distance between a run and a wall is 20 cm.
- The dimensions given above should be maintained in front of distribution cabinets if possible.
- In the area of doors, the distance to the reveal should be at least 10 cm.

Pipes of different diameters or other assemblies within a run have to be compensated for in such a way that a flat support area is created for impact sound insulation.

Sound insulation

German standard DIN 4109 defines rooms requiring sound insulation as being those rooms in which persons have to be protected against outside noise, noise from neighbouring rooms and noises caused by building service facilities.

Relevant standards

German standard DIN 4109 entitled "Sound insulation in building constructions" dated November 1989:

- Governs the requirements for structural sound insulation
- Sound insulation does not mean that noise must be completely prevented
- Requirements are different depending on the building use and the room use

German standard DIN 4109/A1 (modification A1) from January 2001:

- The requirements relating to installation noise have been made more strict:
  Living rooms and bedrooms 30 dB(A)
  Teaching rooms and offices 35 dB(A)
- Individual short-term noise peaks during operation of fittings and devices (opening, closing, resetting, interruption, etc.) are not taken into consideration

Note:

DIN 4109 is no longer valid as an accepted technical regulation! For this reason, VDI 4100 is hereby referred to.

VDI 4100 "Sound insulation of dwellings" dated August 2007 was issued as supplementary to DIN 4109.
DIN 4109 has gained legitimate public significance because of the building authority introduction. Implementations according to VDI 4100 are therefore to be understood as a private law agreement between the building owner and those persons involved in the construction.

- VDI 4100 makes a distinction between 3 sound insulation levels (SSt)
- SSt 1 corresponds to the requirements of DIN 4109, this is regarded as the absolutely minimum value for sound insulation in dwellings
- SSt 2 to 3 describe higher requirements for sound insulation in dwellings

The constructional sound insulation should be agreed contractually. At least SSt 2 is recommended

Space requiring sound insulation

The requirements relating to the sound level in accordance with German standard DIN 4109 refer to the "space requiring sound insulation" in another person's living area. The following are classified as requiring sound insulation:

- Living spaces (including hall-cum-living rooms)
- Bedrooms (including hotels and care homes)
- Classrooms and
- Offices (except open-plan offices)

Not needing protection in the sense of DIN 4109 (only for plumbing noise) include for instance:

- Own living area
- The room in which the sanitary item causing the noise is located
- "Loud" rooms in third-party living areas (e.g. bathroom, kitchen)
- Rooms in which people are not expected to stay constantly (such as cellars, storage rooms) and
- Open-plan offices

Installation of the TECEflex system with appropriate sound protection

For a water-bearing pipe, the main attention must be given to structure-borne noise. For this reason, the installation has to be decoupled from the building.

- Use of pipe attachments that insulate structure-borne noise
- Pipes that pass through screed or are laid in masonry have to be provided with an insulation of at least 9 mm. The TECEflex range contains pre-insulated pipes. Corrugated pipe sheathing used for protection does not offer sufficient sound insulation
- Compared to mounting directly on the building walls themselves, dry-wall/pre-wall installations such as TECEprofil offer improved sound insulation for sanitary objects because they are decoupled from the building
- Group 1 fittings – with a noise level defined according to DIN 52218 of Lap ≤ 20 db(A) – should be given preference over group 2 fittings
- Install potable water and heating systems on sufficiently heavy walls with a weight of at least 220 kg/m²
- A pressure at rest of 5 bar should not be exceeded
- The permitted discharge rate for fittings should be adhered to
- If possible, water-bearing pipes should not be installed on the walls of rooms requiring sound insulation

Fire protection

Wherever fire protection regulations have to be observed, pipes may be passed through walls, ceilings, etc. only if there is no danger of the transfer of fire and smoke, or precautions have been taken to avoid this happening (Model Building Regulations, MBO § 37). In these constructions, only approved pipe feedthroughs or insulation materials may be used.
These prerequisites are met if the requirements of the model pipe system guideline are met.
Only non-combustible insulation materials of material class A1 and A2, flame-retardant building materials B1 and normally flammable building materials B2 may be used. Easily flammable building materials B3 are forbidden.
Furthermore, it must be made certain that pipe feedthroughs do not adversely affect the integrity of fire resistant ceilings and walls.
TECE recommends the fire protection solutions produced by the companies Armacell and Rockwool. These are sufficiently described in the respective processing instructions. For more information, please refer to the websites www.armacell.de and www.rockwool.de.
If and when required, seek advice from the competent fire protection officer or engineer to clarify detailed questions.

Caution:
Stricter requirements apply for gas lines. See also: Feeding TECEflex gas lines through walls or ceilings of buildings of classes 3–5

Technique for laying TECEflex gas lines

TECEflex gas installations must be implemented in accordance with DVGW Worksheet G600 (TRGI 2008). When using TECEflex pipes for interior gas installation, the gas installation must be explosion-proof. In themselves, the TECEflex aluminium composite pipes do not provide high thermal load (HTB) quality. To ensure an installation is explosion-proof, safety devices are required in conjunction with specific fracture behaviour requirements to be met by the TECEflex system, as well as a special pipe run to the individual gas devices that is specially tailored to these requirements. These safety devices also ensure protection against intervention by unauthorized persons.

Safeguarding the TECEflex gas installation

TECEflex gas installations are safeguarded by including an upstream load-matched gas flow detector (GS).
Connection of several gas devices can be achieved by tee installation or by using a gas safety manifold.

Selecting the gas flow detector

Depending on the particular installation case, the choice of gas flow detector is determined by the procedure described in the section: "Planning of the gas installation". Only gas flow detectors of type K may be used.
The gas flow detector must be additionally safeguarded by a thermal shut-off unit (TAE) connected directly to it.
The installation instructions provided by the manufacturer of the gas flow detector and the manufacturer of the thermal shut-off unit must be followed without exception.

TECEflex gas safety fittings

The TECEflex gas safety fittings combine a type-K gas flow detector with a thermal shut-off unit in one single component. The TECEflex pipe can be pressed directly onto the gas safety fitting so that threaded connections are avoided. The TECEflex gas safety fittings can be installed horizontally or leading upwards. Installation leading downwards is not permitted.

Pipe run of TECEflex gas lines

The pipes are to be laid exposed, concealed without hollow space, or in channels. The pipes must be attached in such a way that static hold is achieved for operation.
If fire areas and/or fire compartments are not exceeded, TECEflex gas lines can be laid without further connections up to the device connection or the gas socket in channels and in hollow spaces, such as suspended ceilings, post-and-beam walls or pre-walls without additional protective measures.

TECEflex gas lines must not be laid in elevator shafts, ventilation lines or waste disposal plants, passed through chimneys or fed into chimney flanks. This does not apply if these facilities have been permanently shut down and are clearly used as pipe ducts.
If there are pipe runs passing through movement joints that separate two parts of a building from each other, it is necessary to ensure that relative movements cannot have a damaging effect on the pipes, e.g. by mounting a sturdy pipe jacket made of steel. For fire resistance requirements (F30 to F90) see section "Feeding TECEflex gas lines through walls or ceilings of buildings of classes (...)".

TECEflex gas lines must not be laid in screed. However, they may run below screed in recesses within the unfinished floor or within a compensation layer below the impact sound insulation on the unfinished floor.
It is vital that the requirements relating to thermal protection and impact sound are observed.
For TECEflex gas pipes laid on the unfinished floor, an attachment distance of at least one metre applies.

TECEflex pipe dimension	Spacing of attachment (m)
14	1
16	1
20	1.15
25	1.3
32	1.5
40	1.8
50	2
63	2

Attachment spacing distances for surface-mounted TECEflex gas pipes.

It is necessary to ensure that the pipes laid on the unfinished floor are not damaged by ladders, scaffolding, wheel-barrows, being permanently walked over or similar after they have been laid. The pipes must be checked immediately before the screed is laid.

Laying outdoors

According to TRGI 2008, TECEflex gas pipes may not be laid outdoors. There is only one exception: A gas pipe laid in the ground for the connection of gas appliances for use outdoors is permitted according to TRGI 2008.
Such outdoor pipes laid in the ground must be laid in accordance with TRGI 2008 with respect to laying depth, implementation etc.
The following points must be carefully attended to without fail:

- Pipes must be protected against damage.
- Repair or extension of a gas pipe laid in the ground after it has been put into operation is forbidden. In such a case, the complete gas pipe must be replaced.
- The section of pipe between the pipe laid in the ground and the gas appliance connection must not be implemented as an exposed outdoor pipe.

Impermissible heating of TECEflex gas lines

If a TECEflex gas pipe is subjected to a temperature of more than 100°C, as a result of the adhesion of bitumen sheets for example, the affected line components must be replaced.

Feeding TECEflex gas lines through walls or ceilings of buildings of classes 1 + 2

If pipes are fed through walls or ceilings, it is necessary to make sure that no pipe damage can occur. This also applies within building units such as apartments and residential buildings of classes 3–5.

Feeding TECEflex gas lines through walls or ceilings of buildings of classes 3–5

TECEflex gas lines that penetrate walls and ceilings to which fire resistance requirements (F 30–F 90) apply must be:

- either passed through partitions with a general approval for use by the construction-supervising authority that have fire resistance of 30–90 minutes (pipelines of fire resistance class R 30–R 90 in accordance with German standard DIN 4102-11, version from December 1985); the distance between the partitions is specified in the applicable general approval; if specifications are unavailable, a minimum distance of 50 mm is required,

- or run within installation channels and ducts that have fire resistance of 30-90 minutes and are made of non-combustible material (these requirements also apply to the closures of openings).

Caution: It is possible that the fire protection solutions for gas installations differ from those for water-bearing pipes. For example the Rockwool Conlit solutions.

TECEflex gas lines in escape routes

Exposed or concealed TECEflex gas lines are not yet permitted in escape routes, required stairwells and in rooms between the required stairwells and the exits to outside, or in the required corridors.

Planning and layout

The TECEflex system can be used for potable water and heating systems. Since the 2008 TRGI (German Technical Rules for Gas Installations) came into force, gas lines in the indoor area up to 100 mbar can also be installed with TECEflex. Every application puts special demands on the installation system, and this must be given due consideration during the planning phase.

Insulation of potable water and heating pipes

The insulation of pipe systems, fittings and devices has to meet requirements concerning heat dissipation, heat absorption, sound insulation, protection against corrosion, fire protection and, if and when applicable, the compensation of thermal linear expansion, among other things.
The insulation has to be chosen so as to meet the respective purposes.
No insulating materials may be used which may cause chemical corrosion or contact corrosion at fittings or pipes.

Insulation against frost

If water-bearing pipe systems are passed through areas prone to frost, they have to be insulated at least in accordance with the German Energy Saving Ordinance (EnEV). If longer stagnation occurs, the pipes may freeze despite insulation. Trace heating should be used here, if and when applicable.

Insulation against heating

Cold water-bearing potable water systems have to protected against being heated in accordance with German standard DIN 1988-2. At the tapping points, the temperature of the potable water must not exceed 25° C. The insulation thicknesses shown in the following table are the minimum requirements. The structural conditions must be checked and the insulation thicknesses increased if necessary.

Example:

Ducts or pre-walls can heat up a great deal because of heating pipes. The potable water must be provided with special protection here. It may possibly be sensible to divide a duct into two, to separate potable water pipes from hot water pipes. The potable water pipes must be protected against the formation of condensation.

If there is a risk of moisture penetrating the insulation materials, such as condensation on cold-water pipes, diffusion-tight insulation materials must be used.
The potable water pipes must be laid at a sufficient distance away from any warm pipes. Installation on warm structural elements, such as a chimney or a heated wall, should be avoided.

Laying conditions of the pipe system	Insulation thickness at λ = 0.040 W/(mK)*
Exposed, in unheated rooms	4 mm
Freely laid in heated rooms	9 mm
In a channel without heated pipes	4 mm
In a channel next to heated pipes	13 mm
In recesses next to heated pipes	4 mm
In recesses next to heated pipes	13 mm
On concrete ceilings	4 mm
* For other thermal conductivities, the insulation thicknesses must be calculated accordingly, relative to diameter d = 20 mm.	

Guideline values for minimum insulation thicknesses for insulating potable water pipe systems (cold).

The insulation thicknesses shown in the table are also suitable for protection against condensation at a potable water temperature of 10 °C. Protection against condensation is not required if the TECEflex pipe-in-pipe system is used. The TECEflex range offers pre-insulated pipes with insulation thicknesses of 9 mm and 13 mm.

Insulation of hot water and heat distribution lines

Hot-water-bearing pipe systems have to be protected against heat dissipation. The requirements relating to insulation are defined in the German Energy Saving Ordinance (EnEV), attachment 5.

Excerpt from the German Energy Saving Ordinance (EnEV 2009), attachment 5:

"1. Heat loss from heat distribution lines and hot-water lines as well as fittings has to be limited by insulation in compliance with Table 1."
If the pipes for central heating systems as described in lines 1 to 4 are in heated spaces or in components between a user's heated spaces and their heat dissipation can be influenced by a freely accessible shut-down device, no requirements are specified for the minimum thickness of the insulation thickness. This also applies for TECEflex hot water lines in apartments up to a dimension of 25 mm which are neither included in the circulation system nor fitted with electric trace heating."

"3. In the case of materials with thermal conductivities other than 0.035 W/(m·K) the minimum insulation thicknesses have to be calculated correspondingly."
Pre-insulated TECEflex pipes with an insulation thickness of 9 or 13 mm meet the insulation required in line 7, while pipes with an insulation thickness of 26 mm meet the requirements in line 1.

Line	Type of pipe system /fittings	Minimum thickness of the insulation relative to a thermal conductivity of 0.035 W/(m·K)
1	Internal diameter up to 22 mm	20 mm
2	Internal diameter over 22 mm to 35 mm	30 mm
3	Internal diameter over 35 mm to 100 mm	same as internal diameter
4	Internal diameter over 100 mm	100 mm
5	Pipe systems and fittings in conformity with lines (1) to (4) in wall and ceiling break-throughs, in the intersection area of pipe systems, at pipe joining point, in central distribution lines	½ of the requirements specified in lines 1 to 4
6	Pipe systems and fittings in conformity with lines (1) to (4), which are laid in building parts between heated rooms of different users after the effective date of this ordinance	½ of the requirements specified in lines 1 to 4
7	Pipes according to line (6) in floor construction	6 mm
8	Cooling distribution pipes and cold water pipes as well as fittings of ventilation and air-conditioning systems	6 mm

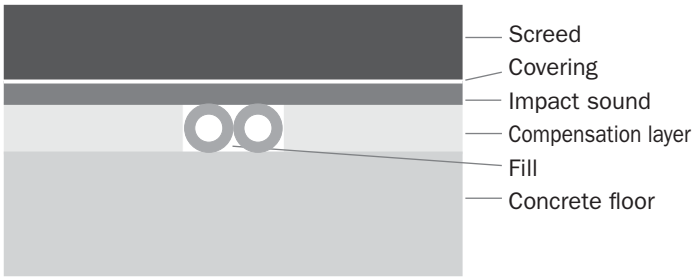
EnEV 2009 attachment 5, table 1: Heat insulation of heat distribution pipes and hot water pipes, cooling distribution pipes and cold water pipes as well as fittings

Type of pipe	Multi-family house	Rooms of a user, also detached house	Commercial building, several users
Potable water - hot			
Hot water in circulation system or with trace heating; pipes of all nominal widths, concealed or exposed	100%, Lines 1 to 4	100%, Lines 1 to 4	100%, Lines 1 to 4
Circulation systems, concealed or exposed	100%, Lines 1 to 4	100%, Lines 1 to 4	100%, Lines 1 to 4
Hot water without circulation and without trace heating; pipes up to dim. 22 mm, concealed or exposed (in accordance with DVGW worksheet W 551 maximum pipe contents 3 litres)	Without insulation requirements in accordance with EnEV; sheathing may be required for other reasons	Without insulation requirements in accordance with EnEV; sheathing may be required for other reasons	100%, Lines 1 to 4
	Recommendation: Consultation, information of the building owner, conclusion of contractual agreement		
Pipes and fittings in wall and ceiling openings, in the intersection area of pipelines, at line connection points, in central line distributors	50%, line (5)	50%, line (5)	50%, line (5)
Heating			
Pipe system exposed/surface-mounted in heated spaces	100%, Lines 1 to 4	Without insulation no. 1, paragraph below Table 1	100%, Lines 1 to 4
Pipe system in channel/concealed between heated spaces of different users	50%, line (6)		50%, line (6)
Pipe system exposed/in channel/concealed in unheated spaces and in building parts adjacent to unheated spaces	100%, Lines 1 to 4	100%, Lines 1 to 4	100%, Lines 1 to 4
Pipes laid in flooring, also radiator connection lines between heated spaces	6 mm, line 7 Note: for the usual insulation materials with λ 0.04 · 9 mm	Without insulation Section no. 1 below table (1)	6 mm, line 7 Note: for the usual insulation materials with λ 0.04 · 9 mm
Pipes laid in flooring, also radiator connection lines between ground / heated rooms	100%, Lines 1 to 4	100%, Lines 1 to 4	100%, Lines 1 to 4

Application example for insulation of hot-water and heating pipe systems against heat loss.

Insulation of pipes laid in the floor structure

German standard DIN 18560-2 stipulates that impact sound insulation has to be laid over the entire area and without interruptions. If insulation pipes are laid on the bare concrete, a suitable compensation layer has to be applied up to the height of the upper edge of the pipe including pipe insulation. The impact sound insulation can then be laid on top of this.



Laying example for a TECEflex pipe system in the floor structure

Example:
According to Table 1, attachment 5 of the German Energy Saving Ordinance (EnEV), heating pipes in the floor structure have to be provided with 6 mm of insulation. Thus, a TECEflex pipe with a dimension of 16 mm would have an outside diameter of 28 mm. In this case, a compensating insulation EPS 035 DEO dh 30 mm (previously PS 20 WLG 035 or: Heat-insulation boards made of quality-assured polystyrene hard foam in accordance with DIN EN 13163 and DIN 4108. Compressive strain at 10 per cent compression ≥ 150 kPa. building material class B1 according to DIN 4102.) or also an alternative insulation material can be used.
The heat-insulation boards are laid up to the pipework. The spaces between have to be filled with a suitable fill. The impact sound insulation can then be laid on top of this construction. For example, an EPS insulation of type DR 30-2 is suitable. It must be ensured that only an impact sound layer is applied. In order to minimize the effect of thermal bridges, the insulating material has to be applied in a joint-tight layer.
If laying the TECEflex heating pipes in a compensation layer is not possible, they can also be laid in the impact sound insulation because the insulation of the pre-insulated TECEflex pipes has been certified as suitable in accordance with DIN 18560-2. This certificate can be downloaded from the website www.tece.com. If other insulating materials are used, a corresponding proof of suitability has to be obtained from the supplier of the insulating material.

Dimensioning of potable water systems

DIN 1988, DIN EN 806, DIN EN 1717/A1, DVGW worksheets W 551 and W 553 as well as VDI 6023 apply for planning and setting up potable water systems. The potable water systems have to be designed in such a way that they meet hygienic and hydraulic specifications.

Hygienic requirements

A potable water system has to ensure that the water removed at the tapping point meets the requirements of the German Ordinance on Potable Water.
The biological and chemical suitability of the TECEflex system is proven by DVGW and further European permits. The technical measures to be taken to reduce the growth of Legionella as well as the planning, operation and restoration of potable water systems are described in the DVGW Worksheet W 551.

The following points have to be observed during planning work:

Documentation

DVGW Worksheet W551 requires documentation of the potable water system. This has to be prepared for new systems as well as for modifications to existing systems. If no documents are available for potential restoration work, an inventory has to be carried out. The documentation has to comprise installation inventories, plant descriptions, plant data and the maintenance and operating instructions. It has to be handed over to the plant operator when the potable water system is started up.

Pipework systems

The hot-water system must be designed so that nowhere in the whole system does the temperature fall below 55 °C.
Pipework not required should be severed directly at the outlet. It is necessary to check whether hot-water lines for rarely used tapping points can be disconnected and these tapping points can be supplied by decentralized water heaters.
Shut-off fittings in drain down lines must be fitted directly at the main line. Connecting pipes to vents and breathers should be disconnected in the case of collector-unit backflow prevention systems. Fittings with individual backflow prevention should be installed.
In order to achieve the necessary temperature in pipework with a circulation system, control valves are usually required for hydraulic compensation.

Circulation pipes

Circulation pipes must be implemented according to DVGW worksheets W 551 and W 553. Circulation pipes must always be planned if the water volume of the pipe from the water heater to the tapping point is greater than three litres. Storey pipes and/or individual pipes with a water volume of up to three litres can be constructed without a circulation pipe. The "three-litre rule" is considered the upper limit; smaller volumes are to be aimed for.

TECEflex dim.	Water volume per metre (litres)	Pipe length with a volume of 3 litres (m)
16	0.11	27.27
20	0.16	18.75
25	0.25	12.00
32	0.45	6.67
40	0.80	3.75
50	1.32	2.27
63	2.04	1.47

Water volume of TECEflex pipe systems

Circulation lines are to be laid directly up to the straight-way mixer taps.
Circulation systems and self-regulating trace heating systems must be operated so that the water temperature in the system is not more than 5 K below the hot water outlet temperature of the water heater. For reasons of hygiene, a water outlet temperature at the water heater of 60° C should be aimed for. In hygienically perfect conditions, circulation systems can be operated at lower temperatures for a maximum of 8 hours every 24 hours in order to save energy.
Gravity circulation systems are not recommended from a hygienic point of view.

Circular pipelines

For hygiene reasons, TECE recommends that a potable water installation should be implemented as a circular pipeline. An appropriate selection of double wall plates is available in the TECEflex range.

A circular pipeline offers the following advantages compared with the other methods of laying:

- The water always flows from two directions to the fittings
- Continuous flushing of the whole installation because of this
- Easy and fast laying because of the small number of fittings
- Water content is completely changed in the fastest possible time
- Small pipe diameter
- Very low pressure losses through the parallel circuit
- Unused or dead pipe sections are excluded from the start

Note: To achieve ideal hygienic conditions, it is also useful to install the double wall plates so that the connections are pointing upwards and the pipe loops are laid above the wall plates. This has the advantage that the system can easily and safely be emptied when it is not used for long periods (holiday etc.). In particular, this is not possible if the pipe loops are laid underneath the fittings.
TECE emphasises that a circular pipeline which is not operated as intended does not automatically protect against hygiene problems, even if it was installed as prescribed!

Connection to potable water heaters and flow heaters

Unregulated or hydraulically controlled flow heaters may damage the connected TECEflex pipe because of pressure which is too high and excessively high temperatures. TECEflex may only be connected directly to electronically controlled devices. In the case of uncontrolled devices, a metal pipe with a minimum length of one metre must be fitted in between. The manufacturer's instructions of the flow heaters must be observed.

Caution: Hot-water tanks heated by a solar system or solid-fuelled boilers may reach temperatures above 100° C ! In these cases, a temperature-limiting safety fitting has to be installed upstream of the TECEflex pipework.

According to DIN EN 806-5, plastic pipe lines must not be connected to potable water heaters and flow heaters if for a short time (10 seconds), the safety devices permit a high temperature above 95 °C and a water pressure above the highest operating pressure of the system.

Hydraulic set-up

Potable water systems using TECEflex should be dimensioned and planned on the basis of DIN 1988, Part 3 entitled "Technical Rules for Potable Water Installations (TRWI) – Determination of Pipe Diameters, Technical Rules of the DVGW". For product-specific data, please refer to the illustrations and tables below.
The first table shows the loss coefficient values for TECEflex fittings, the second table shows the minimum flow pressures and calculation flow rates of conventional water withdrawal fittings.

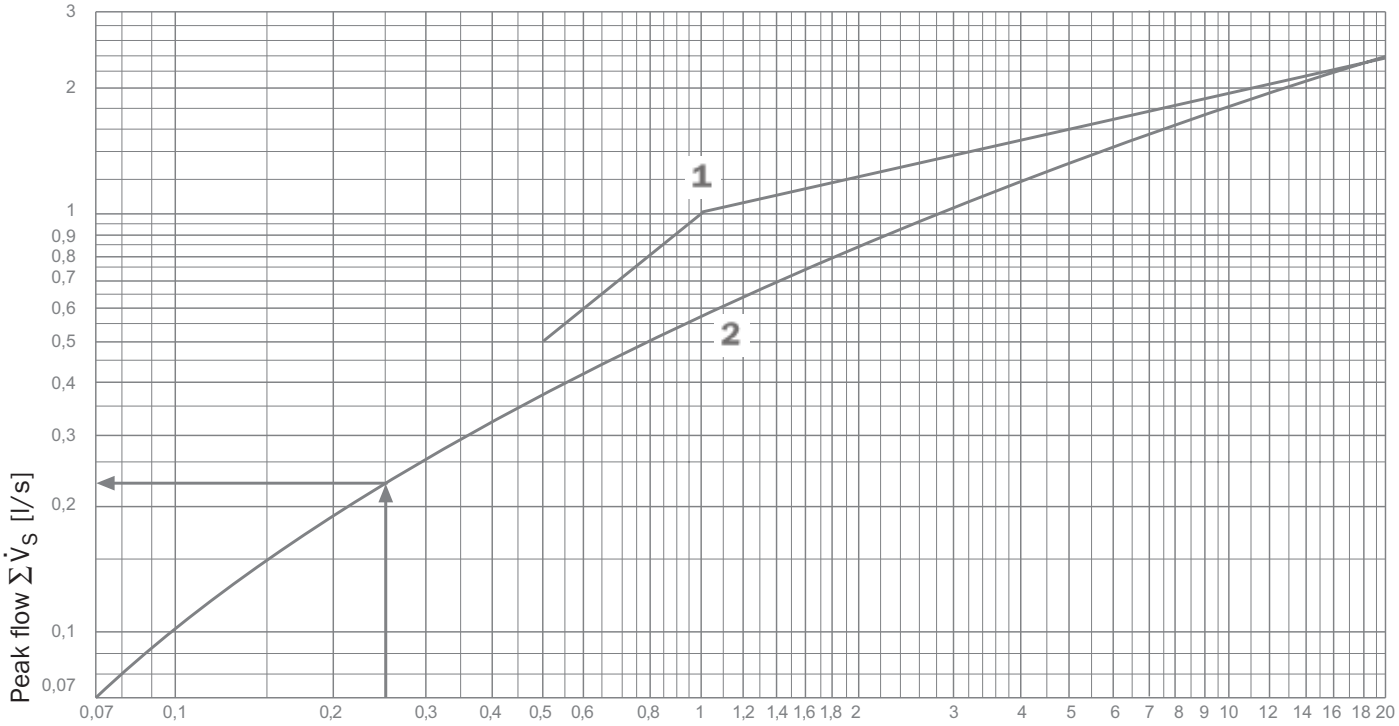
Fitting	Version	Zeta value	Equivalent pipe length (m)
Transition connector	14 mm x ½"	0.8	0.2
Coupler	14 mm	1	0.3
Elbow	14 mm	4	1.1
Tee DG	14 mm	0.8	0.2
Tee AG	14 mm	4	1.1
Transition connector	16 mm x ½"	1	0.3
Coupler	16 mm	0.5	0.2
Elbow	16 mm	3.2	1.3
Bend	16 mm	1.1	1.3
Tee DG	16 mm	0.8	0.3
Tee AG	16 mm	3.6	1.5
Transition connector	20 mm x ¾"	1.7	0.6
Coupler	20 mm	0.9	0.5
Elbow	20 mm	4.3	2.4
Bend	20 mm	1.9	2.4
Tee DG	20 mm	1.1	0.6
Tee AG	20 mm	4.7	2.6
Transition connector	25 mm x ¾"	0.8	0.4
Coupler	25 mm	0.3	0.2
Elbow	25 mm	2.3	1.7
Bend	25 mm	1.1	1.7
Tee DG	25 mm	0.6	0.4
Tee AG	25 mm	2.6	1.9
Transition connector	32 mm x 1"	0.5	0.3
Coupler	32 mm	0.2	0.2
Elbow	32 mm	2.4	2.5
Bend	32 mm	0.6	2.5
Tee DG	32 mm	0.3	0.3
Tee AG	32 mm	2.5	2.6
Transition connector	40 mm x 1¼"	0.4	0.4
Coupler	40 mm	0.2	0.2
Elbow	40 mm	2.1	2
Bend	40 mm	0.6	2
Tee DG	40 mm	0.3	0.3
Tee AG	40 mm	2.2	2.2
Transition connector	50 mm x 1½"	0.4	0.5
Coupler	50 mm	0.1	0.2
Elbow	50 mm	1.8	2.3
Bend	50 mm	0.5	2.3
Tee DG	50 mm	0.2	2.3
Tee AG	50 mm	1.9	2.5
Transition connector	63 mm x 2"	0.3	0.6
Coupler	63 mm	0.1	0.2
Elbow	63 mm	2.2	3.7
Bend	63 mm	0.6	3.7
Tee DG	63 mm	0.5	0.8
Tee AG	63 mm	2.2	3.7

Loss coefficients of TECEflex fittings

Type of potable water withdrawal point	DN	Minimum flow pressure $P_{min\ FL}$ [bar]	In case of dual-purpose water withdrawal each cold $\dot{V}_R$ FL [l/s]	hot $\dot{V}_R$ [l/s]	In case of withdrawal of cold or hot water $\dot{V}_R$ [l/s]
Kitchen fittings					
Sink mixer tap	15	1	0.07	0.07	-
Household washing machine	15	1	-	-	0.25
Household dishwasher	10	1	-	-	0.15
Tap with aerator	10	1	-	-	0.15
Tap with aerator	15	1	-	-	0.15
Bathroom fittings					
Bathtub mixer tap	15	1	0.15	0.15	-
Shower mixer tap	15	1	0.15	0.15	-
Shower heads for cleaning showers	15	1	0.1	0.1	0.2
Washbasin mixer tap	15	1	0.07	0.07	-
Bidet mixer tap	15	1	0.07	0.07	-
Toilet fittings					
Cistern (in acc. with German standard DIN 19542)	15	0.5	-	-	0.13
Flush valve (to DIN 3265 part 1)	15	1.2	-	-	0.7
Flush valve (to DIN 3265 part 1)	20	1.2	-	-	1
Flush valve (to DIN 3265 part 1)	25	0.4	-	-	1
Urinal flush valve	15	1	-	-	0.3
Individual potable water heater					
Electric water boiler	15	1	-	-	0.1
Special fittings					
Taps without aerator	15	0.5	-	-	0.3
Taps without aerator	20	0.5	-	-	0.5
Taps without aerator	25	0.5	-	-	1
Mixer tap	20	1	0.3	0.3	-

Minimum flow pressures and calculation flow rates of conventional water withdrawal fittings (if fittings are not listed, follow the manufacturer's specifications!)

The illustration below shows the performance map for calculating the peak flows ($\dot{V}_S$) from the cumulative flow ($\dot{V}_R$) for residential buildings, office and administration buildings up to a cumulative flow ($\Sigma\dot{V}_R$) of 20 l/s.



1 for calculation flow rate $\dot{V}_R \geq 0.5$ l/s applicable for flush valves

2 for calculation flow rate $\dot{V}_R < 5$ l/s applicable for cisterns

Pressure drop tables in potable water installations – dimensions 14/16/20/25 mm

TECEflex composite pipes – pressure drops caused by pipe resistance in potable water installations												
Water speed	Dim. 14			Dim. 16			Dim. 20			Dim. 25		
	V	m	R	V	m	R	V	m	R	V	m	R
			hPa/m			hPa/m			hPa/m			hPa/m
m/s	l/s	kg/h	mbar/m	l/s	kg/h	mbar/m	l/s	kg/h	mbar/m	l/s	kg/h	mbar/m
0.1	0.008	28.3	0.4	0.011	38.0	0.3	0.016	58.6	0.2	0.025	91.6	0.1
0.2	0.012	42.4	0.6	0.016	57.1	0.5	0.024	87.9	0.3	0.038	137.4	0.2
0.2	0.016	56.5	0.8	0.021	76.1	0.6	0.033	117.3	0.4	0.051	183.2	0.5
0.3	0.020	70.7	1.0	0.026	95.1	0.8	0.041	146.6	1.0	0.064	229.0	0.7
0.3	0.024	84.8	1.3	0.032	114.1	1.8	0.049	175.9	1.3	0.076	274.8	1.0
0.4	0.027	99.0	2.8	0.037	133.2	2.3	0.057	205.2	1.7	0.089	320.6	1.3
0.4	0.031	113.1	3.5	0.042	152.2	2.9	0.065	234.5	2.2	0.102	366.4	1.6
0.5	0.035	127.2	4.3	0.048	171.2	3.5	0.073	263.8	2.7	0.115	412.2	2.0
0.5	0.039	141.4	5.1	0.053	190.2	4.2	0.081	293.1	3.2	0.127	458.0	2.4
0.6	0.043	155.5	6.1	0.058	209.3	5.0	0.090	322.5	3.8	0.140	503.8	2.8
0.6	0.047	169.6	7.0	0.063	228.3	5.8	0.098	351.8	4.4	0.153	549.7	3.3
0.7	0.051	183.8	8.1	0.069	247.3	6.7	0.106	381.1	5.1	0.165	595.5	3.8
0.7	0.055	197.9	9.2	0.074	266.3	7.6	0.114	410.4	5.7	0.178	641.3	4.3
0.8	0.059	212.1	10.3	0.079	285.3	8.5	0.122	439.7	6.5	0.191	687.1	4.9
0.8	0.063	226.2	11.6	0.085	304.4	9.6	0.130	469.0	7.3	0.204	732.9	5.5
0.9	0.067	240.3	12.9	0.090	323.4	10.6	0.138	498.4	8.1	0.216	778.7	6.1
0.9	0.071	254.5	14.2	0.095	342.4	11.7	0.147	527.7	8.9	0.229	824.5	6.7
1.0	0.075	268.6	15.6	0.100	361.4	12.9	0.155	557.0	9.8	0.242	870.3	7.4
1.0	0.079	282.7	17.1	0.106	380.5	14.1	0.163	586.3	10.7	0.254	916.1	8.1
1.1	0.082	296.9	18.6	0.111	399.5	15.4	0.171	615.6	11.7	0.267	961.9	8.8
1.2	0.094	339.3	23.5	0.127	456.6	19.4	0.195	703.6	14.8	0.305	1099.3	11.2
1.3	0.102	367.6	27.0	0.137	494.6	22.4	0.212	762.2	17.0	0.331	1190.9	12.9
1.4	0.113	405.3	32.1	0.151	545.3	26.6	0.233	840.4	20.2	0.365	1313.1	15.3
1.5	0.118	424.1	34.8	0.159	570.7	28.8	0.244	879.4	21.9	0.382	1374.1	16.6
1.6	0.126	452.4	39.0	0.169	608.7	32.3	0.261	938.1	24.6	0.407	1465.7	18.6
1.7	0.134	480.7	43.4	0.180	646.8	36.0	0.277	996.7	27.4	0.433	1557.4	20.7
1.8	0.141	508.9	48.0	0.190	684.8	39.8	0.293	1055.3	30.3	0.458	1649.0	23.0
1.9	0.149	537.2	52.9	0.201	722.9	43.8	0.309	1114.0	33.4	0.483	1740.6	25.3
2.0	0.157	565.5	57.9	0.211	760.9	48.0	0.326	1172.6	36.6	0.509	1832.2	27.7
2.1	0.165	593.8	63.2	0.222	799.0	52.4	0.342	1231.2	40.0	0.534	1923.8	30.3
2.2	0.173	622.0	68.6	0.233	837.0	56.9	0.358	1289.9	43.4	0.560	2015.4	32.9
2.3	0.181	650.3	74.3	0.243	875.1	61.7	0.375	1348.5	47.0	0.585	2107.0	35.6
2.4	0.188	678.6	80.2	0.254	913.1	66.5	0.391	1407.1	50.8	0.611	2198.6	38.5
2.5	0.196	706.9	86.3	0.264	951.1	71.6	0.407	1465.7	54.6	0.636	2290.2	41.4
2.6	0.204	735.1		0.275	989.2		0.423	1524.4		0.662	2381.8	44.4
2.7	0.212	763.4		0.285	1027.2		0.440	1583.0		0.687	2473.4	47.5
2.8	0.220	791.7		0.296	1065.3		0.456	1641.6		0.713	2565.0	50.8
2.9	0.228	820.0		0.306	1103.3		0.472	1700.3		0.738	2656.7	54.1
3.0	0.236	848.2		0.317	1141.4		0.489	1758.9		0.763	2748.3	57.5
3.6	0.283	1017.9		0.380	1369.7		0.586	2110.7		0.916	3297.9	80.1
4.0	0.314	1131.0		0.423	1521.8		0.651	2345.2		1.018	3664.4	97.1
4.6	0.361	1300.6		0.486	1750.1		0.749	2697.0		1.171	4214.0	125.3
5.0	0.393	1413.7		0.528	1902.3		0.814	2931.5		1.272	4580.4	146.0

Pressure drop tables in potable water installations – dimensions 32/40/50/63 mm

TECEflex composite pipes – pressure drops caused by pipe resistance in potable water installations												
Water speed	Dim. 32			Dim. 40			Dim. 50			Dim. 63		
	V	m	R	V	m	R	V	m	R	V	m	R
			hPa/m			hPa/m			hPa/m			hPa/m
m/s	l/s	kg/h	mbar/m	l/s	kg/h	mbar/m	l/s	kg/h	mbar/m	l/s	kg/h	mbar/m
0.1	0.045	162.9	0.1	0.080	289.5	0.1	0.132	475.3	0.1	0.204	735.4	0.0
0.2	0.068	244.3	0.2	0.121	434.3	0.1	0.198	712.9	0.1	0.306	1103.1	0.1
0.2	0.090	325.7	0.3	0.161	579.1	0.2	0.264	950.6	0.2	0.409	1470.8	0.1
0.3	0.113	407.2	0.5	0.201	723.8	0.3	0.330	1188.2	0.3	0.511	1838.5	0.2
0.3	0.136	488.6	0.7	0.241	868.6	0.5	0.396	1425.9	0.3	0.613	2206.2	0.3
0.4	0.158	570.0	0.9	0.281	1013.4	0.6	0.462	1663.5	0.5	0.715	2574.0	0.3
0.4	0.181	651.4	1.1	0.322	1158.1	0.8	0.528	1901.2	0.6	0.817	2941.7	0.4
0.5	0.204	732.9	1.4	0.362	1302.9	1.0	0.594	2138.8	0.7	0.919	3309.4	0.5
0.5	0.226	814.3	1.7	0.402	1447.6	1.2	0.660	2376.5	0.8	1.021	3677.1	0.6
0.6	0.249	895.7	2.0	0.442	1592.4	1.4	0.726	2614.1	1.0	1.124	4044.8	0.8
0.6	0.271	977.2	2.3	0.483	1737.2	1.6	0.792	2851.7	1.2	1.226	4412.5	0.9
0.7	0.294	1058.6	2.6	0.523	1881.9	1.8	0.858	3089.4	1.3	1.328	4780.2	1.0
0.7	0.317	1140.0	3.0	0.563	2026.7	2.1	0.924	3327.0	1.5	1.430	5147.9	1.2
0.8	0.339	1221.5	3.4	0.603	2171.5	2.4	0.990	3564.7	1.7	1.532	5515.6	1.3
0.8	0.362	1302.9	3.8	0.643	2316.2	2.6	1.056	3802.3	1.9	1.634	5883.3	1.5
0.9	0.385	1384.3	4.2	0.684	2461.0	2.9	1.122	4040.0	2.2	1.736	6251.0	1.7
0.9	0.407	1465.7	4.7	0.724	2605.8	3.3	1.188	4277.6	2.4	1.839	6618.7	1.8
1.0	0.430	1547.2	5.1	0.764	2750.5	3.6	1.254	4515.3	2.6	1.941	6986.4	2.0
1.0	0.452	1628.6	5.6	0.804	2895.3	3.9	1.320	4752.9	2.9	2.043	7354.2	2.2
1.1	0.475	1710.0	6.1	0.844	3040.1	4.3	1.386	4990.6	3.2	2.145	7721.9	2.4
1.2	0.543	1954.3	7.8	0.965	3474.4	5.4	1.584	5703.5	4.0	2.451	8825.0	3.1
1.3	0.588	2117.2	9.0	1.046	3763.9	6.3	1.716	6178.8	4.6	2.656	9560.4	3.5
1.4	0.648	2334.3	10.7	1.153	4149.9	7.5	1.892	6812.5	5.5	2.928	10541.0	4.2
1.5	0.679	2442.9	11.6	1.206	4342.9	8.1	1.980	7129.4	6.0	3.064	11031.2	4.6
1.6	0.724	2605.8	13.0	1.287	4632.5	9.1	2.112	7604.7	6.7	3.269	11766.6	5.1
1.7	0.769	2768.6	14.5	1.367	4922.0	10.1	2.244	8080.0	7.5	3.473	12502.1	5.7
1.8	0.814	2931.5	16.0	1.448	5211.5	11.2	2.376	8555.2	8.3	3.677	13237.5	6.3
1.9	0.860	3094.3	17.7	1.528	5501.1	12.4	2.508	9030.5	9.1	3.881	13972.9	7.0
2.0	0.905	3257.2	19.4	1.608	5790.6	13.6	2.641	9505.8	10.0	4.086	14708.3	7.7
2.1	0.950	3420.1	21.2	1.689	6080.1	14.8	2.773	9981.1	11.0	4.290	15443.7	8.4
2.2	0.995	3582.9	23.0	1.769	6369.6	16.1	2.905	10456.4	11.9	4.494	16179.1	9.1
2.3	1.040	3745.8	24.9	1.850	6659.2	17.5	3.037	10931.7	12.9	4.698	16914.6	9.9
2.4	1.086	3908.6	26.9	1.930	6948.7	18.9	3.169	11407.0	13.9	4.903	17650.0	10.7
2.5	1.131	4071.5	29.0	2.011	7238.2	20.3	3.301	11882.3	15.0	5.107	18385.4	11.5
2.6	1.176	4234.4	31.1	2.091	7527.8	21.8	3.433	12357.6	16.1	5.311	19120.8	12.4
2.7	1.221	4397.2	33.3	2.171	7817.3	23.4	3.565	12832.9	17.3	5.516	19856.2	13.2
2.8	1.267	4560.1	35.6	2.252	8106.8	25.0	3.697	13308.2	18.5	5.720	20591.6	14.2
2.9	1.312	4722.9	37.9	2.332	8396.3	26.6	3.829	13783.5	19.7	5.924	21327.0	15.1
3.0	1.357	4885.8	40.3	2.413	8685.9	28.3	3.961	14258.7	20.9	6.128	22062.5	16.0
3.6	1.629	5863.0	56.2	2.895	10423.1	39.5	4.753	17110.5	29.2	7.354	26475.0	22.4
4.0	1.810	6514.4	68.1	3.217	11581.2	47.9	5.281	19011.7	35.4	8.171	29416.6	27.2
4.6	2.081	7491.6	88.0	3.700	13318.3	61.9	6.073	21863.4	45.8	9.397	33829.1	35.2
5.0	2.262	8143.0	102.6	4.021	14476.5	72.2	6.601	23764.6	53.4	10.214	36770.8	41.0

Pressure drop tables in heating installations – dimensions 14/16/20/25 mm

Pressure drop caused by pipe resistance in the heating installation												
Connected load (W)				Mass flow	Dim. 14		Dim. 16		Dim. 20		Dim. 25	
					v	R	v	R	v	R	v	R
Spread (K)						hPa/m		hPa/m		hPa/m		hPa/m
20 K	15 K	10 K	5 K	kg/h	m/s	mbar/m	m/s	mbar/m	m/s	mbar/m	m/s	mbar/m
200	150	100	50	8.60	0.03	0.13	0.02	0.07				
300	225	150	75	12.90	0.05	0.19	0.03	0.11				
400	300	200	100	17.20	0.06	0.25	0.05	0.14				
600	450	300	150	25.80	0.09	0.38	0.07	0.21				
800	600	400	200	34.39	0.12	0.51	0.09	0.28				
1000	750	500	250	42.99	0.15	0.64	0.11	0.35				
1200	900	600	300	51.59	0.18	0.76	0.14	0.42				
1400	1050	700	350	60.19	0.21	0.89	0.16	0.49				
1600	1200	800	400	68.79	0.24	1.02	0.18	0.56				
1800	1350	900	450	77.39	0.27	1.15	0.20	0.63				
2000	1500	1000	500	85.98	0.30	2.21	0.23	0.70	0.15	0.30		
2300	1725	1150	575	98.88	0.35	2.80	0.26	0.81	0.17	0.34		
2800	2100	1400	700	120.38	0.43	3.91	0.32	1.94	0.21	0.42		
3000	2250	1500	750	128.98	0.46	4.40	0.34	2.18	0.22	0.79		
3500	2625	1750	875	150.47	0.53	5.73	0.40	2.84	0.26	1.02		
4000	3000	2000	1000	171.97	0.61	7.21	0.45	3.57	0.29	1.29	0.19	0.45
4500	3375	2250	1125	193.47	0.68	8.83	0.51	4.37	0.33	1.57	0.21	0.55
5000	3750	2500	1250	214.96	0.76	10.60	0.57	5.24	0.37	1.88	0.23	0.66
5500	4125	2750	1375	236.46	0.84	12.50	0.62	6.17	0.40	2.22	0.26	0.77
6000	4500	3000	1500	257.95	0.91	14.55	0.68	7.18	0.44	2.57	0.28	0.90
6500	4875	3250	1625	279.45	0.99	16.73	0.73	8.25	0.48	2.95	0.31	1.03
7000	5250	3500	1750	300.95	1.06	19.04	0.79	9.38	0.51	3.36	0.33	1.17
7500	5625	3750	1875	322.44			0.85	10.58	0.55	3.78	0.35	1.31
8000	6000	4000	2000	343.94			0.90	11.84	0.59	4.23	0.38	1.47
8500	6375	4250	2125	365.43			0.96	13.16	0.62	4.70	0.40	1.63
9000	6750	4500	2250	386.93			1.02	14.55	0.66	5.19	0.42	1.80
9500	7125	4750	2375	408.43			1.07	16.00	0.70	5.70	0.45	1.98
10000	7500	5000	2500	429.92					0.73	6.23	0.47	2.16
10500	7875	5250	2625	451.42					0.77	6.79	0.49	2.35
11000	8250	5500	2750	472.91					0.81	7.36	0.52	2.55
11500	8625	5750	2875	494.41					0.84	7.96	0.54	2.75
12500	9375	6250	3125	537.40					0.92	9.21	0.59	3.18
13000	9750	6500	3250	558.90					0.95	9.86	0.61	3.40
14000	10500	7000	3500	601.89					1.03	11.23	0.66	3.87
15000	11250	7500	3750	644.88							0.70	4.37
16000	12000	8000	4000	687.88							0.75	4.89
17000	12750	8500	4250	730.87							0.80	5.44
18000	13500	9000	4500	773.86							0.85	6.01
19000	14250	9500	4750	816.85							0.89	6.61
20000	15000	10000	5000	859.85							0.94	7.24
22000	16500	11000	5500	945.83							1.03	8.56

Pressure drop tables in heating installations – dimensions 32/40/50/63 mm (part 1)

Pressure drop caused by pipe resistance in the heating installation												
Connected load (W)				Mass flow	Dim. 32		Dim. 40		Dim. 50		Dim. 63	
					v	R	v	R	v	R	v	R
Spread (K)						hPa/m		hPa/m		hPa/m		hPa/m
20 K	15 K	10 K	5 K	kg/h	m/s	mbar/m	m/s	mbar/m	m/s	mbar/m	m/s	mbar/m
7000	5250	3500	1750	300.95	0.18	0.30						
7500	5625	3750	1875	322.44	0.20	0.34						
8000	6000	4000	2000	343.94	0.21	0.38						
8500	6375	4250	2125	365.43	0.22	0.42						
9000	6750	4500	2250	386.93	0.24	0.46						
9500	7125	4750	2375	408.43	0.25	0.51						
10000	7500	5000	2500	429.92	0.26	0.55						
10500	7875	5250	2625	451.42	0.28	0.60						
11000	8250	5500	2750	472.91	0.29	0.65	0.16	0.17				
11500	8625	5750	2875	494.41	0.30	0.70	0.17	0.18				
12500	9375	6250	3125	537.40	0.33	0.81	0.19	0.21				
13000	9750	6500	3250	558.90	0.34	0.87	0.19	0.22				
14000	10500	7000	3500	601.89	0.37	0.99	0.21	0.25				
15000	11250	7500	3750	644.88	0.40	1.11	0.22	0.28				
16000	12000	8000	4000	687.88	0.42	1.24	0.24	0.32				
17000	12750	8500	4250	730.87	0.45	1.38	0.25	0.35				
18000	13500	9000	4500	773.86	0.48	1.53	0.27	0.39				
19000	14250	9500	4750	816.85	0.50	1.68	0.28	0.43				
20000	15000	10000	5000	859.85	0.53	1.84	0.30	0.47				
22000	16500	11000	5500	945.83	0.58	2.17	0.33	0.55				
24000	18000	12000	6000	1031.81	0.63	2.52	0.36	0.64				
26000	19500	13000	6500	1117.80	0.69	2.90	0.39	0.74				
28000	21000	14000	7000	1203.78	0.74	3.31	0.42	0.84				
30000	22500	15000	7500	1289.77	0.79	3.73	0.45	0.95	0.27	0.29		
32000	24000	16000	8000	1375.75	0.85	4.19	0.48	1.06	0.29	0.33		
34000	25500	17000	8500	1461.74	0.90	4.66	0.51	1.18	0.31	0.36		
36000	27000	18000	9000	1547.72	0.95	5.15	0.53	1.30	0.33	0.40		
38000	28500	19000	9500	1633.71	1.00	5.67	0.56	1.43	0.34	0.44		
40000	30000	20000	10000	1719.69			0.59	1.57	0.36	0.48		
42000	31500	21000	10500	1805.67			0.62	1.71	0.38	0.52		
44000	33000	22000	11000	1891.66			0.65	1.85	0.40	0.57		
46000	34500	23000	11500	1977.64			0.68	2.01	0.42	0.62		
48000	36000	24000	12000	2063.63			0.71	2.16	0.43	0.66	0.28	0.23
50000	37500	25000	12500	2149.61			0.74	2.32	0.45	0.71	0.29	0.25
52000	39000	26000	13000	2235.60			0.77	2.49	0.47	0.76	0.30	0.27
54000	40500	27000	13500	2321.58			0.80	2.66	0.49	0.81	0.32	0.29
56000	42000	28000	14000	2407.57			0.83	2.84	0.51	0.87	0.33	0.31
58000	43500	29000	14500	2493.55			0.86	3.02	0.52	0.92	0.34	0.33
60000	45000	30000	15000	2579.54			0.89	3.21	0.54	0.98	0.35	0.35
62000	46500	31000	15500	2665.52			0.92	3.40	0.56	1.04	0.36	0.37
64000	48000	32000	16000	2751.50			0.95	3.60	0.58	1.10	0.37	0.39
66000	49500	33000	16500	2837.49			0.98	3.80	0.60	1.16	0.39	0.41
68000	51000	34000	17000	2923.47			1.01	4.00	0.62	1.22	0.40	0.43
70000	52500	35000	17500	3009.46			1.04	4.22	0.63	1.29	0.41	0.45
72000	54000	36000	18000	3095.44			1.07	4.43	0.65	1.35	0.42	0.48

Pressure drop tables in heating installations – dimensions 32/40/50/63 mm (part 2)

Pressure drop caused by pipe resistance in the heating installation												
Connected load (W)				Mass flow	Dim. 32		Dim. 40		Dim. 50		Dim. 63	
					v	R	v	R	v	R	v	R
Spread (K)						hPa/m		hPa/m		hPa/m		hPa/m
20 K	15 K	10 K	5 K	kg/h	m/s	mbar/m	m/s	mbar/m	m/s	mbar/m	m/s	mbar/m
76000	57000	38000	19000	3267.41					0.69	1.49	0.44	0.52
80000	60000	40000	20000	3439.38					0.72	1.63	0.47	0.57
84000	63000	42000	21000	3611.35					0.76	1.78	0.49	0.63
88000	66000	44000	22000	3783.32					0.80	1.93	0.51	0.68
92000	69000	46000	23000	3955.29					0.83	2.09	0.54	0.73
96000	72000	48000	24000	4127.26					0.87	2.25	0.56	0.79
100000	75000	50000	25000	4299.23					0.90	2.42	0.58	0.85
104000	78000	52000	26000	4471.20					0.94	2.59	0.61	0.91
108000	81000	54000	27000	4643.16					0.98	2.77	0.63	0.98
112000	84000	56000	28000	4815.13					1.01	2.96	0.65	1.04
116000	87000	58000	29000	4987.10					1.05	3.15	0.68	1.11
120000	90000	60000	30000	5159.07					1.09	3.35	0.70	1.18
124000	93000	62000	31000	5331.04							0.73	1.25
128000	96000	64000	32000	5503.01							0.75	1.32
132000	99000	66000	33000	5674.98							0.77	1.39
136000	102000	68000	34000	5846.95							0.80	1.47
140000	105000	70000	35000	6018.92							0.82	1.55
144000	108000	72000	36000	6190.89							0.84	1.63
148000	111000	74000	37000	6362.85							0.87	1.71
152000	114000	76000	38000	6534.82							0.89	1.79
156000	117000	78000	39000	6706.79							0.91	1.87
160000	120000	80000	40000	6878.76							0.94	1.96
164000	123000	82000	41000	7050.73							0.96	2.05
168000	126000	84000	42000	7222.70							0.98	2.14
172000	129000	86000	43000	7394.67							1.01	2.23
176000	132000	88000	44000	7566.64							1.03	2.33
180000	135000	90000	45000	7738.61							1.05	2.42
184000	138000	92000	46000	7910.58							1.08	2.52
188000	141000	94000	47000	8082.55							1.10	2.62
192000	144000	96000	48000	8254.51							1.12	2.72
196000	147000	98000	49000	8426.48							1.15	2.82
200000	150000	100000	50000	8598.45							1.17	2.92

Guideline values and mounting times

The following table shows the guideline values for mounting the pipes and pressure sleeve connectors in running metres, completely laid, including attachment for slotted wall and pre-wall installation in single-family and multi-family houses, in group minutes.

TECEflex ∅ (mm)	mounting time per metre, fully laid, incl. attachment (group minutes)
14	5-9
16	5-9
20	6-10
25	7-11
32	8-12
40	14-16
50	16-18
63	18-20

Note: Additional requirements in accordance with the German Regulations for Contracts and Execution of Construction Works (VOB) or additional effort, e.g. for slots, setting up the construction site, 100% insulation and pressure test, are not included. The specified group minutes apply for fitters with experience of the system.

Flushing potable water systems

German standard DIN 1988, Part 2, describes a complex flushing system using an air/water mixture. This flushing method is compulsory for metal pipe systems as shavings, rust or flux may be produced when plumbing a metal installation. These substances may cause hygiene problems or corrosion of the pipe in metal pipelines. Provided it is certain that no contamination has been introduced into the pipework during installation, then thorough flushing of the TECEflex pipes is sufficient, in accordance with the ZVSHK information sheet "Flushing, disinfecting and commissioning potable water installations", issue October 2004.

Pressure test

In order to ensure potable water hygiene as well as protection against corrosion and frost, potable water installations should be filled only shortly before the intended use. Long residence time for the water in a filled or partially filled plant may have negative effects and has to be prevented for this reason. Thus, a leak test with water in accordance with German standard DIN 1988-2, section 11.1 must be performed only under certain circumstances, for example when the leak test is carried out immediately before initial start-up. Guideline 6023 of the Association of German Engineers (VDI) makes reference to **the ZVSHK leaflet entitled "Leak tests in potable water installations using compressed air, inert gas or water"** as a recognized rule of engineering for the execution of the testing procedure.
For safety reasons (compressibility of air), the responsible German Employers' Liability Insurance Association limits the test pressure with compressed air and inert gas in potable water installations to a maximum of 3 bar as was already the case in the tests for gas lines in accordance with DVGW TRGI.

The pressure test comprises a leak and strength test. The leak test always has to be carried out first.
The following specifications must be observed when carrying out the test with compressed air or inert gas:

- Leak test at 110 mbar
- Load test with a maximum of 3 bar
- Divide into small test sections (small pressure product/litre product)

Leak test with oil-free compressed air or inert gas

Prior to the leak test the pipe connections have to undergo a visual inspection. Component parts fitted in the pipe system have to be suitable for the test pressures or have to be removed prior to the line test or have to be replaced by a suitable piece of pipe or have to be tested separately at the pipe ends in the line section.
After applying the test pressure, the test period has to be at least thirty minutes up to a line volume of 100 litres. The test period has to be increased by ten minutes for each additional 100 litres of line volume.

The test commences after the test pressure has been reached, taking into consideration a corresponding waiting time for the stabilization of the media and ambient temperature. The tightness is established by the conformity of the initial and final test pressures - disregarding the normal variations caused by the media temperature and the pressure on the pressure gauge.
The pressure gauge used has to ensure a reading with an accuracy of 1 mbar (10 mmWC) for the pressures to be measured. For this purpose, the U tube pressure gauges or standpipes with 110 mm used in the TRGI tests can also be used here.

Load test

The purpose of this test is to identify faults which may lead to a fracture or opening of a joint in the pipeline under normal operating conditions. The strength test is combined with a visual inspection of all pipe connections. The pipeline to be tested is filled with a medium under pressure, the maximum pressure being 3 bar.

The load test shall be carried out with a higher pressure of
- a maximum of 3 bar for nominal widths of up to DN 50 and
- a maximum of 1 bar for nominal widths of over DN 50 (up to DN 100).

After applying the test pressure, the test period has to be at least thirty minutes up to a line volume of 100 litres. The test period has to be increased by ten minutes for each additional 100 litres of line volume.

During the testing period, the pressure gauge reading has to remain constant. For TECEflex installations, it is necessary to wait for a state of equilibrium before starting the test. For other materials, it is a requirement that the temperature in the system of pipes is constant before the test is performed. The pressure gauge used has to ensure a reading with an accuracy of 0.1 bar (10 mmWC).

Leak test with potable water in accordance with German standard DIN 1988

German standard DIN 1988, Part 2, stipulates that a leak test is mandatory for pipelines. Constant temperature conditions are required for a leak test to be performed correctly. The pressure gauge should have a reading accuracy of 0.5 bar. Hygienically clean water must be used for the leak test. The testing equipment must not adversely affect the hygiene of the water used for testing.

The leak test with potable water according to DIN 1988 is done in three stages:
Step 1 – Fill and ventilation of the pipework.
Step 2 – Preliminary test: The pressure to be applied for the preliminary test is the maximum permissible operating pressure plus 5 bar. As a rule a preliminary test is carried out with 15 bar. Within the first thirty minutes after filling, the pressure may be adapted every ten minutes. This is considered to be a temperature equalization. The actual preliminary test starts after this period and lasts for thirty minutes. During this period the pressure may drop by a maximum of 0.6 bar. No leaks may occur in the installation.
Step 3 – Main test: After the preliminary test has been satisfactorily passed, the main test is carried out immediately. The test pressure of the preliminary test is not lowered. During the following two hours, the pressure may drop by a maximum of 0.2 bar, and there must be no leaks.

Note:

To prevent potable water from stagnating in the system, TECE emphasises that the leak test according to DIN 1988 part 2 section 11.1 must only be used when the leak test is performed immediately before the system is put into operation for the first time.

Heating installations

Prior to the initial use, a heating installation has to be flushed thoroughly in order to remove any metal residues or flux. The TECEflex system is insensitive to these impurities, but metal components of the heating system – such as radiators or heat-generating devices – may be damaged by galvanic corrosion processes.
The pressure test is carried out in the same way as the pressure test for potable water installations. However, the test pressure is only 1.3 times the operating pressure.

Documentation

During installation of the system, the routing of the pipework including all tanks, fittings, outlets etc. must be precisely documented. After the installation has been completed, this documentation must be made into a permanent format and handed over to the owner of the building. ATV DIN 18381 (VOB part C: General technical contract conditions for building work) requires that a report on the pressure test is made and handed over to the client as necessary proof.
Note: In accordance with German law, the pressure tests are contractual additional tasks, and are part of the contractual service to be rendered by the contractor even if they are not mentioned in the description of the work. You will find a suitable initial start-up report as a master copy below.

Pressure test report for potable water installations – according to VDI-6023 (with oil-free compressed air or inert gas as test medium)

Building project: _____

Client: _____

Contractor/fitter: _____

Material of the pipe system: _____

Type of connection: _____

Plant pressure: _____ bar

Ambient temperature _____ °C Temperature of test medium _____ °C

Test medium: ❒ Oil-free compressed air ❒ Nitrogen ❒ Carbon dioxide ❒ _____

The potable water system was tested as: ❒ Complete system ❒ in _____ sections

Leak test

Test pressure: 110 mbar

Test period up to 100 litres pipe volume: at least 30 minutes
(for each further 100 litres, increase test period by 10 minutes)

Line volume: _____ litres

Test period: _____ minutes

Equalization of temperature and state of equilibrium must be ensured, and only then can the test begin.

❒ No drop in pressure was detected during the test period

Strength test with increased pressure

Test pressure up to and including DN 50: 3 bar
Test pressure above DN 50 to DN 100: 1 bar

Test period up to 100 litres pipe volume: at least 30 minutes
(for each further 100 litres, increase test period by 10 minutes)

Test period: _____ minutes

Equalization of temperature and state of equilibrium must be ensured, and only then can the test begin.

❒ No drop in pressure was detected during the test period.

❒ The pipe system is free of leaks.

_____ _____
Place Date

_____ _____
Client/representative (signature) Contractor/fitter (stamp/signature)

Pressure test report for potable water installations – in accordance with DIN 1988, Part 2 (with potable water as test medium)

Building project: _____

Client: _____

Contractor/fitter: _____

Size range from _____ mm to _____ mm

Pipe length approx. _____ m

Water temperature: _____ °C

Ambient temperature: _____ °C

Preliminary test

Test period: 60 minutes	test pressure: 15 bar
Pressure after 30 minutes	_____ bar
Pressure after 60 minutes	_____ bar
Pressure loss in the last 30 minutes	_____ bar (maximum 0.6 bar)
Outcome of preliminary test	_____

Main test **at same test pressure as preliminary test**

Test period: 120 minutes	max. permitted pressure drop: 0.2 bar
Pressure at start of test	_____ bar
Pressure after 120 minutes	_____ bar
Pressure drop during test period	_____ bar (max. 0.2 mbar)
Outcome of the main test:	_____

_____ _____

Start of test End of test

_____ _____

Place Date

_____ _____

Client/representative (signature)

Contractor/fitter (stamp/signature)

Pressure test report for heating systems – according to DIN 18380 (VOB)

Building project: _____

Client: _____

Contractor/fitter: _____

Size range from _____ mm to _____ mm

Pipe length approx. _____ m

Water temperature: _____ °C

Ambient temperature: _____ °C

Preliminary test

Test period: 60 minutes

test pressure: 1.3 x operating pressure in bar

Pressure after 30 minutes

_____ bar

Pressure after 60 minutes

_____ bar

Pressure loss during the last 30 minutes

_____ bar (maximum 0.6 bar)

Outcome of preliminary test

_____

Main test

at same test pressure as preliminary test

Test period: 120 minutes

max. permitted pressure drop: 0.2 bar

Pressure at start of test

_____ bar

Pressure after 120 minutes

_____ bar

Pressure drop during test period

_____ bar (max. 0.2 mbar)

Outcome of the main test:

_____

_____

Start of test

End of test

_____

_____

Place

Date

_____

_____

Client/representative
(signature)

Contractor/fitter
(stamp/signature)

Commissioning and briefing report for the potable water system (page 1 of 2)

Building project: _____

Client/representative: _____

Contractor/representative _____

In the presence of the above persons, these were briefed in the use of the following system components and these were put into operation:

No.	System component, device	Inspection carried out	Comment	n/a
1	Building connection	❒		❒
2	Main shut-off fittings	❒		❒
3	Non-return valve	❒		❒
4	Backflow preventer	❒		❒
5	Filter	❒		❒
6	Pressure relief equipment	❒		❒
7	Distribution pipes	❒		❒
8	Risers/shut-off fittings	❒		❒
9	Storey pipe systems/shut-off fittings	❒		❒
10	Riser pipe vents/dripping water pipe	❒		❒
11	Collector-unit backflow prevention systems/ dripping water pipe	❒		❒
12	Tapping points with single-unit backflow prevention	❒		❒
13	Water heating/drinking water heater	❒		❒
14	Safety valves/pressure relief lines	❒		❒
15	Circulation pipe/circulation pump	❒		❒
16	Metering system	❒		❒
17	Water softening plant	❒		❒
18	Pressure booster system	❒		❒
19	Fire extinguishing systems and fire protection systems	❒		❒
20	Swimming pool inflow	❒		❒
21	Tap fittings	❒		❒
22	Consumption devices	❒		❒
23	Potable water containers	❒		❒
24		❒		❒
25		❒		❒
26		❒		❒
27		❒		❒

Commissioning and briefing report for the potable water system (page 2 of 2)

Supplementary comments from the client:

Supplementary comments from the contractor:

The briefing for operating the system has taken place, the necessary operating documents and the existing operating and maintenance documents according to the above mentioned list were handed over. Attention was drawn to the fact that, despite careful planning and implementation of the installation, potable water of perfect quality can only be present at all tapping points if a regular and complete change of water takes place in all areas of the installation.

Duties of the operator: Measures for longer periods of absence

Absence	Measures before the absence	Measure for the return
> 3 days	Apartments: Close the storey shut-off fittings Single-family house: Close the shut-off fittings after the water meter	After opening the shut-off fittings, allow the water which has been standing to flow out of all tapping points for 5 minutes (fully open)
> 4 weeks	Apartments: Close the storey shut-off fittings Single-family house: Close the shut-off fittings after the water meter	It is recommended that arrangements are made to flush the house installation
> 6 months	Arrange to close the main shut-off fittings (building connection). Fully drain pipes	Arrange for the house installation to be flushed
> 1 year	Disconnect the connection pipe from the supply pipe	Reconnection by the water supply company or professional plumber

Place

Date

Client/representative
(signature)

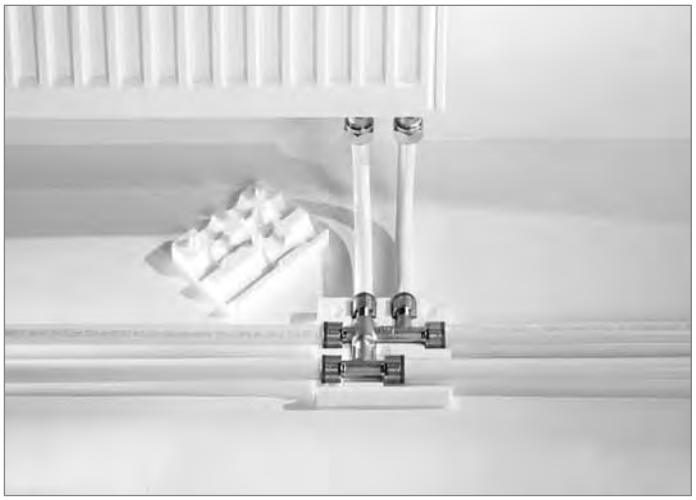
Contractor/fitter
(signature)

Radiator connection

TECEflex system offers an extensive range of fittings for effective radiator connection in the most common construction site situations.

Cross-fitting

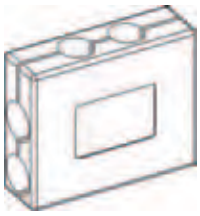
A cross-fitting permits the branching of flow and return lines of two main lines that run in parallel. The height of the fittings with insulation box is just 35 mm.



Radiator connection with cross-fitting

By using a cross-fitting, not only the mounting time is reduced but also the risk of damage to crossed pipes caused by wheelbarrows, flattening by foot or similar is avoided.

Cross-fitting
(Order No. 7 185 01/ ...02/...03)



Protection box
(Order No. 7 180 20)

Connection out of the floor

TECEflex composite pipes can be used to directly connect the radiator to the pipe rising from the screed. In order to prevent "cracking noises", the linear expansion of the pipes has to be compensated for. For this reason the pipes must be fitted with an insulating tube of at least 6 mm in thickness.

In addition, it is advisable to attach a protective sleeve to the visible part of the pipe. Damage to the pipes caused by hoovering, for example, can be prevented in this way. TECEflex-PE MDXc or PE-Xc heating pipes must be passed from the screed with the help of a lead-in elbow.

Lead-in elbow
(Order No. 7 180 05)

Radiator connection with mounting tees/elbows

For more luxurious demands, the TECEflex range offers installation tees made of nickel-plated copper. On account of its right-angled form, the radiator can be connected from flow and return flow pipes running in parallel.

Radiator connection with radiator installation elbow

The nickel-plated copper pipes are connected to the valves of the radiator using compression fittings.

TECEflex-HK installation tee

Dim. 16 × 15 mm Cu
(Order No.: 7 150 16)

Dim. 20 × 15 mm Cu
(Order No.: 7 150 20)

Compression fitting 15 mm x 1/2"
(Order No.: 7 175 01)

If the flow and return flow pipes do not pass underneath the radiator, radiator installation elbows made of nickel-plated copper can be used as an alternative.

Radiator connection with radiator mounting elbow

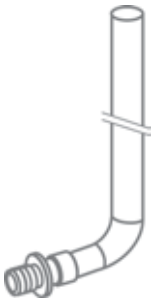
TECEflex radiator mounting elbow

330 mm long:

Dim. 14 × 15 mm Cu
(Order No.: 7 140 14)

Dim. 16 × 15 mm Cu
(Order No.: 7 140 16)

Dim. 20 × 15 mm Cu
(Order No.: 7 140 20)



1100 mm long:

Dim. 16 × 15 mm Cu
(Order No.: 7 145 16)

Compression fitting 15 mm x 1/2"
(Order No.: 7 175 01)

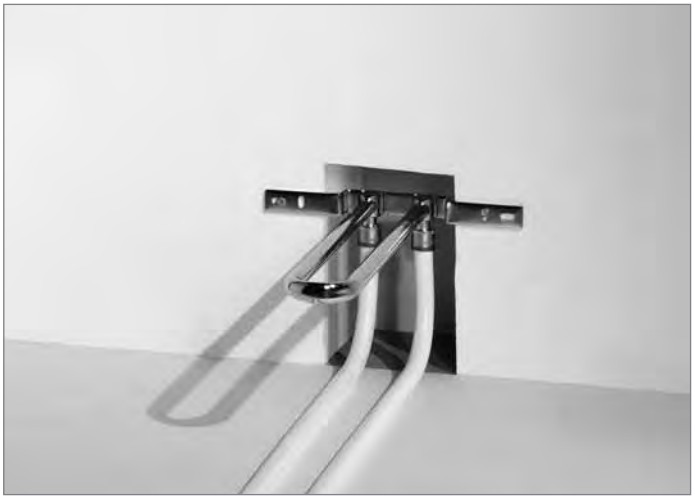
Connection to pipe exiting from the wall

The special bending properties of TECEflex composite pipe permit the radiator to be connected directly to the pipe exiting from the wall. The chase has to be set up in such a way that the minimum bending radii of the TECEflex pipe can be maintained.

Connection of radiator to pipe exiting from the wall

Radiator connection using the radiator mounting unit for connecting compact radiators up to pipes exiting from the wall

The radiator mounting unit has been provided with stable mounting straps for safe attachment to the chase.
The TECEflex connection technique permits pipes to be connected directly in the chase.



Radiator connection using radiator mounting unit – ready for pressure testing

Radiator connection using radiator mounting unit – connected up to the valve block

Because of the connection between flow and return flow pipe, the heating system can be pressure-tested without installing building plugs. To install the radiator, the U tube is cut to length and connected to the radiator valve using a compression fitting.
As an alternative, a radiator mounting unit is available for connection to pipes rising from the floor. It is also fitted with a U pipe and permits pressure testing without building plugs. TECEflex radiator mounting unit Dim. 16 × 15 mm Cu

Wall installation
(Order No.: 714905)

Floor installation
(Order No.: 714901)

Compression fitting 15 mm x 1/2"
(Order No.: 7 175 01)

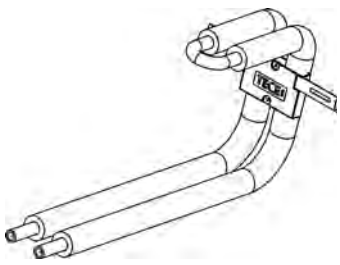
Connection to pipe exiting from the wall using mounting unit

For a perfect connection to pipes exiting from the wall, the radiator mounting unit with pre-insulated pipes can be used. Another special feature is the particularly tight radii of the TECEflex pipe.

Radiator connection using mounting unit – connected up to the valve block

TECEflex radiator mounting unit

length 500 mm
(Order No.: 7 149 07)



Radiator connection from a skirting board

For connection from a skirting board, the TECEflex range offers a skirting board radiator connection set with connecting elbows or elbow shut-offs. During building restoration, radiators can therefore be connected without the need for any mortise work.

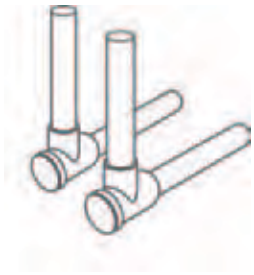
For skirting board systems, only TECEflex composite pipe together with brass fittings may be used. TECE recommends using skirting boards from the company HZ.

Connection of radiator to pipe exiting from the skirting board

TECEflex skirting board radiator connection set
Dim. 16/20 × 15 mm Cu
(Order No. 730110–730130)

TECEflex skirting board radiator connecting elbow
Dim. 15 mm Cu
(Order No. 730025)

TECEflex skirting board radiator elbow shut-off
Dim. 15 mm Cu
(Order No. 730010)



Compressed air installation

Design sizes for pressure loss Δp

Compressed air installations which have a highest pressure p_{max} of 8 bar or more, should have a total pressure loss through the pipe network to the consumer of no more than ΔP = 0.1 bar. TECE recommends the following values for the individual types of pipeline:

- Main line Δp ≤ 0.04 bar
- Distribution line Δp ≤ 0.04 bar
- Connection line Δp ≤ 0.03 bar

For pipeline networks with the highest pressures ≤ 8 bar, the following applies:
Pipeline network pressure loss Δp ≤ 1.5 bar from p_{max}.

Oils

Depending on the compressor type, there may be oil in the compressed air. The compressed air is classified according to the maximum permitted oil content. Depending on the class, the oil content can vary from 0.01 to 25 mg/m³ of compressed air. The TECEflex system is suitable for all qualities of compressor oil.

Pressure test

TECE recommends that a pressure test should be performed following the technical rules of the German Ordinance for Pressure Vessels (TRB 522) before the initial start-up of a compressed air network. The test is divided into two parts: Leak test and strength test.
Precautions must be taken to protect those people involved in the work. During testing, only those staff necessary should be present on-site.

Leak test

Before the leak test is performed, care must be taken that all open positions in the pipework are closed off with plugs, caps or similar devices. The leak test should test the pipe network. Fittings, tools and pressure reservoirs must be separated from the network.

Requirements:

- Pressure for the test: 110 mbar
- Test period: up to 100 litres pipe volume, at least 30 minutes
- For each additional 100 litres of pipe volume, the test period must be increased by 10 minutes. To balance out any pressure fluctuations, the test period starts about 15 minutes after the pressure has been applied. The leak test is considered to be satisfactorily passed if the starting and finishing pressure are the same after the test period has expired.

Strength test

If the leak test has been satisfactorily passed, the strength test can follow immediately. For this, the test pressure is increased to 1.1 times the permitted operating pressure of the system.
In the first 30 minutes after applying the test pressure, it may be created again twice. Afterwards it must be held for 30 minutes. The pressure drop during this time must not exceed 0.1 mbar.

Planning a compressed air installation

Compressed air lines must always be laid in a straight line whenever possible. The fewer the number of fittings used, the lower the pressure losses. When laying the pipes, it is therefore better to use long curves bent by hand than elbow fittings.

Larger compressed air networks should if possible be subdivided into several sections. Each individual section should be equipped with its own shut-off fittings. In this way there it is always possible to take single sections of the network of pipes out of operation to be able to make repairs or perform extension work.

On larger compressed air networks, it can definitely be useful to incorporate a second compressor. As a result, the pipeline network can be supplied from a second place as well. As a result, the compressed air has to cover shorter distances and pressure losses are reduced.

Pipeline network without drying of compressed air

If a dryer is omitted in a compressed air system, condensation will occur in the form of water droplets.
In this case, in order to prevent damage to the compressed air consumers, attention must be paid to various points:

- Prevention of cooling
  The route of the pipes should be chosen so that the compressed air is not cooled down on its way to the consumers. In the ideal case, the compressed air in the pipeline network should gradually warm up. In this way the relative humidity of the air is reduced and condensation is prevented.
- The compressed air lines must be given a fall of about 1.5 % to 2 % in the direction of the flow, so that the condensate can collect at the lowest point in the pipeline network.
- Main lines which directly leave the pressure reservoir should rise vertically upwards. Condensation which occurs will then run back into the pressure reservoir.

- A condensate drainer must be installed at the lowest point in the pipeline network.
- Connecting lines must branch off upwards in the direction of flow.
- A service unit with filter, water separator and pressure regulator must always be installed. Depending on the application, a compressed air oiler is also necessary.

Pipe network with dry compressed air

If an air dryer is installed in the compressed air network, then most of the measures concerned with the handing of condensate are unnecessary. Then pipelines may also be laid without falls.

Condensation controllers are then still only necessary at the filter in the compressed air reservoir and the compressed air dryer. Connection lines can be connected vertically downwards. Installation of a pipeline network for dry compressed air is significantly less expensive. As a rule, the purchase of a compressed air dryer pays off, even for smaller systems.

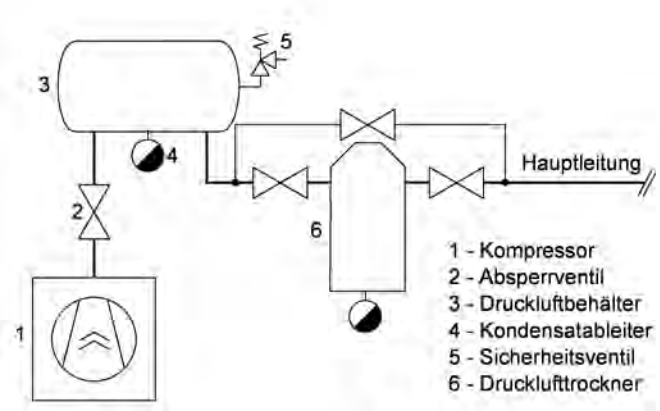
Compressed air lines

A compressed air line can usually be divided into three types of line:

- Main line
- Distribution line
- Connection line

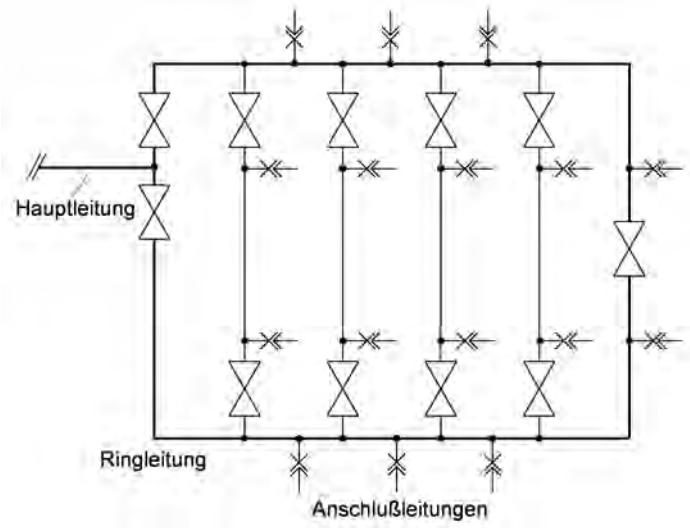
The main line

The main line connects the compressor with the distribution lines. As a rule, the compressed air preparation and compressed air reservoir are connected to the main line. This conveys all of the quantity supplied by the compressor. The pressure drop in the main line should not exceed 0.04 bar.



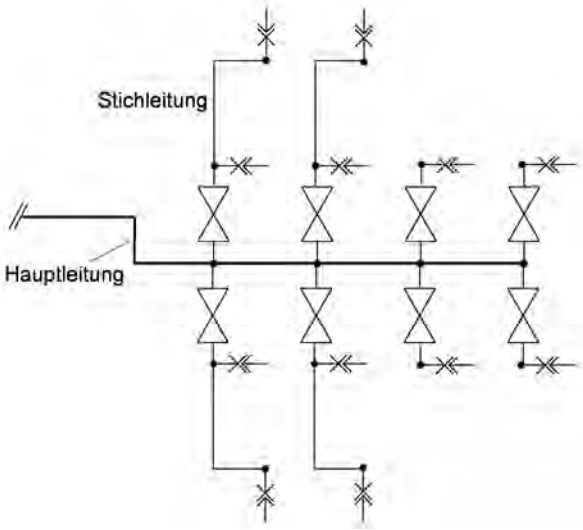
Distribution line as a circular pipeline

Whenever possible, distribution lines should be implemented as a circular pipeline. The efficiency of the system is considerably increased by this. A circular pipeline forms a closed distribution ring. This makes it possible to shut off individual sections of the network without having to interrupt the compressed air supply to the other areas. The compressed air must cover a shorter distance here compared with spur distribution lines. When dimensioning the circular pipeline, the calculations can therefore be performed with half the fluidic pipe lengths and half the volume flow.



The distribution line as a spur line

The spur lines connect the main line with the connection lines. Spur lines are often used to supply consumers which are further away. Spur lines are often implemented so that less pipe material needs to be worked. This advantage is mostly cancelled out because they must be larger dimensioned than a circular pipeline. The pressure drop of spur lines must not exceed 0.3 mbar.



Connection lines

Connection lines join the consumer to the supply line. As a rule, compressed air consumers are operated at different pressures. For this reason, a pressure regulator is mostly installed at the end of a connection line. Connection lines are always connected to the distribution line from above and then lead downwards, because otherwise large quantities of condensed water or compressor oil collect in the connection line.
For industrial applications, TECE recommends that connection lines are always implemented with a dimension of 32 mm. This dimension is only slightly more expensive than the smaller dimensions and as a rule always ensures a steady supply of compressed air. For connection lengths up to 10 metres, consumers with a compressed air requirement of 1800 litres per minute can safely be connected. The pressure drop in a connection line should not exceed 0.3 mbar.

Manifold

If several compressors are connected to a line, then the line is called a manifold. Attention should be paid to the following points with these lines:

- Manifold with falls:
  The manifold must be laid with a fall of about 1.5 % to 2 % in the direction of flow. The connection line must be connected to the manifold from above.
- With longer rising lines to the manifold, a water separator with automatic drainage must be connected downstream of the compressor to collect the condensate running back.

Calculation fundamentals for compressed air installations

The correct dimensioning and design of a compressed air installation is in the economic interests of every operator. Pipelines with dimensions which are too small cause pressure losses in the pipeline network. These must then be compensated for by higher compression of the air to ensure the necessary power at the consumers. This would however lead to disproportionately high costs for the operator of the system.

The following parameters affect the internal diameter of the pipe d_i:

Nominal length (m)

The pipe length must be measured exactly in every case. The equivalent pipe length must be inserted for fittings and shaped parts – the same equivalent length can be used as for gas installations – and must be added to the measured pipe length.
As an estimate, the measured pipe length can also be multiplied by 1.6 (+ 60 %). The result gives the assumed total pipe length for calculation of the internal diameter:

$L_{total} = L_{straight} \times 1.6$

This multiplier is the estimated part of the individual resistances of pipe elbows, fittings and valves.

Volume flow ($\dot{V}$ l/s)

When determining the internal diameter of the pipe d_i, the largest possible air throughput should be assumed, because at the maximum compressed air requirement a high pressure drop has a particularly large effect.

Operating pressure or excess pressure (bar)

To determine the internal diameter of the pipe d_i, the compressor switch-off pressure p_{max} is assumed, because at the highest pressure, the pressure drop Δp is also the highest.

Dimensioning

There are various approaches to determining the required internal diameter of the pipe. A relatively easy method is to calculate using the following approximation formula.

$$d_i = \sqrt[5]{\frac{1{,}6 \cdot 10^3 \cdot \dot{V}^{1{,}85} \cdot L}{10^{10} \cdot \Delta p \cdot p_{max}}}$$

d_i = internal diameter of the pipeline [m]
$\dot{V}$ = total volume flow [m³/s]
L = fluidic pipe length [m]
Δp = target pressure drop [bar]
p_{max} = compressor switch-off pressure [bar absolute]

Example 1

The internal diameter of the pipe d_i for a compressed air installation in a workshop is to be calculated using the approximation formula given above. The distribution line is designed as a spur line. The target pressure drop Δp is 0.08 bar. The maximum operating pressure (compressor switch-off pressure) is 8 bar absolute. The measured pipe length is 75 metres, the number of fittings and shaped parts is unknown. A volume flow of 90 m³/h passes through this pipeline.

First of all, the fluidic total pipe length is now calculated as follows:

L_{total} = 75 m x 1.6
= 120 m

giving: L =120 metres
$\dot{V}$ = 90 m³/h => 0.025 m³/s
Δp = 0.08 bar
p_{max} = 8 bar

$$d_i = \sqrt[5]{\frac{1{,}6 \cdot 10^3 \cdot 0{,}025^{1{,}85} \cdot 120}{10^{10} \cdot 0{,}08 \cdot 8}}$$

=> d_i = 0.032 m = 32 mm

Selected pipe dimension:
TECEflex composite pipe dim. 40 (40 x 4 mm)

Example 2

We take the same workshop for this example calculation as for the first example. The difference however is that in it, the distribution line is implemented as a circular pipeline. With a circular pipeline, smaller pipe diameters are possible, the calculation in this case can be done according to the following approximation formula:

$$d_i = \sqrt[5]{\frac{1{,}6 \cdot 10^3 \cdot \dot{V}^{1{,}85} \cdot L}{10^{10} \cdot \Delta p \cdot p_{max} \cdot 7{,}21}}$$

The constant 7.21 allows for the half fluidic pipe length and the half volume flow.

This then results in:

$$d_i = \sqrt[5]{\frac{1{,}6 \cdot 10^3 \cdot 0{,}025^{1{,}85} \cdot 120}{10^{10} \cdot 0{,}08 \cdot 8 \cdot 7{,}21}}$$

=> d_i = 0.021 m = 21 mm

Selected pipe dimension:
TECEflex composite pipe dim. 32 (32 x 4 mm)

The calculation shows that by using a circular pipeline as the distribution line, in most cases the pipe size can be reduced to the next dimension lower.

Gas installation

The specifications of TRGI 2008 must be followed when planning and designing the TECEflex gas installation.

Limits of application

The application area of the TECEflex system is limited to an input load of ≤ 138 kW or ≤ 110 kW for the connection of only one gas appliance. Higher capacities would require larger gas flow detectors, which would in turn allow such a large volume flow to pass that their purpose of protecting against explosion would no longer be given.

Protection against unauthorized intervention

Active and, if applicable, passive measures are required in order to minimize the consequences of intervention by unauthorized persons in the gas installation of buildings with residential or similar use (domestic installations) or to make this intervention more difficult.

Active measures

The protective purpose of active measures is to interrupt the gas supply if the gas is released in an abnormal way by:

- opening the free pipe cross-section at any point in the pipe network according to gas flow detector type K
- opening the outlet connection of device fittings

For TECEflex gas lines, all the requirements relating to active measures are already met by the gas flow detector type K required as a safety element.

Gas flow detector type K must be matched to the required performance and must always be connected to a thermal shut-off unit. This connection must be metallic conductive (e.g. directly screwed on). The pipe network must be dimensioned in such a way that there is sufficient supply pressure at the consumer and that sufficient gas exits when a pipe cross-section is fully opened at the most unfavourable point, so that the gas flow detector type K closes safely. Line ends and line outlets must be avoided wherever possible.

Inspection openings must not be included before the gas pressure controller. Inspection openings after the gas pressure controller must have a bore diameter of ≤ 1 mm achieved through design measures. If inspection openings with a larger opening diameter are required for operational reasons, in "generally accessible spaces" they must be passively protected.

The first component of an active measure is to be installed directly after the main shut-off unit or gas pressure control device, if this is positioned directly after the main shut-off unit (exception: multi-family house with storey gas use with low-pressure gas distribution ≤ 25 mbar).

A gas flow detector must be installed in the case of consumption or branch lines with section loads ≤ 138 kW. This gas flow detector must be installed directly after the branching from the distribution line or directly after the pipe comes out of the wall/channel.

For TECEflex gas lines, protection against intervention by unauthorized parties is already achieved with the required safety element, the gas flow detector type K. Passive measures are therefore not mandatory, but can be used if appropriate.

Passive measures are:

- Avoidance of line ends or line outlets.
- Positioning of the gas installation in "spaces that are not generally accessible".
- Use of safety seals in accordance with DVGW provisional testing information VP 634. Note: Seals with protection against rotation with the aid of a "thread sealing adhesive" in accordance with DVGW provisional testing information VP 405 are regarded as safety seals.
- Use of devices as design-related protective measures for connections that can be disconnected. These are suitable encapsulations of rotatable parts such as the union nuts of screw connections or flange screws.
- Elements protecting against rotation for union nuts with the aid of a "thread adhesive" in accordance with DVGW provisional testing information VP 405 are regarded as safety seals.

In "generally accessible spaces", the above mentioned safety seals and design-related protective measures and access protection measures are required in pipe sections that come before the active measures.

Measuring procedure

To ensure secure operation, the TRGI measuring procedure is based on the following aims:

- Ensuring a gas device connection pressure of 20 mbar after the gas device screw connection
- Ensuring the functioning of the gas flow detector if the pipe cross-section is opened at any point or the gas device screw connection is opened.
  Protective aim: Protection against manipulation
- Ensuring the functioning of the gas flow detector if the TECEflex pipe system fails as a result of thermal load in the event of a fire.
  Protective aim: Protection against fire and explosion

The basic conditions for the measuring procedure are:

- Gas installations up to 100 mbar
- Relating to natural gas L with 8.6 kWh/m³
- Outlet pressure at gas pressure control device 23 mbar
- Conversion of pressure drops from mbar to Pascal (Pa)
- Permitted total pressure drop between gas pressure control device outlet and device connection fitting no more than 300 Pa
- Load-dependent calculation of pressure drops of individual components including the gas meter
- Shaped components and connectors are taken into consideration as equivalent additions to the pipe length
- Modification of simultaneity in accordance with today's device types and operating conditions
- Selection and arithmetic check of the gas flow detector as an integral part of the measuring procedure
- Introduction of a chart and table procedure

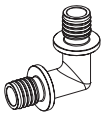
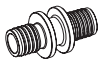
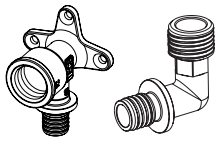
Chart procedure

The chart procedure is a simplified procedure for individual feeds and distribution installations. The maximum permitted line length is found from a chart of specified component part combinations. The selection of components (gas flow detector, gas meter and device connection fittings) is specified according to the nominal or section load. The pressure drop for these components and the total pressure drop of 300 Pa are specified.

Using the chart procedure

The chart procedure can be used for an individual feed or distribution installation. It leads to far quicker results, but requires that, in addition to the calculated pipe diameter, the assigned parameters for the gas flow detector, gas meter and device connection fittings assigned in the chart are used as specified. A total pressure drop of 300 Pa is specified. A larger device connection fitting can also be selected, but in the chart procedure, the pressure drop saved as a result of this cannot be used to reduce the pipe diameter. This is only possible with the table procedure.
A larger gas meter provided by a network operator or measuring point operator can also be selected but cannot be used to reduce the pipe diameter or increase the pipe length. The charts specify the maximum length of lines for a given section load.

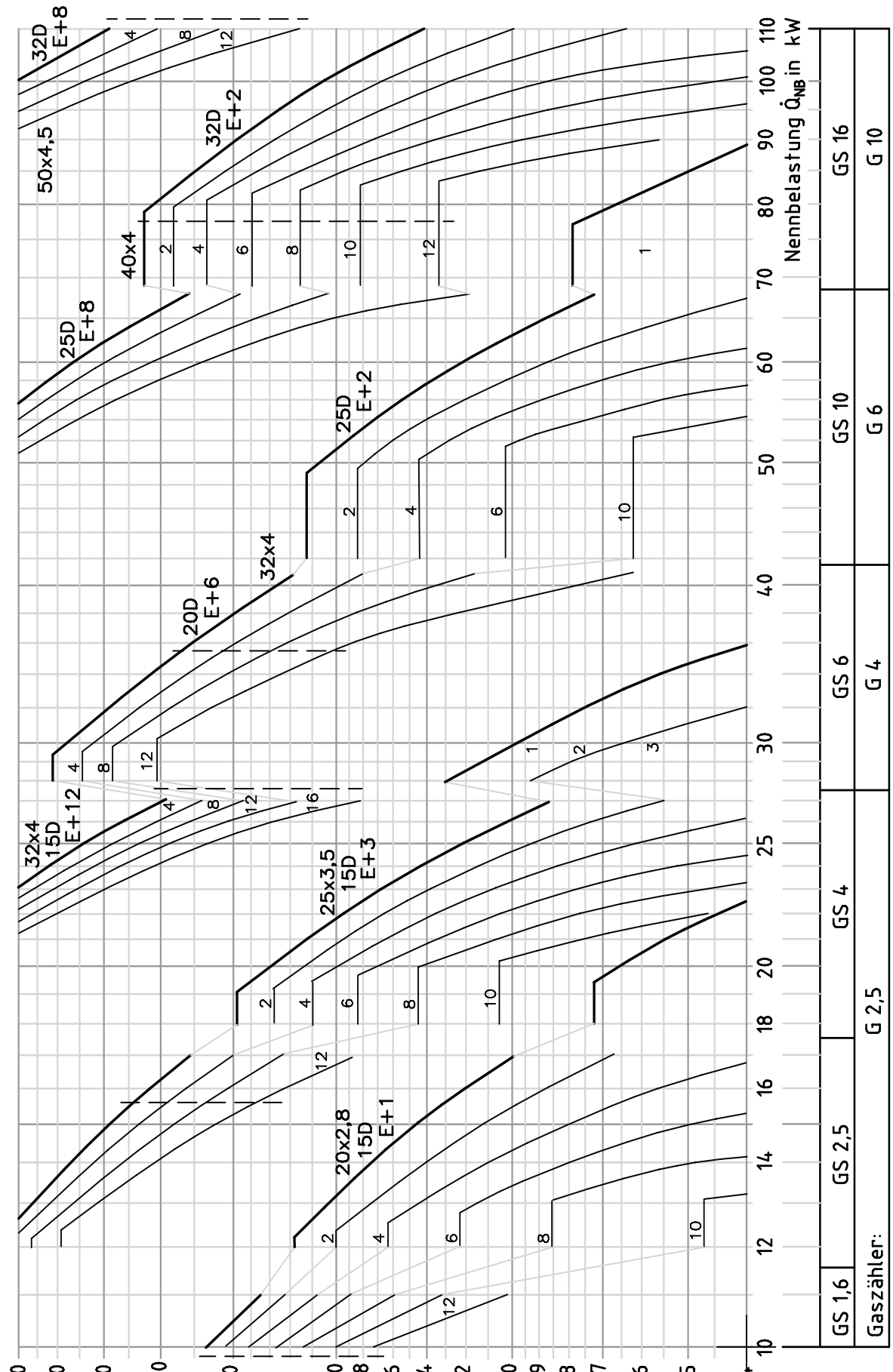
In the chart, characteristic curves are shown for each TECEflex pipe dimension. The characteristic curves represent the maximum pipe lengths when a straight connection fitting is used. For dimension 20 mm (20 x 2.8), the characteristic curve applies for a connection fitting DN 15 (1/2 inch). This has the designation 15D, where the "D" stands for "Durchgang" [through].
If an angled device connection fitting is used, the pressure drop via the additional bend is taken into consideration. The number of additional bends are on the respective characteristic curve. Example: "E + 1" means angle type with an additional angle.
The bold characteristic curves on the chart are characteristic curves without additional fittings.
The curves underneath them show the maximum pipe length with the respective number of additional bends or fitting index (2, 4, 6 etc.). For more fittings, the following fitting index must be added:

Fitting		Index
	Elbow	1.0
	Coupler	0.5
	Alternative to straight threaded transition connector: Wall plate or angled transition connector	1.5

Fitting indices for the chart procedure

The pressure gain through height is ignored. The gas flow detector type K and gas meter are selected in the line under the charts. **Selection of a larger gas flow detector is NOT permitted!** The gas flow detector arithmetic check is already contained in the chart.

Chart 3 – Measuring the TECEflex individual feeds

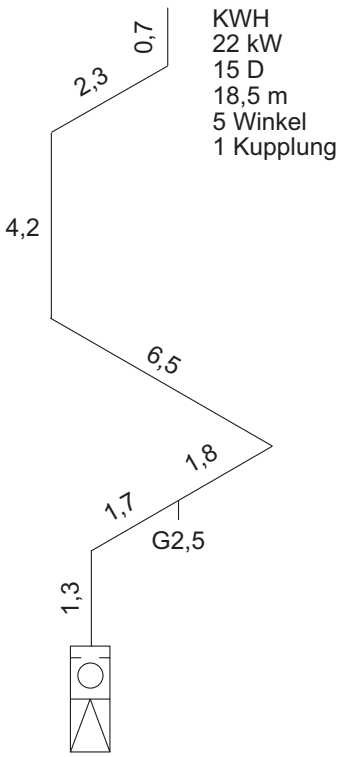


Diagr. 3a Einzelzuleitung, TECE flex

Sample calculation using the chart procedure

Note: The tables and charts are numbered in the same way as the charts in TRGI 2008.

Example:



Example - individual feed

The individual connection of a heating device with a nominal load of 22 kW is calculated as an example.
The device requires a connection line of 18.50 m.
In addition, five elbows and one straight standard coupler are required. The device connection tap is a 1/2" through type (DN 15 D). The gas flow detector type K is mounted after the pressure controller.

1. Determination of the gas meter

The nominal load can be read on the horizontal axis of the graph (see next page). A straight line is dropped from the value 22 kW. There is a two-line table under the chart. The gas meter suitable for the nominal load can be read off from the lower line (see Ⓐ), in this example the meter type G 2,5. A larger gas meter can readily be selected, such as the gas meter type G 4. However, selection of a smaller gas meter is not possible.

2. Selecting the gas flow detector

The gas flow detector to be used can be read off from the upper line of the table (see Ⓑ). For a nominal load of 22 kW, a gas flow detector type 4 is required, and only this type may be used.

3. Determination of the maximum possible pipe length

Five elbows and one straight coupler fitting are to be fitted in the installation. The chart contains an array of curves for each pipe dimension. The bold curves represent the maximum pipe length without additional fittings. Under these curves are the arrays of curves for the fitting indices.

Note:
An elbow has a fitting index of 1. All other relevant fitting indices can be found in the table "Fitting indices for the chart procedure" (see above). The fitting index is determined as follows for this example:

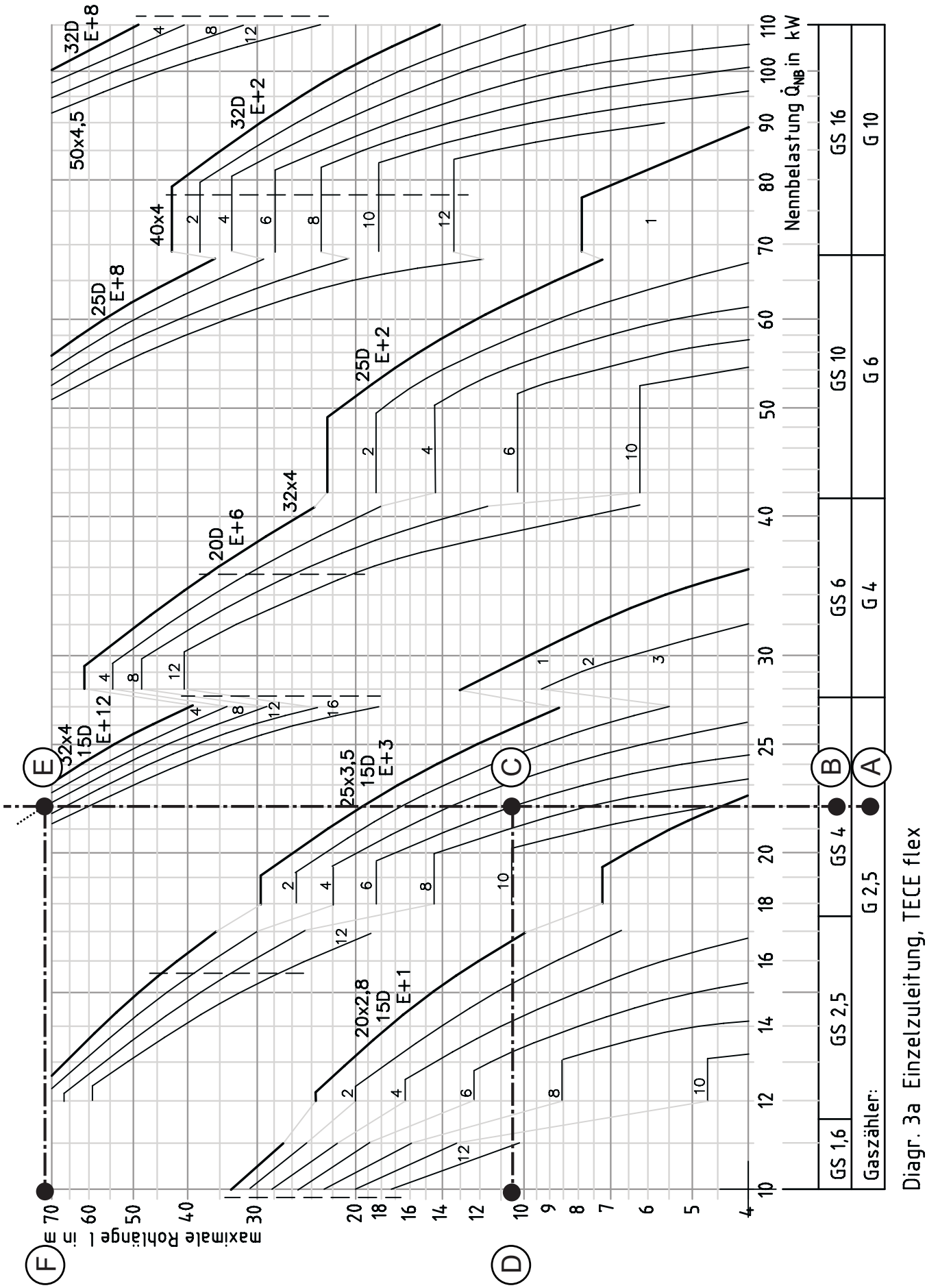
Elbow:	5 x 1 = 5
Coupler:	1 x 0.5 = 0.5
Total fitting index:	5 + 0.5 = 5.5

Selected = characteristic curve "6"

If a vertical line is drawn vertically on the chart at 22 kW, this straight line intersects the characteristic curve of dimension 25 with fitting index 6 (see Ⓒ) at a pipe length of about 10.50 m (see Ⓓ). However, a line length of 18.50 m is specified in the task. In this case, therefore, a pipe with dimension 25 will not suffice. If the gas line were to be laid without fittings, dimension 25 would suffice: The vertical line intersects the characteristic curve of dimension 25 with 0 fittings at approx. 20 m. However, because 5 elbows and 1 coupler are required, dimension 32 is necessary: The intersect of the vertical and the characteristic curve of dimension 32 mm is off the chart at about 75 m (see Ⓔ and Ⓕ).

Result:
If a gas appliance with a nominal load of 22 kW is operated on a gas line with a length of 18.50 m with five elbows and one coupler, a line dimension of 32 mm must be chosen. This ensures the appropriate supply pressure for the gas appliance and the functioning of the gas flow detector. A subsequent arithmetic check of the calculation is not required.

Chart 3 – Example for measuring individual feeds TECEflex



Diagr. 3a Einzelzuleitung, TECE flex

Table procedure

The advantage of the table procedure is that different pipe materials in a system can be taken into account.
The pressure gains from the geodetic height or oversized gas meters can also be taken into consideration.
The table procedure also allows more complex systems to be calculated.

The table procedure is applied in four steps.

1. Step: The nominal load can be used to determine:
- The pressure drop of the gas flow detector (table 19.1 and 19.2)
- The pressure drop of the meter group (table 14.2)
- The pressure difference of the pipelines (table 20.1 and 20.2)
- The pressure drop of the device connection fitting (table 17)

2. Step: Determination of the pressure drops of the pipes in the individual sections

3. Step: Take into account the pressure gain from the geodetic height (Δp_H = -4 x H)

4. Step: Gas flow detector arithmetic check (table 21)

Pipe diagram

It is advisable to draw the system as a pipe diagram in an isometric representation. The TRGI provides a few example calculations in the attachment.

Determination of the nominal load

The nominal load for the calculations must be rounded to integers.

- The nominal load is to be taken from the gas device's description or type plate
- A nominal thermal load of 9 kW applies for gas cookers with a maximum of 4 burners
- For gas cookers with more than 4 burners, 0.6 times the sum total of all burners applies
- If the nominal load of the connected device is known, this value is used. Otherwise, a nominal thermal load of 9 kW or 13 kW applies for gas sockets, depending on the installation location.
  (See TRGI 2008 table 28 in section 8.1.3.5.3)

Consideration of the pressure difference as a result of the geodetic height difference

There is a pressure gain in rising pipes as a result of the difference in density between natural gas and air.
The installation as a whole, rather than the individual parts, is considered. Height "H" results from the height difference between the service line and gas device.

Δp_H = -4 x H
H (m)
Δp_H (Pa)

Determination of the calculation length

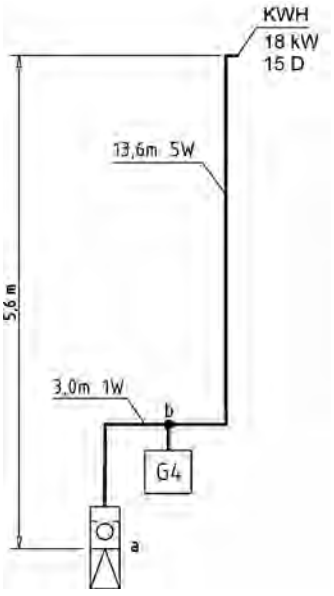
The calculation length is made up of the pipe length and the sum of the equivalent lengths of the fittings used (table 23).

Arithmetic check of gas flow detector type K

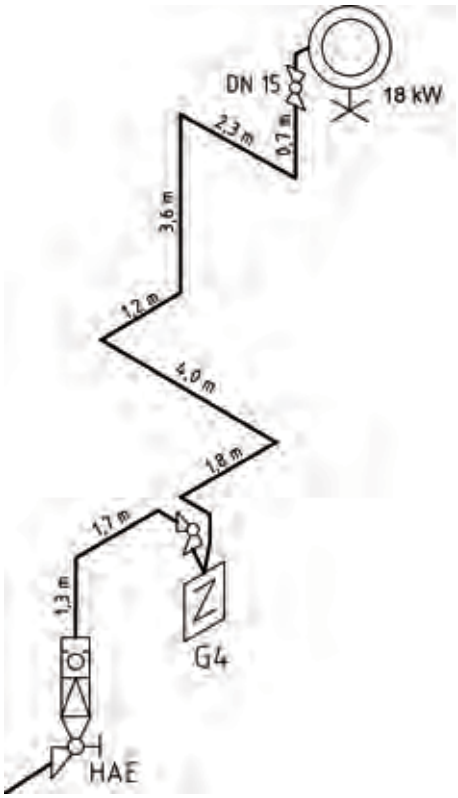
To ensure the aim of protecting against fire and explosion, a gas flow detector arithmetic check in accordance with table 21 is mandatory.

Example calculation using the table procedure

The calculation is based on the (outlined) pipe diagram of the planned gas installation. The TRGI and schematic representations are shown below:



Individual feed, schematic representation with abbreviations



Individual feed, representation according to TRGI

Example:
The individual connection of a heating device with a nominal load of 18 kW is calculated as an example. The device requires a connection line with a length of 18.5 m as well as six angles and four transition connectors. The device connection tap is a 1/2" through type (DN 15 D).
Gas meter type 2.5 is specified by the provider.

First, the specifications from the example are transferred to the "calculation sheet for individual feeds" (see filled-out form below):

- Designation of the gas appliance: Combination water heater
- Nominal load: 18 kW
- Device connection fitting: 15 D
- Gas meter: G 2.5

1. Measuring the gas flow detector

With the given nominal load of 18 kW, a K 4 gas flow detector must be used. The pressure drop (according to table 19.1) is 15 Pa. **Important:** The gas flow detector chosen must not be larger than the one determined here.

- Gas flow detector: K 4
- Pressure drop of the gas flow detector: 15 Pa

2. Determination of the pressure drop of the meter group

With the given gas meter G 2.5 and a nominal load of 18 kW, the pressure drop (read from table 14.1) is 60 Pa.

- Pressure drop of the meter group: 60 Pa

3. Determination of the pressure drop of the pipeline

If a pipe material other than TECEflex is used before the gas meter, the corresponding pressure drop can be entered in the bottom part of the form (pipe before the meter). If the entire pipe system consists of TECEflex, the pressure drop is entered in the top part (pipe pressure drop R).
The calculation length is calculated from the sum of the pipe lengths and the equivalent pipe lengths of the fittings.

As a pipe length of 18.5 m is relatively high, the specific pressure drop should not be so high. For a TECEflex pipe of dimension 25 mm, table 20.1 shows a specific pressure drop for the pipeline of 6 Pa/m, at a nominal load of 18 (19) kW.

- Pipe dimension: 25
- R according to table: 6 Pa/m

The pipe length is calculated from the sum of the individual sections: 1.3 m + 1.7 m + 1.8 m + 5.9 m + 1.2 m + 3.6 m + 2.3 m + 0.7 m = 18.5 m

- Pipe length: 18.5 m

Table 23 produces an equivalent pipe length of 1.7 m for each of the six elbows and 0.4 m for each of the four transition connectors. This leads to the following addition for the shaped components:
6 x 1.7 m = 10.2 m
4 x 0.4 m = 1.6 m
10.2 m + 1.6 m = 11.8 m

- Shaped component addition: 11.8 m

The pipe length and shaped component addition produces the calculation length:
11.8 m + 18.5 m = 30.3 m

- Calculation length: 30.3 m

The pressure drop is the product of the specific pressure drop and the calculation length:
30.3 m x 6 Pa/m = 181.6 Pa

- Pipe pressure drop: 181.6 Pa, rounded to 182

4. Consideration of the pressure gain from geodetic height

In this example, the height difference (H) between the gas pressure controller and device connection fitting is:

H = 5.6 m (1.3 m + 3.6 m + 0.7 m)

Δ pH = -4 x H

-4 x 5.6 = -22.4 Pa

- Height of device above start of pipe: 5.6 m
- Pressure gain through height: -22 Pa (rounded)

5. Taking into account the pressure drop of the device connection fitting

A 15 D device connection fitting with an 1/2" orifice is used. From the designation 15 D and the nominal load (18 kW) table 17b allows the corresponding pressure drop to be read:

- Pressure drop, device connection fitting: 20 Pa

6. Pressure drop to gas device

All pressure drops/gains (details in square brackets) are then added together:

20 - 22 + 182 + 60 + 15 = 255

- Total pressure drop to device: 255 Pa

The calculated pressure drop of 255 Pa is below the permitted total pressure drop in accordance with TRGI 2008 of 300 Pa, and the supply pressure is therefore ensured.

7. Arithmetic check of the gas flow detector

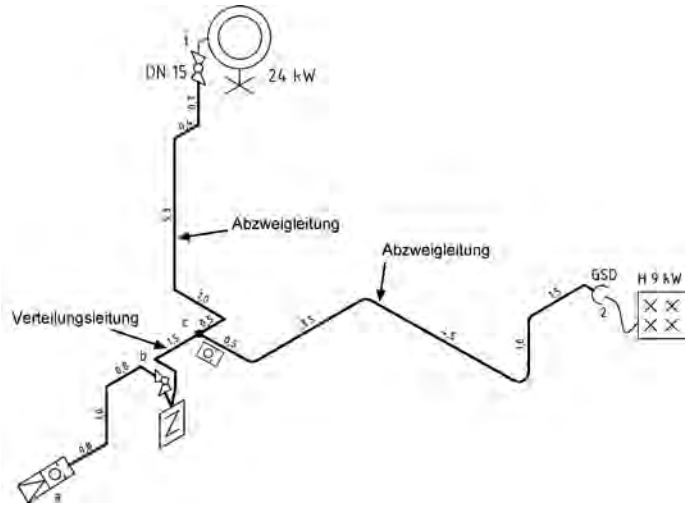
Finally, the arithmetic check for the gas flow detector is carried out with the help of table 21: The calculated pipe length of 30.3 m is less than the maximum length of the gas flow detector K 4 (31 m).

As a result, the condition of operating safety is met for the gas flow detector.

8. Calculation of gas installations with two or more devices

In the calculation for installations with two or more gas devices, different tables to those for the connection lines must be used for the distribution lines. The pressure drop tables for the distribution lines contain simultaneity factors as expected in the usual use of gas devices.

The tables for the connection lines do not take account of simultaneity factors. The tables are therefore subdivided and labelled accordingly.



Formblatt 1.1

für 1 Gasgerät (Einzelzuleitung)

Benennung Gasgerät: KWH

Nennbelastung $\dot{Q}_{NB}$: 18 kW

255 — Gesamtdruckverlust bis zum Gerät ΔP_g - 300 Pa

Geräteanschlussarmatur: 15 D — 20 — Druckverlust Geräteanschlussarmatur nach Tab. 17 a/b

Höhenunterschied Gerät zu Leitungsanfang: 5,6 m — -22 — Druckgewinn/-verlust durch Höhe $\Delta p_h = (-4) \times H$

Teilstrecke (b) ab GZ bis Geräteanschluss

Rohrdimension TECEflex (d_a oder DN): 25

R nach Tab. 20.1: 6 Pa/m — 182 — Rohrdruckverlust $\Delta p_{Rohr} = (R \times l_R)$

Rohrlänge l	+	Formteilzuschlag l_{FT} nach Tab. 23	=	Berechnungslänge l_R
18,5	+	11,8	=	30,3 m

Gaszähler: G 2,5 — 60 — Druckverlust der Zählergruppe Δp_{ZG} nach Tab. 14.1

Teilstrecke (a) von HAE bis GZ

Rohrdimension (d_a oder DN): _____ — Rohrart vor dem Zähler

R nach
- Tab. 20.1 (TECEflex)
- TRGI Tafel 1–4 (metallene Rohrleitung)

: _____ Pa/m — _____ — Rohrdruckverlust $\Delta p_{Rohr} = (R \times l_R)$

Rohrlänge l	+	Formteilzuschlag l_{FT} nach Tab. 23	=	Berechnungslänge l_R
_____	+	_____	=	_____ m

Gasströmungswächter mit TAE GS-T Typ K: 4 — 15 — Druckverlust des GS Δp_{GS} nach Tab. 19.1

Übertragung Druckverlust aus Verteilungsleitung oder = 0: 0

reduzierte Länge l_{GS}: 30,3 < 31 — maximal zulässige Rohrlänge l_{Gsmax} nach Tab. 21

Calculation using table procedure: Example - individual feed

Calculation tables

Δp_{ZG}	G 2.5	G 4	G 6	G 10	G 16
Pa	$\dot{Q}_{NB}$ [kW]				
30	5	8	12	20	25
35	8	14	21	35	44
40	11	18	27	45	57
45	13	21	32	53	68
50	15	24	36	61	77
55	16	27	40	67	85
60	18	29	44	73	92
65	19	31	47	78	99
70	21	33	50	84	106
75	22	35	53	88	112
80	23	37	56	93	118
85	24	39	58	97	123
90	25	40	61	101	128
95	26	42	63	105	134
100	27	43	65	109	(138)
105	28	45	68	113	
110	29	46	70	117	
115	30	48	72	120	
120	31	49	74	124	
125		50	76	127	
130	32	52	78	130	

Tab. 14.1 Pressure drop, meter group (positive displacement gas meter) – individual feed

Δp_{ZG}	G 2.5	G 4	G 6	G 10	G 16
Pa	$\dot{Q}_{NB}$ [kW]				
30	5	8	13	22	28
35	9	15	23	39	51
40	12	20	30	53	83
45	14	23	35	74	110
50	16	27	40	92	133
55	18	30	45	108	(153)
60	20	32	50	123	
65	21	35	58	(137)	
70	23	37	66		
75	24	39	73		
80	25	41	80		
85	27	43	86		
90	28	45			
95	29	47			
100	30	49			
105	31	53			
110	32				
115	33				
120	34				

Tab. 14.2 Pressure drop, meter group (positive displacement gas meter) – consumption line

Δp_{ZG}	G 25	G 40	G 65	G 100
Pa	$\dot{Q}_{NB}$ [kW]			
30	43	69	112	(173)
35	75	121	(196)	
40	97	(156)		
45	115			
50	131			
55	(145)			

Tab. 14.3 Pressure loss positive displacement gas meter* G 25 to G 100 (*For rotary piston and turbine flow meters, the pressure drop data from the manufacturer must be used.)

Δp_{ZG}	Gas socket GSD*	DN 15	DN 20	DN 25	DN 32	DN 40	DN 50
Pa	$\dot{Q}_{NB}$ [kW]						
5		7	12	21	37	58	75
10	5	10	16	27	48	75	97
15	6	11	19	32	57	89	115
20		13	21	36	65	101	130
25	7	14	24	40	72	112	(144)
30	8	15	26	44	78	121	
35		16	28	47	84	130	
40	9	17	29	50	89	(139)	
45		18	31	53	94		
50	10	19	33	55	99		
55		20	34	58	104		
60		21	36	60	108		
65	11	22	37	63	112		
70		23	38	65	116		
75	12		40	67	120		
80		24	41	69	124		
85		25	42	71	128		
90	13	26	43	73	131		

***Gas socket calculated with gas flow detector 1.6 K**

Tab. 17a Pressure drop device connection fitting with integrated thermal shut-off unit (TAE) – angle type

Δp_{ZG}	DN 15	DN 20	DN 25	DN 32	DN 40	DN 50
Pa	$\dot{Q}_{NB}$ [kW]					
5	10	21	33	56	83	(135)
10	13	27	43	73	108	
15	16	32	51	86	127	
20	18	36	58	97	(144)	
25	20	40	64	108		
30	21	44	69	117		
35	23	47	74	126		
40	25	50	79	134		
45	26	53	84	(142)		
50	27	55	88			
55	29	58	92			
60	30	60	96			
65	31	63	100			
70	32	65	103			
75	33	67	107			
80	34	69	110			
85	35	71	114			
90	36	73	117			

Tab. 17b Pressure drop device connection fitting with integrated thermal shut-off unit (TAE) – through type (also applies for single TAE)

Δp_{GS+TAE} Pa	GS K 1.6	GS K 2.5	GS K 4	GS K 6	GS K 10	GS K 16
10	6					
15	7	12	18	28	42	69
20	8	13	20	30	51	81
25	9	14	23	34	57	91
30	10	16	25	37	62	99
35	11	17	27	41	68	110
45	12*					
50	13*					

*** Only if a safety gas socket is used**

Tab. 19.1 Pressure drop, gas flow detector GS K in combination with thermal shut-off unit (TAE) – individual feed and branch line

Δp_{GS+TAE} Pa	GS K 1.6	GS K 2.5	GS K 4	GS K 6	GS K 10	GS K 16
10	7					87
15	8				52	116
20	9	14	23	35	67	138
25	10	16	25	38	82	
30	11	17	28	41	86	
35	12	19	30	45		
40	13	20	32	51		
45		21	34			
50		22				

Tab. 19.2 Pressure drop, gas flow detector GS K in combination with thermal shut-off unit (TAE) – consumption and distribution line
(Only applies for partial sections over which are connected only gas devices with nominal loads of ≤ 40 kW.)

R Pa/m20	Dim. 16	Dim. 20	Dim. 25	Dim. 32	Dim. 40	Dim. 50	Dim. 63
0.4				8	20	40	74
0.6			4	11	26	51	94
0.8			5	13	30	61	110
1.0			6	15	35	70	
1.2		3	7	16	38	77	
1.4			8	18	42	83	
1.6		4		19	45	90	
1.8			9	21	48	96	
2.0		5	10	23	52	104	
2.5		6	11	26	60	110	
3.0	3		12	29	66		
3.5		7	14	31	72		
4.0	4	8	15	34	79		
5	5	9	17	39	90		
6		10	19	43	99		
7	6	11	21	47	107		
8			**22**	**51**	**110**	Initial selection limit	
9	7	12	24	54			
10		13	26	59			
12	8	15	29	65			
14	9	16	31	71			
16	10	17	34	76			
18		19	36	81			
20	11	20	38	86			

Tab. 20.1 Pipe pressure difference TECEflex – individual feed and branch line

R Pa/m20	Dim. 20	Dim. 25	Dim. 32	Dim. 40	Dim. 50	Dim. 63
0.4			9	22	45	125
0.6			12	28	69	138
0.8		6	14	34	93	
1.0		7	17	39	110	
1.2		8	18	43		
1.4		9	20	46		
1.6			22	53		
1.8		10	23	61		
2.0		11	25	72		
2.5	6	12	29	90		
3.0	7	14	32	105		
3.5	8	15	35	120	Initial selection limit Distribution line	
4.0	**9**	**17**	**38**	**138**		
5	10	19	44			
6	11	21	49			
7	12	23	59		Initial selection limit Consumption line	
8	**13**	**25**	**68**			
9	14	27	76			
10	15	29	88			
12	16	32	103			
14	18	35	117			
16	19	38	131			
18	21	40	138			
20	22	43				

Tab. 20.2 TECEflex pipe pressure difference – consumption and distribution line

GS K	Pipe d_a	l_{GSmax} m
1.6	16	22
	20	58
2.5	16	10
	20	26
	25	79
4	16	4
	20	10
	25	31
6	20	5
	25	16
	32	63
10	25	6
	32	24
	40	100
16	32	10
	40	42

Tab. 21 Maximum pipe length l_{GSmax} of gas flow detector GS K

Copper d_a	15	18	22	28	35	42	54
Steel* DN	10	15	20	25	32	40	50
PE-X d_a (eq.)	**16**	**20**	**25**	**32**	**40**	**50**	**63**

* medium and heavy

Tab. 21.1 Equivalent nominal values for mixed installation

$\dot{Q}_{NB}$ [kW]	5	6	7	8	9	10	11	12	13
Δp_{GA} [Pa]	7	10	13	17	22	28	32	38	45

Tab. 22 Gas socket according to VP 635-1 without gas flow detector (GS)

Fitting	Version	Equivalent pipe length (m)
Transition connector	16 mm x ½"	0.3
Coupler	16 mm	0.2
Elbow	16 mm	1
Tee DG	16 mm	0.2
Tee AG	16 mm	1.1
Transition connector	20 mm x ¾"	0.6
Coupler	20 mm	0.4
Elbow	20 mm	1.7
Tee DG	20 mm	0.5
Tee AG	20 mm	1.9
Transition connector	25 mm x ¾"	0.4
Coupler	25 mm	0.2
Elbow	25 mm	1.7
Tee DG	25 mm	0.3
Tee AG	25 mm	1.6
Transition connector	32 mm x 1"	0.3
Coupler	32 mm	0.2
Elbow	32 mm	1.6
Tee DG	32 mm	0.2
Tee AG	32 mm	1.6
Transition connector	40 mm x 1¼"	0.4
Coupler	40 mm	0.2
Elbow	40 mm	2
Tee DG	40 mm	0.3
Tee AG	40 mm	2.2
Transition connector	50 mm x 1½"	0.5
Coupler	50 mm	0.2
Elbow	50 mm	2.3
Tee DG	50 mm	2.3
Tee AG	50 mm	2.5
Transition connector	63 mm x 2"	0.6
Coupler	63 mm	0.2
Elbow	63 mm	3.7
Tee DG	63 mm	0.8
Tee AG	63 mm	3.7

Tab. 23 Equivalent pipe lengths (additions) for TECEflex fittings

Δp_{AE}	DN 15	DN 20	DN 25	DN 32	DN 40	DN 50
Pa	$\dot{Q}_{NB}$ [kW]					
5	10	18	29	53	82	106
10	13	23	38	68	106	(137)
15	16	27	45	81	126	
20	18	31	51	92	(143)	
25	20	34	56	101		
30	21	37	61	110		
35	23	39	66	118		
40	25	42	70	126		
45	26	44	74	133		
50	27	47	78	(140)		

Tab. 24.1a Pressure drop shut-off unit – individual feed and branch line – angle type (Pressure drops for angle type shut-off units also apply for solenoid valves)

Δp_{AE}	DN 15	DN 20	DN 25	DN 32	DN 40	DN 50
Pa	$\dot{Q}_{NB}$ [kW]					
5	15	29	47	79	118	(191)
10	19	38	61	103	(152)	
15	22	45	72	121		
20	25	51	82	(138)		
25	28	56	90			
30	31	61	98			
35	33	66	105			
40	35	70	112			
45	37	74	119			
50	39	78	125			

Tab. 24.1b Pressure drop shut-off unit – individual feed and branch line – through type

Δp_{AE}	DN 15	DN 20	DN 25	DN 32	DN 40	DN 50
Pa	$\dot{Q}_{NB}$ [kW]					
5	11	20	33	72	(146)	(205)
10	15	25	42	111		
15	17	30	52	(142)		
20	20	34	67			
25	22	38	81			
30	24	41	93			
35	26	44	105			
40	27	47	115			
45	29	51	125			
50	30	57	(135)			

Tab. 24.2a Pressure drop shut-off unit – consumption and distribution line – angle type

Δp_{AE}	DN 15	DN 20	DN 25	DN 32	DN 40	DN 50
Pa	$\dot{Q}_{NB}$ [kW]					
5	16	33	58	(138)	(234)	(418)
10	21	42	92			
15	25	52	120			
20	28	67	(144)			
25	31	81				
30	34	93				
35	37	105				
40	39	115				
45	41	125				
50	43	(135)				

Tab. 24.2b Pressure drop shut-off unit – consumption and distribution line – through type

Test regulations for TECEflex gas lines

The test for TECEflex pipe lines within buildings up to 100 mbar consists of a preliminary test and a main test.
The tests must be performed before the lines are covered or plastered. The tests must be documented.

Preliminary test

Newly laid TECEflex gas lines must undergo a load test.
If the system components have a corresponding pressure rating, these can also be included in the preliminary test.
During the preliminary test, there can be no connection to a gas-bearing part of the system. For the duration of the test, all line openings must be tightly sealed with plugs, caps, blanks or blind flanges made of metal materials.
The preliminary test must be carried out using air or nitrogen. Oxygen is not permitted as a test medium.
The test pressure is 1 bar and must not drop over a period of one hour.

Main test

The main test is a leak test and applies to the pipes and fittings, but not the gas devices and associated control and safety devices. The gas meter can be included in the main test.
The main test is to be carried out with air or inert gas (for example nitrogen or CO_2), but not with oxygen.
The test pressure is 150 mbar.
After temperature equalization, the test pressure may not drop during the subsequent test period of at least 10 minutes. The measuring device must have a display accurate enough to enable a pressure drop of 0.1 mbar to be identified.

Initial start-up

The regulations of TRGI 2008 apply for the initial start-up of a gas installation.
Before the system is filled with gas, it is necessary to ensure that the tests described in "Test regulations for TECEflex gas lines" have been carried out successfully.
Before introducing gas, it is also necessary to make sure that all the line openings are sealed. This can also be ensured by the immediately preceding tests.
An inspection of every system part is also required, to be certain that every opening has been sealed with metal elements such as plugs or sealing flanges. Closed shut-off units are not regarded as sufficient here. These must also be sealed with metal plugs, blanks, caps or blind flanges.
The line systems must be blown out with gas until the system no longer contains any air or inert gas. The gas must be safely fed to the outdoor area with a hose.
Good ventilation of the room must be ensured.
Directly after the gas has been introduced, the connection points not covered by the main check or the combined load and leak test must be tested.

Software for TECEflex gas installation

TECEflex SCGas

The TECEflex gas software is available for calculating the dimensioning of gas installations with the TECEflex pipe system. This table-based program is quick to learn and easy to use. You can download it and the operating manual free of charge from the website (www.tece.com).

TECEdendrit

For TECEdendrit domestic systems software, you can purchase an extended licence, which also enables you to calculate indoor gas installations (price available on request).

Report on load and leak test for TECEflex gas installation

– Please note the information and explanations in the current TECEflex Technical Documentation! –

Building project: _____

Client/representative: _____

Contractor/fitter: _____

Max. operating pressure (mbar) (≤ 100 mbar): _____

The gas line was tested ❒ as a complete line ❒ in _____ sections

Test medium ❒ (oil-free) air ❒ nitrogen ❒ _____

All gas lines are sealed with metal plugs, caps, blanks or blind flanges.

Gas installation ≤ 100 mbar (low pressure)

1. Load test

1.1 Fittings

❒ removed

❒ installed (nominal pressure ≥ test pressure)

1.2 ❒ test pressure 1 bar

1.3 ❒ test period 10 minutes

1.4 ❒ no drop in the test pressure during the test period

TECEflex dimension	Pipe length (m)	Line volume (l/m)	Result (l)
16 x 2.7		x 0.11 =	
20 x 3.3		x 0.16 =	
25 x 4,0		x 0.25 =	
32 x 4.0		x 0.45 =	
40 x 4.0		x 0.80 =	
50 x 4,5		x 1.32 =	
63 x 6.0		x 2.04 =	
			∑ =

2. Leak test

2.1 ❒ The fittings are installed.

2.2 ❒ test pressure 150 mbar

2.3 ❒ test period according to table (right)

2.4 ❒ no drop in test pressure during the test period

2.5 ❒ The system has no leaks.

Pipe volume	Adjustment time	Test period
< 100 l	10 min	10 min
≥ 100 l < 200 l	30 min	20 min
≥ 200 l < 300 l	60 min	30 min

Place _____ Date _____

Client/representative (signature) _____ Contractor/fitter (stamp/signature) _____

Template for copying

Start-up and briefing report for the TECEflex gas installation

– Please note the information and explanations in the current TECEflex Technical Documentation! –

Building project: _____

Client/representative: _____

Contractor/fitter: _____

The following system parts were started up:

No.	System component, device *	Remarks
1	Network operator systems	
2	Pipelines including connections	
3	Shut-off units	
4	Gas devices (heat generating devices and potable water heaters)	
5	Gas ovens, gas clothes driers and similar small domestic gas appliances	
6	Flue gas evacuation (connections and joints)	
7	Combustion air	
8	Condensation discharge	
9	Other	

* Delete if not applicable, add anything missing.

Supplementary comments by the client/operator:

Supplementary comments by the contractor/contractual installation company:

❒ Briefing on operation of the system has been provided, the required operating documents, operating instructions and information for maintenance measures have been handed over in full.

_____ _____

Place Date

_____ _____

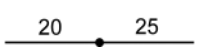
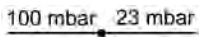
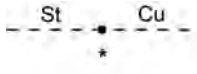
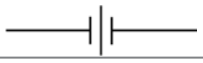
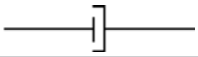
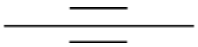
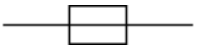
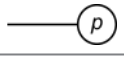
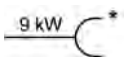
Client/representative (signature)

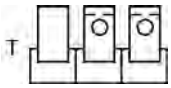
Contractor/fitter (stamp/signature)

Template for copying

Appendix

Symbols and abbreviations used (TRGI)

No.	Name	Graphical symbol	Abbreviation	Comment
1	Line			
2	Crossing line			No connection between the pipes
3	Branch			
4	Nominal width transition			here: for steel pipes (DN) for copper, stainless steel and plastic (d_a)
5	System operating pressure transition			
6	Material transition			here: from steel to copper Other pipe materials: NRS = Non-rusting steel MKV = Metal-plastic composite pipe PE-X = PE-X plastic pipe * Replace with BR = Braze connection CP = Clamp connection SC = Screw connection WE = Welded connection CR = Push fitting connection FL = Flange connection The above connections can also be replaced by separate symbols.
7	Pipeline in ground plan			
8	Electrical separation insulating piece			
9	Equipotential bonding earthing			
10	Detachable connection			e.g. screw or flange
11	Wall or ceiling bushing with protective pipe			
12	Wall or ceiling bushing with protective pipe and sealing (jacket pipe)			
13	Wall or ceiling bushing with protective pipe and fire protection sleeve			* = R 60, R 90, R 120
14	Line termination			
15	Pipe connection			
16	Gas pressure regulator		**GR**	
17	Gas meter (one-pipe)			
18	Gas meter (two-pipe)			
19	Pressure gauge			
20	Safety gas socket (GSD)		**GSD**	13 kW also possible * Replace with: AP = surface-mounted socket UP = flush-mounted socket
21	Gas safety hose line			
22	Shut-off unit		**AE**	Through type

No.	Name	Graphical symbol	Abbreviation	Comment
23	Shut-off unit		**AE**	Angled type
24	Solenoid valve			
25	Tapping clamp			
26	Thermal shut-off unit (TAE)		**TAE**	
27	Shut-off unit with combined TAE			Through type
28	Shut-off unit with combined TAE			Angled type
29	Gas flow detector (GS)		**Gas flow detector:**	Example: GS 6 M 6 = GS nominal value / M or K = GS type
30	Shut-off unit with combined gas flow detector (GS)			Through type
31	Shut-off unit with combined gas flow detector (GS)			Angled type
32	Gas pressure control device with combined gas flow detector (GS)			
33	Gas flow detector (GS) type K with combined thermal shut-off unit (TAE)		**GS-T**	K = gas flow detector(GS) type
34	Gas safety manifold GS K with combined thermal shut-off unit (TAE)			The gas flow detector on the manifold outlet can be omitted if the upstream gas flow detector at the start of the line (after main shut-off unit/ gas pressure control device) has the same performance level
35	Gas flow water heater		**DWH**	
36	Gas storage water heater		**VWH**	
37	Gas combination water heater		**KWH**	
38	Gas boiler		**HK**	
39	Gas radiant heater		**HS**	
40	Gas independent heater		**RH**	
41	Gas warm air heater		**WLE**	
42	Gas cooker		**H**	

No.	Name	Graphical symbol	Abbreviation	Comment
43	Gas powered range		**HH**	
44	Gas refrigerator		**KS**	
45	Gas heat pump		**WP**	
46	Gas sauna stove		**SO**	
47	Gas clothes drier		**WT**	
48	Gas grill		**G**	
49	Gas patio heater		**TS**	
50	Gas combined heat and power unit		**BHKW**	
51	Natural gas small service station		**ETS**	
52	Fuel cell heating device		**BZ**	
53	Gas lamp (gas light or flare)		**L**	
54	Decorative gas fire for open fireplace		**DF**	
55	Gas air conditioning unit		**KG**	

Tab. A 1 Symbols and abbreviations used

Units used (TRGI)

Pressure	N/m² 0 Pa	bar	mbar = hPa	mm WS	MPa
1 N/m² = 1 Pa =	1	10^{-5} 0.00001	10^{-2} 0.01	0.102	10^{-6} 0.000001
1 bar =	10^{5} 100000	1	10^{3} 1000	1.02 x 10^{4} 10200	10^{-1} 0.1
1 mbar = 1 hPa =	10^{2} 100	10^{-3} 0.001	1	10.20	10^{-4} 0.0001
1 mm WS =	9.81	9.81 x 10^{-5} 0.0000981	9.81 x 10^{-2} 0.0981	1	1.02 x 10^{-5} 0.0000102
1 MPa =	10^{6} 1000000	10	10^{4} 10000	1.02 x 10^{5} 102000	1

The following can be used for calculations with sufficient accuracy: 1 mmbar = 10 mm WS

Tab. A 2.1 Pressure units used

Heat quantity	kWh	MJ	J = Ws	kcal	BTU
1 kWh =	1	3.6	3.6 x 10^{6} 3600000	8.6 x 10^{2} 860	3.4121 x 10^{3} 3412.1
1 MJ =	0.2778	1	10^{6} 1000000	2.388 x 10^{2} 238.8	947.8
1J = Ws =	2.778 x 10^{-7} 0.0000002778	10^{-6} 0.000001	1	2.388 x 10^{-4} 0.000238	947.8 x 10^{-4} 0.0009478
1 kcal =	1.163 x 10^{-3} 0.001163	4.1868 x 10^{-6} 0.0000041868	4,1868 x 10^{3} 4186.8	1	3.9683
BTU =	2.931 x 10^{-4} 0.0002931	1,0551 x 10^{-5} 0.000010551	1.0551	0.2520	1

Tab. A 2.2 Heat quantity units used (work, energy)

Thermal output	kW	J/s = W	Mj/h	kcal/min	kcal/h
1 kW =	1	10^{3} 1000	3.6	14.33	8,6 x 10^{2} 860
1J/s = W =	10^{-3} 0.001	1	3.6 x 10^{-3} 0.0036	1.433 x 10^{-2} 0.01433	0.860
1 MJ/h =	0.2778	2.778 x 10^{2} 277.8	1	3.98	2.388 x 10^{2} 238.8
1 kcal/min =	6.9768 x 10^{-2} 0.069768	69.768	0.2512	1	60
1 kcal/h =	1.163 x 10^{-3} 0.001163	1.163	4.1868 x 10^{-3} 0.0041868	1.667 x 10^{-2} 0.01667	1

Tab. A 2.3 Thermal output units used (output, energy flux, heat flux)

Forms for table procedure

(see next pages)

Formblatt 1.1

für 1 Gasgerät (Einzelzuleitung)

Benennung Gasgerät .....

Nennbelastung $\dot{Q}_{NB}$ ..... kW

Gesamtdruckverlust bis zum Gerät
$\Delta P_g \leq 300$ Pa

Geräteanschlussarmatur .....

Druckverlust Geräteanschluss-armatur nach Tab. 17 a/b

Höhenunterschied
Gerät zu Leitungsanfang ..... m

Druckgewinn/-verlust durch Höhe
$\Delta p_h = (-4) \times H$

Teilstrecke (b) ab GZ bis Geräteanschluss

Rohrdimension TECEflex
(d_a oder DN) _____

R nach Tab. 20.1 ..... Pa/m

Rohrdruckverlust
$\Delta p_{Rohr} = (R \times l_R)$

..... + ... = ... m

Rohrlänge l | Formteilzuschlag l_{FT} nach Tab. 23 | Berechnungslänge l_R

Gaszähler G.....

Druckverlust der Zählergruppe
Δp_{ZG} nach Tab. 14.1

Teilstrecke (a) von HAE bis GZ

Rohrdimension
(d_a oder DN) _____

Rohrart vor dem Zähler

R nach
- Tab. 20.1 (TECEflex)
- TRGI Tafel 1–4
(metallene Rohrleitung) ..... Pa/m

Rohrdruckverlust
$\Delta p_{Rohr} = (R \times l_R)$

..... + ... = ... m

Rohrlänge l | Formteilzuschlag l_{FT} nach Tab. 23 | Berechnungslänge l_R

Gasströmungswächter
mit TAE GS-T Typ K .....

Druckverlust des GS
Δp_{GS} nach Tab. 19.1

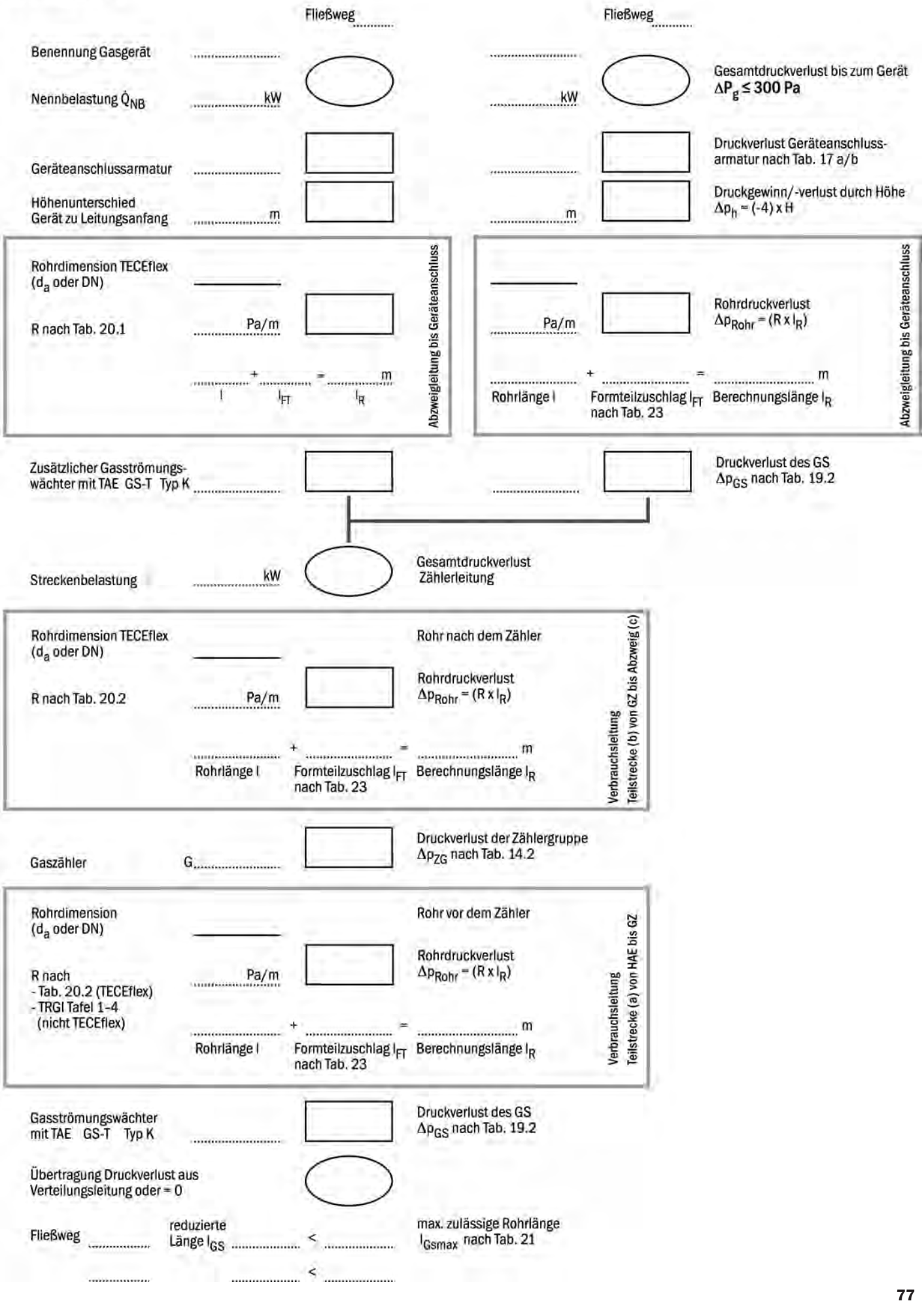
Übertragung Druckverlust aus
Verteilungsleitung oder = 0

reduzierte Länge l_{GS} ..... < .....

maximal zulässige Rohrlänge l_{Gsmax}
nach Tab. 21

Formblatt 1.2

für 2 Gasgeräte



PPSU resistance list

Brand name	Date	Concentration	Manufacturer	Use
Refrigerant oil				
Castrol nonol refrigerant oil		100 %	Castrol	Forbidden
Rocol RTD		100 %		Forbidden
Refrigerant oil M200 No. 1	June 2009	100 %		Forbidden
Disinfectant				
FINKTEC FT-99 CIP		6 %	Finktec GmbH	Forbidden
Mikro Quat		100 %	Ecolab	Forbidden
Mikrobac forte		1 %, 23 °C	Bode Chemie	Permitted
Hydrogen peroxide		35 %, 23 °C		Permitted
Potassium permanganate KMnO4		15 mg/l, 23 °C		Permitted
Sodium hypochlorite NaOCl		> 6 %, 23 °C		Permitted
Calcium hypochlorite Ca(ClO)2		50 mg/l, 23 °C		Permitted
Chlorine dioxide ClO2		6 mg/l, 23 °C		Permitted
Aniosteril D2M	June 2009	5 %	Laboratoires Anios	Permitted
Aniosteril Contact	June 2009	1 %	Laboratoires Anios	Permitted
Witty W4		2 %, 23 °C, 4 h		Permitted
Descaler (Entkalker)				
DS-40		4 %		Forbidden
Boiler noise control (Kessellärmschutz)		0.20 %		Permitted
Calcolith DP		10 %, 40 °C, 24 h		Permitted
Calcolith TIN-BE		5 %, 80 °C, 24 h		Permitted
Household descaler (rapid descaler) (Haushaltsentkalker (Schnellentkalker))		20 %		Permitted
LS1		0.60 %		Permitted
MB1		4 %		Permitted
Super Concentrate		0.20 %		Permitted
Superfloc		2 %		Permitted
Cleaning agent (Reinigungsmittel)				
Arkopal 110		5 %	Hoescht	Forbidden
ANTIKAL		100 %	P & G	Forbidden
BREF - Bath (Bad)		100 %	Henkel	Permitted
BREF - Fresh Shower (Frische Dusche)		100 %	Henkel	Permitted
CAROLIN - Gloss Cleaner (Glanzreiniger)		1.80 %	Boltom Belgium	Permitted
CAROLIN - active fresh (aktiv frisch)		1.90 %	Boltom Belgium	Permitted
CAROLIN - with linseed oil (mit Leinsamenöl)		1.90 %	Boltom Belgium	Permitted
CAROLIN - Marseille Soap (Seife)		1.80 %	Boltom Belgium	Permitted
Meister Proper - Lemon (Zitrone)		3.40 %	P & G	Forbidden
Meister Proper - Extra Hygiene		3.50 %	P & G	Permitted
Meister Proper - sensitive surfaces (empfindliche Oberflächen)		2.40 %	P & G	Forbidden
Meister Proper - Orange Zest (Orangenschale)		3.40 %	P & G	Forbidden
Meister Proper - Winter Fresh (Winterfrisch)		3.40 %	P & G	Forbidden
TERRA - Stone Floors (Steinböden)		12 %	Henkel	Permitted
TERRA - Parquet (Parkett)		3.20 %	Henkel	Permitted
TERRA - High Gloss Floors (Hochglanzböden)	June 2009	100 %	Henkel	Permitted

Brand name	Date	Concentration	Manufacturer	Use
Seals				
Cimberio Loxeal 58 11 PTFE thread seal (Gewindedichtung)		100 %		Forbidden
Dreibond 5331		100 %, 23 °C	Dreibond	Forbidden
EPDM rubber O-ring		100 %	Join de France	Permitted
Easyfit (Griffon)	June 2009	100 %	Bison International	Forbidden
Everseal pipe thread seal (Rohrgewindedichtung)		100 %, 82 °C	Federal Process Corp.	Forbidden
FACOT PTFE SEAL (PTFE Dichtung)		100 %		Forbidden
Filjoint	June 2009	100 %	GEB	Forbidden
FILETPLAST POTABLE WATER (EAU POTABLE)	June 2009	100 %	GEB	Permitted
GEBATOUT 2	June 2009	100 %	GEB	Permitted
GEBETANCHE 82 (EX-GEB)	June 2009	100 %	GEB	Forbidden
Griffon installation kit (Montagekit)		100 %	Verhagen-Herlitzius BV.	Permitted
Kolmat joint paste (- 30 to + 135 °C)		100 %	Denso	Permitted
Locher Special Paste (Paste Spezial)		100 %	Locher & Co AG	Permitted
Loctite 5061		100 %	Loctite	Permitted
Loctite 518 gasket eliminator (Dichtungseliminator)		100 %, 82 °C	Loctite	Forbidden
Loctite 5331	June 2009	100 %	Loctite	Permitted
Loctite 5366 silicomet AS-310		100 %	Loctite	Permitted
Loctite 542		100 %, 23 °C	Loctite	Forbidden
Loctite 55	June 2009	100 %	Loctite	Forbidden
Loctite 572 thread seal (Gewindedichtung)	June 2009	100 %, 60 °C	Loctite	Forbidden
Loctite 577		100 %, 23 °C	Loctite	Forbidden
Loctite Dryseal	Sep. 2008	100 %	Loctite	Permitted
Manta Tape		100 %		Permitted
Multipak		100 %		Permitted
Neo-Fermit		100 %	Nissen & Volk	Permitted
Neo-Fermit Universal 2000		100 %	Nissen & Volk	Permitted
Plastic Fermit - seal (Dichtung)		100 %	Nissen & Volk	Permitted
Precote 4		100 %	Omnifit	Forbidden
Precote 80		100 %	Omnifit	Forbidden
RectorSeal # 5		100 %, 82 °C	RectorSeal Corp.	Forbidden
Red Silicone Sealant (- 65 to + 315 °C) (Silikon-Dichtungsmittel)		100 %	Loctite	Permitted
Rite-Lok		100 %	Chemence	Forbidden
Scotch-Grip rubber and sealing adhesive (Kautschuk & Dichtungskleber) # 1300		100 %, 82 °C	3M	Forbidden
Scotch-Grip rubber and sealing adhesive (Kautschuk & Dichtungskleber) # 2141		100 %, 82 °C	3M	Forbidden
Scotch-Grip rubber and sealing adhesive (Kautschuk & Dichtungskleber) # 847		100 %, 82 °C	3M	Forbidden
Selet Unyte		100 %, 82 °C	Whitman	Forbidden
Tangit metalock	Apr. 2007	100 %	Henkel	Forbidden
Tangit Racoretanche	June 2009	100 %	Loctite	Permitted
Tangit Unilock	June 2009	100 %	Henkel	Forbidden
TWINEFLO (PTFE band) + processing agent (Verarbeitungsmittel)		100 %	Resitape / Ulith	Permitted
Twineflon	March 2009	100 %	Unith	Permitted

Brand name	Date	Concentration	Manufacturer	Use
Unipack	May 2006	100 %		Forbidden
Unipack Packsalve		100 %		Permitted
Viscotex Locher Paste 2000		100 %		Permitted
Adhesives				
Atmosfix	July 2009	100 %	Atmos	Forbidden
ARMAFLEX 520 KLEBER ADHESIVE	Dec. 2008	100 %, 50 °C		Forbidden
ARMAFLEX HT 625	Dec. 2009	100 %, 50 °C		Forbidden
BISON SANITARY SILICONES KIT (SILIKONENKIT SANITAIR)		100 %		Permitted
Bison-Tix contact adhesive (Kontaktkleber)		100 %, 23 °C	Perfecta International	Forbidden
CFS SILICONE SEALANT S-200 (Silikon Dichtungsmittel)		100 %		Permitted
Colle Mastic high performance (hautes Performances)	June 2009	100 %	Orapi	Permitted
Epoxy ST100	July 2007	100 %		Forbidden
GENKEM CONTACT ADHESIVE (KONTAKTKLEBER)		100 %		Forbidden
GOLD CIRCLE SILICONE KIT BOUW TRANSPARENT		100 %		Permitted
Knauf sanitary silicone kit (Sanitär-Silikonkit)		100 %		Permitted
Knauf silicone kit for acrylic (Siliconkit für Acryl)	July 2009	100 %	Henkel	Permitted
Pattex rigid adhesive PVC (colle rigide)		100 %		Forbidden
PEKAY GB480 (Vidoglue) adhesive (Kleber)		100 %		Forbidden
PEKAY GB685 (Insulglue) adhesive (Kleber)		100 %		Permitted
Repa R 200		100 %		Permitted
RUBSON SILIKON SANITÄR TRANSPARENT SET		100 %	Rubson	Permitted
RUBSON SILIKON SANITÄR TRANSPARENT SET		100 %	Rubson	Permitted
Water-repellent wood glue		100 %		Permitted
Foams				
BISON PURE FOAM (PUR SCHAUM)	March 2009	100 %		Forbidden
Boxer installation foam (Montageschaum)	Feb. 2007	100 %		Forbidden
Gunfoam - Winter - Den Braven East sp. z o.o.	Feb. 2007	100 %		Forbidden
Gunfoam Proby	Feb. 2007	100 %		Forbidden
Hercusal	Feb. 2007	100 %		Forbidden
MODIPUR HS 539	July 2009	100 %	Wickes	Forbidden
MODIPUR US 24 PART 2 (TEIL 2)	July 2009	100 %		Forbidden
MODIPUR HS 539 / US 24 PART 2 (1/1) (TEIL 2)	July 2009	100 %		Forbidden
PUR foam (Schaum) (contains diphenylmethane-4,4-di-isocyanate)		100 %		Forbidden
O.K. - 1 K PUR		100 %		Forbidden
Omega Faum - Foam (Schaum)	Feb. 2007	100 %		Forbidden
Proby installation foam (Montageschaum)	Feb. 2007	100 %		Forbidden
PURATEC - 1 K PUR		100 %		Forbidden
PURATEC - 2 K PUR		100 %		Forbidden
Ramsauer PU foam (Schaum)	July 2009	100 %		Forbidden
Klima plus duct and standpipe foam (Schacht- und Brunnenschaum)		100 %		Forbidden
Soudal installation foam for low temperatures (Montageschaum für tiefe Temperaturen)	Feb. 2007	100 %		Forbidden
SOUDAL gun foam (Pistolenschaum) Soudalfoam -10	Feb. 2007	100 %		Forbidden
SOUDAL PU foam (Schaum)	July 2009	100 %		Forbidden

Brand name	Date	Concentration	Manufacturer	Use
2-K Klima plus door installation foam (Türmontageschaum)		100 %		Permitted
TYTAN Professional Winter gun foam (Pistolenschaum)	Feb. 2007	100 %		Forbidden
TYTAN Professional for PCV gun foam (Pistolenschaum)	Feb. 2007	100 %		Forbidden
TYTAN Professional Lexy 60 low pressure (Niederdruck)	Feb. 2007	100 %		Forbidden
TYTAN Euro-Line installation foam (Montageschaum)	Feb. 2007	100 %		Forbidden
TYTAN Professional for PCV installation foam (Montageschaum)	Feb. 2007	100 %		Forbidden
ZIMOWA SUPER PLUS - installation foam (Montageschaum)	Feb. 2007	100 %		Forbidden
Greases				
BAYSILONE ÖL M 1000		100 %		Permitted
BECHEM BERUSOFT 30		100 %	Bechem	Permitted
Bechem Berulube Sihaf 2	May 2008	100 %	Bechem	Permitted
Dansoll Silec Blue Silicone Spray (Silikon-Spray)		100 %	Dansoll	Permitted
Dansoll Super Silec sanitary installation paste (Sanitär-Montagepaste)		100 %	Dansoll	Permitted
Hempseed oil		100 %		Permitted
Kluber Proba 270		100 %	Kluber	Permitted
Kluber Paralig GTE 703		100 %, 80 °C, 96 h	Kluber	Permitted
Kluber Syntheso glep1		100 %, 135 °C, 120 h	Kluber	Forbidden
KLÜBERSYNTH VR 69-252		100 %	Kluber	Permitted
Kluber Unislikikone L641		100 %	Kluber	Permitted
Kluber Unislikikone TKM 1012		100 %, 80 °C, 96 h	Kluber	Permitted
OKS 462 / 0956409		100 %	Kluber	Permitted
OKS 477 TAP GREASE (HAHNFETT)		100 %	Kluber	Permitted
Laureat Zloty Installator		100 %		Permitted
Luga Spray (Leif Koch)		100 %	Leif Koch	Permitted
Rhodorsil 47 V 1000		100 %, 80 °C, 96 h		Permitted
SiliKon Spray (Motip)		100 %	Motip	Permitted
silicona lubricante SDP ref S-255		100 %		Permitted
Silkonöl M 10 - M 100000		100 %		Permitted
Silikonöl M 5		100 %		Permitted
Turmisilon GL 320 1-2		100 %		Permitted
UNISILIKON L250L	June 2008	100 %		Permitted
Wacker Silikon		50 %, 95 °C, 96 h	Wacker	Forbidden
Metals				
Copper ions (Cu 2+)		50 ppm		Permitted
Soldering flux S 39	June 2009	100 %		Permitted
Soldering flux S 65	July 2009	100 %		Forbidden
YORKSHIRE FLUX		100 %		Forbidden
Degussa Degufit 3000		100 %	Degussa	Permitted
Aluminium ions (Al 3+)		50 ppm		Permitted
Atmosflux	July 2008	100 %		Permitted
Paints				
Sigma Superprimer TI		100 %	Sigma Coatings	Permitted
Sigma Amarol		100 %	Sigma Coatings	Permitted

Brand name	Date	Concentration	Manufacturer	Use
Decalux		100 %	De Keyn Paint	Permitted
Permaline		100 %	ITI-Trimetal	Permitted
Silvatane		100 %	ITI-Trimetal	Permitted
DULUX water-based high gloss paint		100 %	ICI	Forbidden
DULUX water-based silk gloss paint, satin		100 %	ICI	Forbidden
DULUX for microporous wood, silk gloss		100 %	ICI	Permitted
DULUX floor paint, very hard-wearing, silk gloss		100 %	ICI	Permitted
DULUX metal paint, anti-corrosion, high gloss		100 %	ICI	Permitted
Hammerite white, silk gloss		100 %	ICI	Permitted
Hammerite white, high gloss, based on xylene		100 %	ICI	Forbidden
Hammerite silver grey high gloss, based on xylene		100 %	ICI	Permitted
Boss Satin		100 %	BOSSPAINTS	Permitted
Hydrosatin Interior		100 %	BOSSPAINTS	Permitted
Carat		100 %	BOSSPAINTS	Permitted
Bolatex		100 %	BOSSPAINTS	Permitted
Optiprim		100 %	BOSSPAINTS	Permitted
Elastoprim		100 %	BOSSPAINTS	Permitted
Plastiprop		100 %	BOSSPAINTS	Forbidden
Formule MC		100 %	BOSSPAINTS	Forbidden
MAPEGRUNT		100 %	Mapei	Permitted
DULUX PRIMER		100 %	ICI	Permitted
UNI-GRUNT		100 %	Atlas	Permitted
Wall filler and construction products				
Bituperl (insulating filler with bitumen)		100 %		Permitted
Insulating paint with bitumen		100 %		Permitted
Cold adhesive for bitumen paper		100 %		Permitted
Climacoll adhesive for pipe insulation foam		100 %		Forbidden
Compactuna		6 %		Permitted
FERROCLEAN 9390	Feb 2008	100 %		Permitted
FT-extra		100 %		Permitted
Giso base primer		100 %		Forbidden
KNAUF STUC PRIMER	July 2009	100 %		Permitted
Mellerud mould killer (Schimmelvernichter)		100 %		Permitted
Mineral wool insulation with barrier layer against metal vapour	July 2007	100 %		Forbidden
Nivoperl insulating filler (isolierender Füllstoff)		100 %		Permitted
PCI LASTOGUM	Feb 2008	100 %		Permitted
PCI Seccoral 1K	Feb 2008	100 %		Permitted
Perfax fills all (Rebouche tout)	July 2009	100 %		Permitted
PE pipe insulation foam (Rohr Isolierungsschaum)		100 %		Permitted
Polyfilla interior filler (Innenwand-Füllstoff)		100 %	Polyfilla	Permitted
Porion ready to use filler (Sofortspachtel)		100 %	Henkel	Permitted
Porion Mörtel für Reparaturen		100 %	Henkel	Forbidden
Portland Cement - Zement		100 %	CBR	Permitted
RIKOMBI KONTAKT (RIGIPS)		100 %		Permitted

Brand name	Date	Concentration	Manufacturer	Use
PE foam self-adhesive insulation (wrapping tape) (Selbstklebende Isolierung PE-Schaum (Wickelband))		100 %		Forbidden
SOPRO FDH 525 liquid film (Flüssigfolie)	Sep. 2008	100 %		Permitted
Stucal plaster (Putz)		100 %	Gyproc	Permitted
TANGIT CLEANER (REINIGER)	July 2007	100 %		Forbidden
TANGIT special cleaner (Spezialreiniger)	July 2007	100 %		Permitted
Tile adhesive.		100 %		Permitted
Universal primer (Universalgrundierung)		100 %		Permitted
Wood-concrete Multiplex Bruynzeel (fumes from ...)		100 %		Forbidden
Wood pine (fumes from ...)		100 %		Forbidden
Wood MDF medium density fibreboard (fumes from ...)		100 %		Forbidden
Wood Multiplex waterproof glued (fumes from ...)		100 %		Forbidden
Anti-Termite				
Aripyreth Oil Solution		100 %, 23 °C		Permitted
Baktop MC		100 %, 23 °C		Permitted
Ecolofen CW		100 %, 23 °C		Permitted
Ecolofen Emulsifiable Concentrate - Emulgierbares Konzentrat		100 %, 23 °C		Permitted
Ecolofen Oil Solution - Öllösung		100 %, 23 °C		Permitted
Grenade MC		100 %, 23 °C		Permitted
Hachikusan 20WE/AC		100 %, 23 °C		Permitted
Hachikusan FL		100 %, 23 °C		Permitted
Kareit Oil Solution - Öllösung		100 %		Permitted
Rarap MC		100 %, 23 °C		Permitted
Corrosion inhibitors				
BAYROFILM T 185		0.30 %		Permitted
Copal corrosion inhibitor	April 2007	100 %		Permitted
KAN-THERM	Sep. 2008	100 %		Permitted
INIBAL PLUS	Sep. 2008	100 %		Permitted
NALCO VARIDOS 1PLUS1	Jan. 2009	2 %, 23 & 95 °C		Permitted
Gas leak sprays				
LIQUI MOLY leak finding spray (Lecksuchspray)		100 %, 23 °C		Permitted
Multitek gas leak spray (Gasleckspray)		100 %		Forbidden
Sherlock gas leak warner (Gasleckmelder)		100 %		Permitted
Ulith leak detector spray (Leckdetektorspray)	Sep. 2008	100 %		Permitted
LEAK FINDER SPRAY (LECK-SUCH-SPRAY) 400ML (ITEM. 3350)	Jan. 2009	100 %, 23 °C & 95 °C		Permitted
LEAK FINDER SPRAY (LECK-SUCH-SPRAY) 400ML (ITEM. 1809)	Jan. 2009	100 %, 23 °C & 95 °C		Permitted
LEAK FINDER PLUS (LECKSUCHER PLUS) (ITEM 890-27)	Jan. 2009	100 %, 23 °C & 95 °C		Permitted
LEAK FINDER (LECKSUCHER) 400 ML (ITEM 890-20)	Jan. 2009	100 %, 23 °C & 95 °C		Permitted
LEAK FINDER SPRAY (LECKSUCHERSPRAY) ROTEST	Jan. 2009	100 %, 23 °C & 95 °C		Permitted
GUPOFLEX LEAK-SEEKER (ITEM 301)	Jan. 2009	100 %, 23 °C & 95 °C		Permitted

Brand name	Date	Concentration	Manufacturer	Use
LEAK FINDER (LECKSUCHER) 5 L (ITEM 4120)	Jan. 2009	100 %, 23 °C & 95 °C		Permitted
GUEPO LEAK-SEEKER ETL (ITEM 121)	Jan. 2009	100 %, 23 °C & 95 °C		Permitted
GUEPO LEAK-SEEKER SOAPLESS (ITEM 131) leak finder without soap	Jan. 2009	100 %, 23 °C & 95 °C		Permitted
GASLEAK DETECTOR (GRIFFON)	June 2009	100 %, 60 °C		Permitted
GASLEAK DETECTOR KZ	June 2009	100 %, 60 °C		Permitted

The data in this table is correct to the best of our knowledge and is for general information. The results in the table show typical average values from a representative number of individual measurements. The values must not be taken as specifications under any circumstances.
Furthermore, TECE does not accept any liability for the use of products which are not listed in this table.

Measurement sheet

Notes

TECElogo
Technical Guidelines

TECE
Intelligente Haustechnik

Description of the system

TECElogo is a universal plumbing system for potable water and heating installations. Composite pipes in sizes from 16 mm to 50 mm are available for it. The pipes are joined without the use of compression tools. Only a pipe cutter and a calibrator are needed for the process. The prepared pipe is simply pushed into the TECElogo connector – that's all.

TECElogo offers:
- Connection without the need for compression tools
- High resistance to pressure and temperature
- Hygienically clean
- Flush mounting possible
- Rigid composite pipes, stable towards bending
- Removable and re-usable fittings

Types of pipe

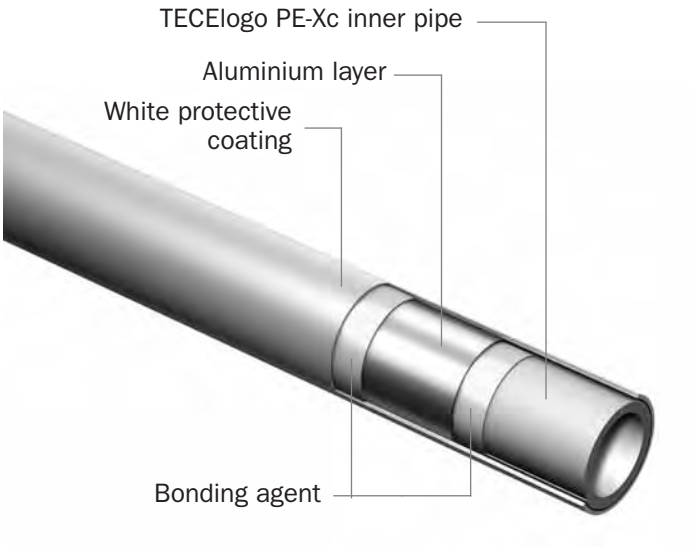
TECElogo composite pipes are available in two versions:
- PE-Xc composite pipe
- PE-RT composite pipe

Advantages of the TECElogo composite pipes:
- Universal pipe for potable water and heating installations.
- Linear expansion similar to a metal pipe
- Optically attractive white covering
- East to lay as the pipes are stable towards bending and consistent in shape
- Corrosion-resistant
- Resistant to heating system inhibitors
- Third-party and own monitoring
- DVGW-certified
- Permissible operating pressure 10 bar.

TECElogo composite pipes can be used:
- For storey and apartment distribution
- In cellar, riser and surface-mounted areas
- In the wall inside the insulation
- In radiator connection areas
- For floor and wall heating etc

TECElogo PE-Xc composite pipe

TECElogo PE-Xc composite pipe is a pipe with butt-welded aluminium layer and PE-Xc inner pipe. The material combination reduces the thermal linear deformation and makes the pipe consistent in shape and at the same time stable towards bending. By using PE-Xc, this composite pipe has an outstanding fatigue strength at temperatures of up to 90° Celsius.



Structure of the TECElogo PE-Xc composite pipe

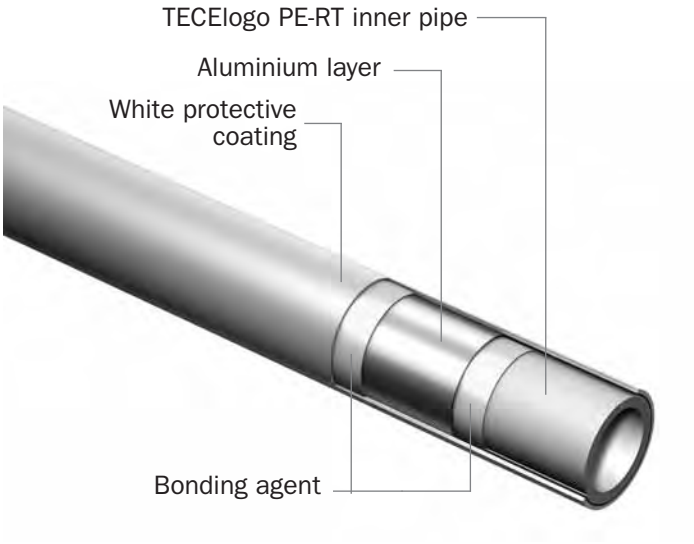
Versions supplied:
- Sizes 16–50 mm (16/20/25/32/40/50 mm)
- As rolls (up to 25 mm) or straight lengths
- In black corrugated protective pipe (16/20 mm) or
- Pre-insulated (16/20 mm).

Special advantages of TECElogo PE-Xc pipes

The high mechanical strength of the electron beam cross-linked TECElogo pipes:
- Very good long-term behaviour during constant internal pressure testing, even at high temperatures
- Good thermal ageing stability so that no damage caused by thermo-oxidative changes occurs, when used as intended
- Good resistance to the formation of stress cracks
- Good resistance to chemicals, which means the pipes are also resistant to heating system additives such as inhibitors
- Can be laid cold, without any heat treatment
- Good abrasion resistance and resistance to tear propagation
- Impact-resistant at low temperatures
- No creep behaviour of the plastic material

TECElogo PE-RT composite pipe

TECElogo PE-RT composite pipe is a pipe with butt-welded aluminium layer and PE-RT inner pipe. The material combination reduces the thermal linear deformation and makes the pipe consistent in shape and at the same time stable towards bending. By using type 2 PE-RT, this composite pipe has good fatigue strength at temperatures of up to 90° Celsius.



Structure of the TECElogo PE-RT composite pipe

Versions supplied:

- Sizes 16–25 mm (16/20/25)
- As rolls or straight lengths or
- In black corrugated protective pipe (16/20/25)

Fittings

Fittings made of brass and polyphenyl sulphone (PPSU) are available for sanitary and heating installations. Properties and characteristic features of the TECElogo fittings:

- One fitting for potable water and heating installations.
- Hygienically clean
- Mechanically high load bearing

Brass fittings

Fittings made of DR brass

The brass fittings are manufactured from a special dezincification-resistant brass recommended by the DVGW (German Technical and Scientific Association for Gas and Water) and meet the requirements of the DVGW Worksheet W 534 "Pipe connectors and pipe connections" and the current German Ordinance on Potable Water. The fittings can be used for potable water and heating systems.

PPSU plastic fittings

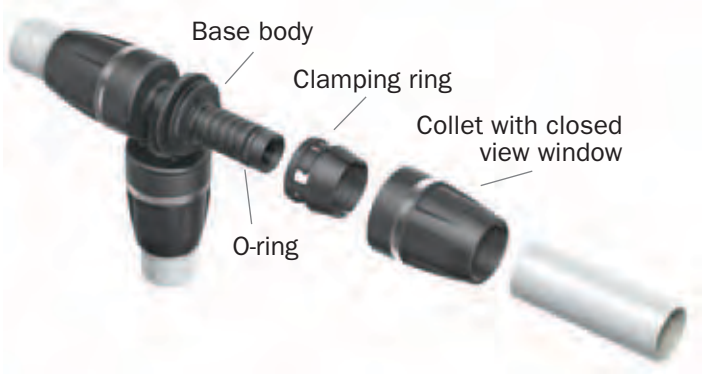
PPSU plastic fitting

PPSU is a mechanically high load-bearing and extremely impact-resistant special plastic material recommended by the DVGW for potable water installation. The PPSU fittings are corrosion-resistant and hygienically clean.

TECElogo connection

The TECElogo fitting is very compact and consists of only three ready-mounted components plus an O-ring:

- Base body with O-ring
- Clamping ring and
- Collet



Structure of a TECElogo fitting.

Limits of application

The TECElogo system is classified according to the type of application. Suitable for potable water installation according to application class 2 and for heating installation according to application class 5. Please also see table "Classification of operating conditions ISO 10508"

It has a theoretical service life of more than fifty years. The assessment is carried out by means of a standardised temperature group which is based on real operating temperatures. The TECElogo programme has two qualities of pipe in the range. The inner pipes are made of different plastics:

- PE-Xc
- PE-RT

Both qualities of pipe are tested together with the TECElogo push-fit connectors and DVGW certified. They meet the requirements of class 2 (domestic hot water) and class 5 (heating) according to ISO 10508. However, for installations which are permanently operated at high temperatures, we recommend the use of the PE-Xc composite pipe.

The following applies to TECElogo composite pipe:

- Must not be used in solar systems
- Unregulated hot water boilers must not be directly connected. There must be at least 1 metre of metal pipe installed between TECElogo and the hot water boiler.
- With solid fuel boilers, suitable measures must be taken to make certain that the permitted temperatures according to ISO 10508 are not exceeded.
- There must be no contact with naked flames.

TECElogo system pipe	PE-RT-composite pipe		
Pipe designation	PE-RT/Al/PE	PE-RT/Al/PE	PE-RT/Al/PE
size	**16**	**20**	**25**
Delivery lengths of roll (m)	100	100	50
Straight lengths (m) (5 m/length)	100	70	45
Field of application*	TWA, HKA, FBH	TWA, HKA, FBH	TWA, HKA, FBH
Application class/ operating pressure	2 / 10 bar 5 / 10 bar	2 / 10 bar 5 / 10 bar	2 / 10 bar 5 / 10 bar
Approval	DVGW	DVGW	DVGW
Colour	White	White	White
Outside diameter (mm)	16	20	25
Wall thickness (mm)	2	2.25	2.5
Inside diameter (mm)	12	15.5	20
Available in corrugated protective pipe	Yes	Yes	Yes
Available with 9 mm insulation Iλ = 0.040 W/(m · K)	–	–	–
Available with 13 mm insulation Iλ = 0.040 W/(m · K)	–	–	–
Pipe weight empty (kg/m)	0.10	0.15	0.21
Internal volume (dm^3/m)	0.11	0.19	0.31
Pipe roughness (mm)	0.007	0.007	0.007
Uninsulated heat conductivity ($W/(m^2 \cdot K)$)	0.41	0.41	0.41
Coefficient of thermal expansion (mm/(m · K))	0.026	0.026	0.026
Minimum bending radius (mm) - without bending spring - with bending spring	 80 64	 100 80	 125 –

* TWA – potable water system; HKA – radiator connection; FBH – floor heating.

Technical data for the TECElogo PE-RT composite pipe

TECElogo system pipe	PE-Xc composite pipe*					
Pipe designation	PE-Xc/Al/PE	PE-Xc/Al/PE	PE-Xc/Al/PE	PE-Xc/Al/PE	PE-Xc/Al/PE	PE-Xc/Al/PE
size	**16**	**20**	**25**	**32**	**40**	**50**
Delivery lengths of roll (m)	100	100	50	–	–	–
Ready-cut pipes (m) (5 m/length)	100	70	45	30	15	15
Field of application*	TWA, HKA, FBH	TWA, HKA, FBH	TWA, HKA, FBH	TWA, HKA, FBH	TWA, HKA, FBH	TWA, HKA, FBH
Application class/ operating pressure	2 / 10 bar 5 / 10 bar	2 / 10 bar 5 / 10 bar	2 / 10 bar 5 / 10 bar	2 / 10 bar 5 / 10 bar	2 / 10 bar 5 / 10 bar	2 / 10 bar 5 / 10 bar
Approval	DVGW	DVGW	DVGW	DVGW	DVGW	DVGW
Colour	White	White	White	White	White	White
Outside diameter (mm)	16	20	25	32	40	50
Wall thickness (mm)	2	2.25	2.5	3	4	4.5
Inside diameter (mm)	12	15.5	20	26	32	41
Available in corrugated pipe sheathing	Yes	Yes	Yes	–	–	–
Available with 9 mm insulation Iλ = 0.040 W/(m · K)	Yes	Yes	–	–	–	–
Available with 13 mm insulation Iλ = 0.040 W/(m · K)	Yes	Yes	–	–	–	–
Pipe weight empty (kg/m)	0.10	0.15	0.21	0.32	0.54	0.77
Internal volume (dm³/m)	0.11	0.19	0.31	0.53	0.8	1.32
Pipe roughness (mm)	0.007	0.007	0.007	0.007	0.007	0.007
Uninsulated thermal conductivity W/(m² · K)	0.43	0.43	0.43	0.43	0.43	0.43
Coefficient of thermal expansion mm/(m · K)	0.026	0.026	0.026	0.026	0.026	0.026
Minimum bending radius (mm) - without bending spring - with bending spring	 80 64	 100 80	 125 –	 160 –	 200 –	 250 –

* TWA – potable water system; HKA – radiator connection; FBH – floor heating.

Technical data for the TECElogo PE-Xc composite pipe

Application class	Calculation temperature T_D °C	Operating period [b] at T_D years[a]	T_{max} °C	Operating period at T_{max} years	T_{mal} °C	Operating period at T_{mal} hours	Typical application range
1 [a]	60	49	80	1	95	100	Hot water supply (60 °C)
2 [a]	70	49	80	1	95	100	Hot water supply (70 °C)
3 [c]	20	0.5	50	4.5	65	100	Low temperature floor heating
	30	20					
	40	25					
4 [b]	20	2.5	70	2.5	100	100	Floor heating and low temperature radiator connection
	40	20					
	60	25					
5 [b]	20	14	90	1	100	100	High temperature radiator connection
	60	25					
	80	10					

T_D = Temperature for which the pipe is designed. T_{max} = Maximum temperature which may occur for a short period
T_{mal} = Highest possible "one-off" temperature which may occur during a breakdown (maximum 100 hours in 50 years)

[a] Depending on its national regulations, a country may choose either class 1 or class 2.

[b] For an application class, if more than one calculated temperature results for the operating period and its temperature, the associated times for the operating period should be added. "Plus cumulative" in the table implies a temperature group for the temperature given for an operating period (e.g. the temperature group for a period of 50 years for class 5 is made up as follows: 20 °C for 14 years, followed by 60 °C for 25 years, followed by 80 °C for 10 years, followed by 90 °C for 1 year, followed by 100 °C for 100 h).

[c] Only allowed if the breakdown event temperature cannot rise above 65 °C.

Classification of the operating conditions (according to ISO 10508)

Application areas

Potable water installation

Potable water places special demands on a plumbing system. It is a foodstuff and must not be affected by the materials of the plumbing system. The planning and implementation as well as the operation of a potable water installation must be done in accordance with DIN 1988, DIN EN 806, DIN EN 1717/A1 and VDI 6023. The plumber must satisfy himself that he is installing a pipework system which complies with the valid recognised technical regulations. The TECElogo system is DVGW certified and proven suitable for potable water installation. DVGW certification includes:

- Technical test of the components
- A test according to the guidelines of the "Plastics and Potable Water" working group of the German Federal Health Office
- Certification in accordance with Worksheet DVGW W270

Field of application

The TECElogo system is suitable for all potable water qualities according to DIN 50930 part 6, which corresponds to the current potable water regulation (TrinkwV 2011). It cannot be used if the water drops below the following limiting values:

- pH value lower than 6.5 or
- Total hardness less than 5 °dH (German hardness).

The following component parts are available for potable water systems:

- Plastic fittings made of PPSU
- Metal fittings made of dezincification resistant DR brass
- Composite pipe with PE-Xc liner
- Entirely plastic pipe made of PE-Xc

All materials are recommended by the DVGW (German Technical and Scientific Association for Gas and Water), and are recognised all over Europe.

Material selection

The implementer has done his duty of care when he

- Is in receipt of the potable water analysis according to DIN 50930-6 for the supply area from the responsible building authority and has checked the suitability of the TECElogo system,
- Has assured himself of the experience of the supplier,
- Has received an approval for TECElogo from TECE where applicable.

Installation of TECElogo brass adapters in stainless steel installations

Under certain conditions, contact corrosion may occur between brass and stainless steel. However, technically-relevant contact corrosion only occurs if the water-wetted brass surface is very low in relation to the water-wetted stainless steel surface. No contact corrosion is to be expected if the ratio of areas of copper, red brass and brass on the one side and stainless steel on the other is not below about 2–3 : 100. The sequence of the different materials is arbitrary in this case. A flow rule need not be observed. In heating systems this does not apply because no corrosion is to be expected here.

Unprofessional use of hemp on a TECElogo external thread adapter can lead to corrosion in brass, if the fittings are screwed into stainless steel. If hemp is used as a seal, then it must be protected against drying out by the use of a suitable paste. The paste must meet the requirements of DIN EN 751-2 and DIN 30660. For potable water and gas installations, the paste must be DVGW certificated. Excessive tightening torques can also start a corrosion process in brass and must be prevented.
TECE recommends male connectors made of stainless steel up to a size of 25 mm.

Measures for the prevention of Legionella

Potable water installations must be planned, implemented and operated with special care according to DIN EN 806 and DIN 1988, in addition the VDI 6023 and the DVGW worksheet W551 apply.

By following some simple rules, the risk of Legionella contamination can be minimized:

- Unneeded and dead sections of pipe in which water could stagnate must be separated immediately at the outflow.
- Care must be taken during installation to ensure that no dirt enters the pipe system.
- The volume of stored water must be designed to be as small as possible.
- The correct pipe sizes must be chosen.
- Circulation pipelines must not be too large.
- Circulation pipelines must be hydraulically balanced.
- The temperature of the hot water boiler must be at least 60 °C.
- The circulation return must not drop below 55 °C.
- During commissioning, the system should be thoroughly flushed.
- There must be no organic material such as hemp remaining in the potable water installation.
- Uninsulated parts of the hot water pipework should be avoided.

- The correct operation and maintenance of the water treatment system and filters must be ensured.
- If the tapping points are far away or are used only rarely, a decentralized hot water supply is preferable.
- If cold water pipes are located next to hot water pipes or heating pipes, they must be well insulated so that the cold water cannot be heated.
- Pipes carrying cold water should not be laid in cavities in which circulation or heating pipes run.
- For reasons of hygiene, pressure tests must not be performed using water, but with oil-free compressed air or inert gas. Pressure tests using water are only permitted immediately before initial operation of the installation. Only hygienically clean potable water must be used for flushing and the pressure test.

Disinfection of potable water systems

The suitability of the TECEflex system for potable water has been verified by DVGW certification. The components of the TECEflex system are approved all over Europe and are made of tried-and-tested materials. A potable water installation which is planned, implemented and operated according to DIN 1988, DIN EN 806, DIN EN 1717/A1 and VDI 6023 is hygienically clean and in principle does not need any disinfection measures. Disinfection is only necessary in exceptional cases and is only then to be used when an urgent necessity exists (contamination).
It must be considered as an immediate emergency measure to return the potable water installation to a usable state. The reason for the microbial contamination (growth of microbes) must be eliminated (e.g. fault in construction or incorrect operation). Maintaining a usable state of the drinking water installation by repeated disinfection measures must be avoided. In such cases, renovation comes before disinfection measures.
Often repeated disinfection measures have an adverse affect on the lifetime of the installation.

A general distinction must be made between measures taken while the system is not operating (chemical disinfection) and measures while it is still operating (thermal disinfection and continuous chemical disinfection).

Thermal disinfection

DVGW Worksheet W552 prescribes a three-minute flushing of each tapping point with hot water at a minimum temperature of 70° C. In practice, a proven method is to heat the hot water storage tank to 80° C to compensate for temperature losses towards the tapping points. Before flushing the tapping points, any circulation device present must be switched on until the circulation return pipe has reached a temperature of at least 70° C. Care must be taken to be sure that no user can be scalded during the thermal disinfection process. All potable water installation pipes from the TECEflex system can be disinfected effectively with this method. If thermal disinfection is often performed, a reduction in the life of the TECEflex pipes cannot be ruled out and renovation of the potable water installation should be considered.

Chemical disinfection

Chemical disinfection measures must be performed according to DVGW worksheet W 291. Care must be taken that the active substances, concentrations, application time and maximum temperatures listed there are adhered to. A combination of thermal and chemical disinfection is forbidden. The water temperature during chemical disinfection must not exceed 25 °C.

The TECEflex system can be disinfected using the disinfectants listed in the DVGW worksheet W 551. Care must be taken that the dosages are not exceeded. It must be made certain that nobody draws off any potable water during the disinfection process. After a chemical disinfection, it is vital to ensure that all the residual disinfectant is completely flushed from the network of pipes. The water containing the disinfectant must not be allowed to enter the drainage system.

Before carrying out disinfection measures using chemical agents, it must be made certain that all the components of the potable water installation are stable towards the agents. Particular attention should be paid to components made of stainless steel. The specifications of DVGW worksheet W 551 must be adhered to. The suitability of the disinfectant in conjunction with PE-Xc pipes and DR brass must be confirmed by the manufacturer of the disinfectant. The manufacturer's instructions must be followed. The disinfectant properties of the chemical disinfectant usually result from the oxidising effect of the contents. If disinfection is often performed, the agents may also attack the potable water installation. Often repeated chemical disinfection measures have a considerable adverse affect on the lifetime of the TECEflex system. For this reason, the total number of disinfection cycles should be limited to five over the total lifetime of the pipes. Repeated disinfection measures do not correspond to the latest state of the technology. A disinfection measure is only legitimate to return a potable water installation to a usable condition after it has become contaminated.

Continuous chemical disinfection

Disinfection of a contaminated potable water system by continuously dosing with disinfectants is not constructive according to current knowledge. For this reason, it should only be performed in some rare situations. In doing so, the requirements of the current German Ordinance on Potable Water and the UBA list according to § 11 TVO must be met. To achieve an appropriate effect however, the specified limiting values would have to be considerably exceeded. Continuously added disinfectant can have a serious effect on the life of the potable water installation. This type of disinfection is advised against because of the possible damage to materials. We cannot accept any liability for these cases.

Heating installation

TECElogo system has been approved for use in heating installations.
The following components are available:

- Plastic fittings made of PPSU
- Metal fittings made of DR brass with a low level of zincification
- Composite pipe made of PE-Xc or PE-RT for system temperatures up to 90 °C according to ISO 10508
- Connection accessories / adapters made of copper

Because of its aluminium layer, the TECElogo composite pipe is completely impermeable to oxygen.

Connection technique

TECElogo is a safe and fast push-fit system for composite pipes, making it very easy to connect pipes together:
1. Cut pipe to length
2. Calibrate and chamfer
3. Push in - finished

The connection is sealed by a sturdy O-ring seal. Because of its conical shape, the retaining claw makes it easy to push the pipe in and prevents the connection from coming apart. It holds the pipe securely - without damaging it.
The closed view window is used to check the push-in depth and gives the fitter the certainty of a safe connection.

Processing

Important instructions: Only the associated system tools may be used to work with the TECElogo system. The use of other tools which are not part of the system is forbidden!

Connecting TECElogo components to third-party pipes or fittings is forbidden! A warranty entitlement exists only for the uses represented in the system description.

Tool box with pipe cutter, calibrating and chamfering tools and also the dismantling tools

Two sets of tools are available from TECE. The following system tools can be used to produce or undo TECElogo connections in the dimensions of 16 to 25 and 32 to 50 mm.

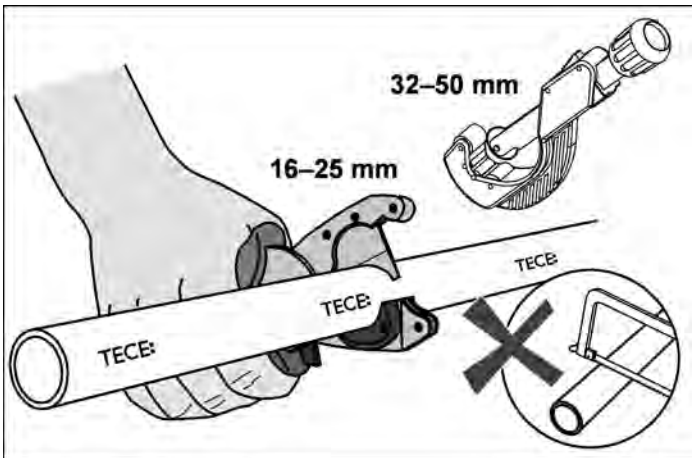
Tools for size 16–25:
- TECElogo pipe cutter (up to size 25)
- TECElogo calibrating and chamfering tools
- TECElogo dismantling tools

Tools for size 32–50*:
- TECE pipe cutter (size 16–50)
- TECElogo calibrating and chamfering tools
- TECElogo dismantling tools

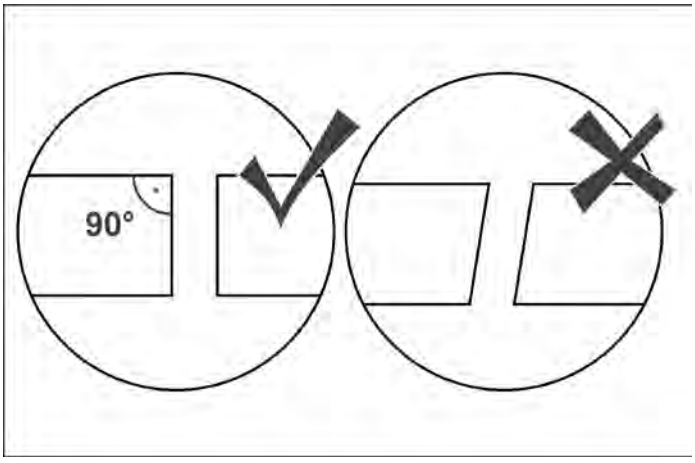
Establishing a connection

The following steps are required for a correct TECElogo connection:

Step 1 – Cutting the pipe to length.

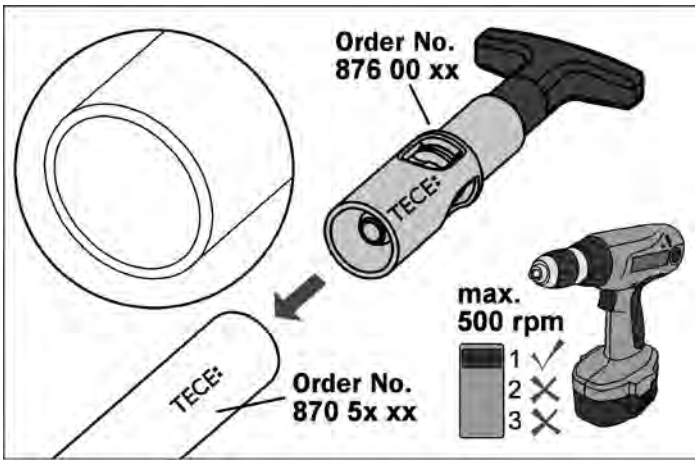


To cut a TECElogo pipe to length, use TECE pipe cutter (Order No. 876.00.02) for the smaller sizes (up to 25 mm) and the TECE pipe cutter (Order No. 876.00.08) for the larger sizes (up to 50 mm).
Cut the pipe at a right angle. Never use a saw or a similar tool under any circumstances!

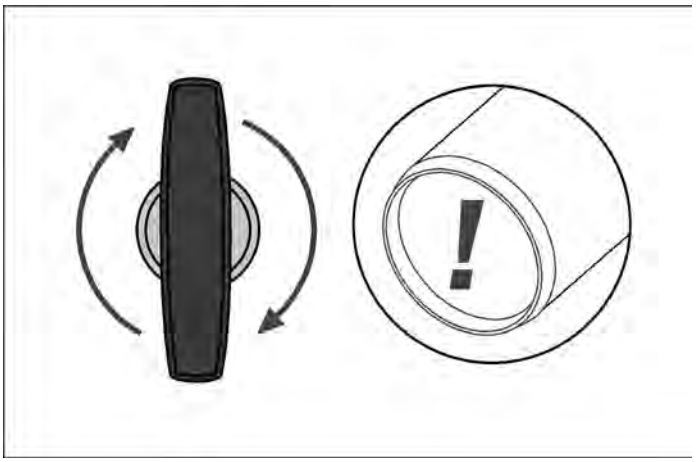


Note: TECElogo pipes must only be processed with TECElogo system tools which are in a perfect condition. In particular, the cutting edge and the small wheel must be sharp and free of burrs; these can be replaced if required.

Step 2 – Calibrating and chamfering the pipe.



Push the calibrating and chamfering tool (Order No. 876.00.xx) appropriate for the pipe size on to the end of a TECElogo pipe and turn it clockwise several times.



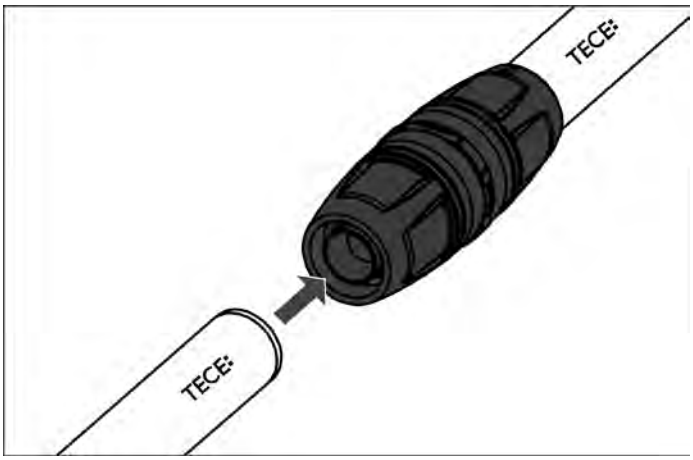
Afterwards the pipe end must have a uniform chamfer and must be free of burrs. There must be no chips left on the chamfer, which must be visually checked after the calibration (see illustration below). The calibrating and chamfering tool must be cleaned ("blown clear") after every calibration process. Chips which remain could otherwise be carried into the sealing area of the connector.

Correctly calibrated pipe

Incorrectly calibrated pipe

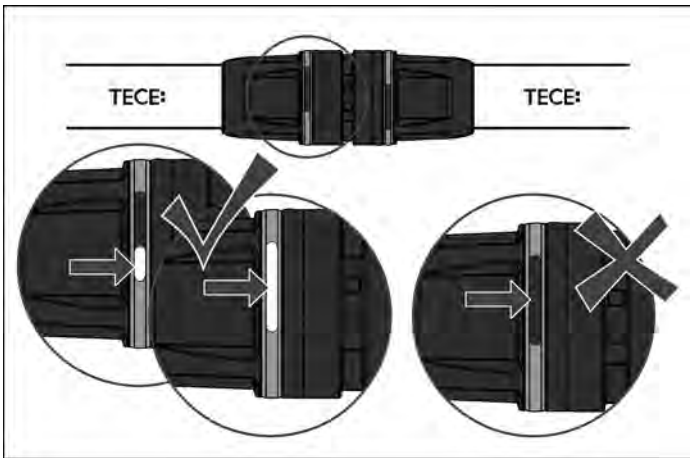
The pipe can also be calibrated using a cordless screwdriver. In doing so, the speed must not exceed 500 revolutions per minute (500 rpm) (= level 1).

Step 3 – Pushing the pipe in



Check the fitting for any contamination; clean or replace it as necessary. Simply push the TECElogo pipe into the fitting, up to the stop.

Step 4 – Visual inspection



The connection is only fully completed if the pipe is visible in one of the view windows.

If working in a blind position, mark the pipe before pushing it in. In this case the pipe must be pushed into the fitting up to this mark.
The distance between the mark and the pipe end depends on the pipe size:

Size	Distance of the mark (mm)
16	26
20	32
25	35
32	45
40	47
50	47

Distance of the mark from the pipe end

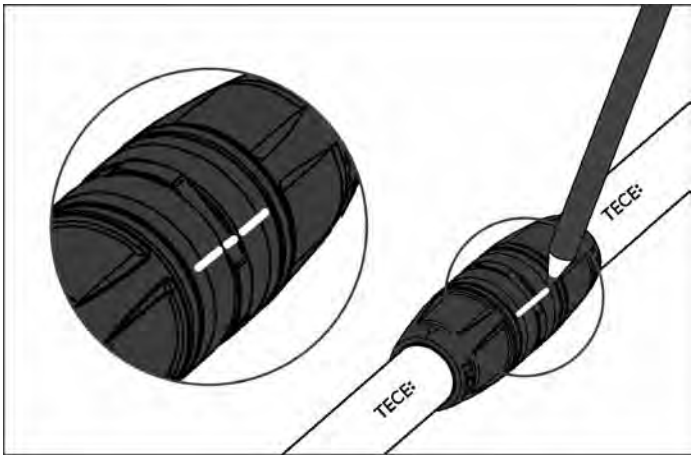
Undoing and remaking a connection

The connections of the TECElogo system can be undone at any time. In case of re-installations, all removed parts can be used again. In the case of connections which have been undone after the initial operation of a TECElogo installation, new pipe ends, collets, clamping rings and O-ring seals must be installed, the basic bodies of the fittings can be used again however. For this purpose, there are suitable repair sets for all sizes (Order No. 879.00.16 / ... 20 / ... 25 etc.).

Note: In all cases, only the TECElogo system dismantling tool may be used for undoing and re-making connections.

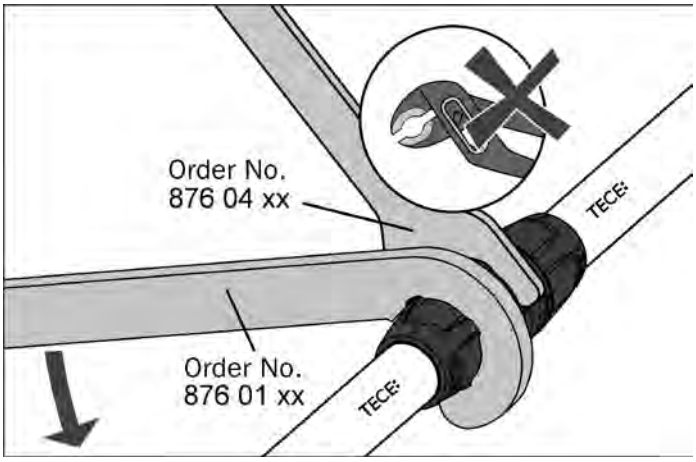
The following steps are required to undo and re-make a connection.

Step 1 – Marking the seat of the collet



Only for the sizes 16–25 mm is it necessary to clearly mark the seat of the collet on the fitting before dismantling.

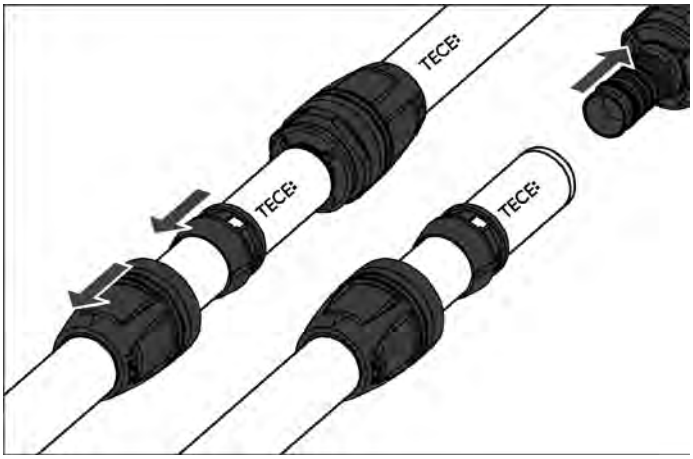
Step 2 – Undoing the collet



Secure the fitting against turning using the open-ended dismantling spanner and unscrew the collet using the appropriate dismantling key.

For the sizes 16–25 mm, in most cases the fitting can either be held by hand – e.g. for a T-union – or if brass fittings they can be held with a pair of pliers. The correct size of open-ended dismantling spanner must always be used to undo a coupling however.

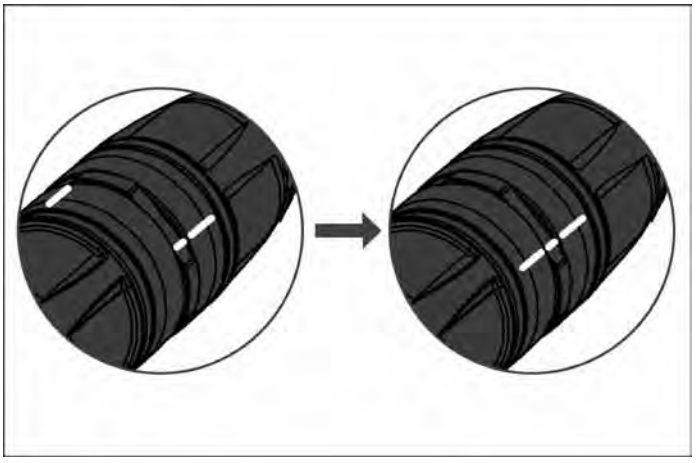
Step 3 – Removing a fitting from a pipe



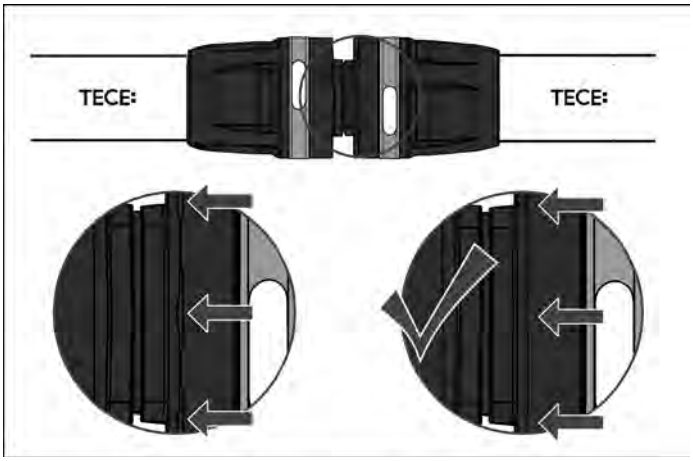
Push the collet on to the pipe, and pull the fitting off the pipe; push the collet and the clamping ring off the pipe.

Step 4 – Pre-mounting the fitting
(A) In case of new installation:
Place the clamping ring on the connecting piece and use the collet to hand tighten. Then use the dismantling tools to tighten the collet so far that

- for the sizes 16–25 mm the marks are aligned again (see illustration below)



- for the sizes 32–50 mm the collet is felt to engage into its final position (see illustration below).



(B) After initial operation:
The repair set has to be used in this case.
Transfer the mark onto the new collet – precisely as on the old collet. Push a new O-ring onto the fitting. Place the clamping ring on the connecting piece and use the collet to hand tighten. Then use the dismantling tools to tighten the collet so far that for the 16–25 size – the marks are aligned again or – for the 32–50 mm size – the collet is felt to engage into its final position.

Step 5 etc.
The other steps – cutting the pipe, calibrating and chamfering, pushing in and the visible inspection – are carried out as already described in the previous chapter titled "Establishing a connection".

Installation regulations

The applicable technical regulations, standards and guidelines must be observed during the installation of heating and potable water systems. Installation must only be carried out by specialists.

General instructions

When using TECElogo pipes, the following instructions must be followed:

Threaded connections

For threaded connections, TECE recommends the use of hemp, combined with sealing paste approved for the purpose. If too much hemp is used, the inside or outside threaded component may be damaged. Please make sure that no hemp remains in the pipe system. If other thread sealants are used, warranty must be provided by the manufacturer of the sealant.

Working temperatures

TECElogo system can be worked with down to a minimum temperature of 0° Celsius. At low temperatures, the ends of the pipes must be warmed to "hand temperature". Do NOT use a flame to do this !

Sheathing of fittings

Suitable sheathing must always be used to protect TECElogo fittings from any contact with masonry, plaster, cement, screed, rapid binders etc. Direct contact with the structural shell must be prevented because of the sound insulation requirements in accordance with German standard DIN 4109 and guideline VDI 4100.

Kinks and deformations

If a kink or a deformation is produced in a TECElogo pipe because of inexpert working or unfavourable site conditions, the location must be repaired, a bend should be used if the radius is tight.

Use in mastic asphalt

The high temperatures which may occur when applying the mastic asphalt (approx. 250° C) would immediately destroy the pipes in direct contact. This also applies for the use of pipe-in-pipe systems. For this reason, suitable protective measures have to be taken. The pipe-in-pipe lines laid on the bare concrete are sufficiently protected against being burned if softboard is laid before applying the asphalt over the pipes. However, the points where the pipes enter the masonry from the bare concrete, rather than the free floor surfaces, are critical. At these critical points, the lines are best protected if edge insulation strips are laid in front of the pipes in such a way that there is a certain spacing which can be filled with sand in the area of the pipes. These protective measures have to be checked once again prior to applying the mastic asphalt in order to prevent potentially irreparable damage to the pipe system. During the application, cold water must be running through the pipes.

Prevention of air locks

Pipe runs must be laid so that no air locks are possible. At the lowest point in the system, there must also be a way of draining the pipeline.

Protection against UV irradiation

Exposure to UV irradiation over an extended period will damage the TECElogo pipes. The packaging of the pipes provides sufficient protection against ultraviolet radiation, but it is not weatherproof. For this reason, the pipes should not be stored outdoors. On the construction site, the pipes should not be subjected to sunlight for unnecessarily long periods. If necessary, they must be protected against UV light. TECElogo pipes laid outdoors must be inside black corrugated tubing to protect them against sunshine.

Identification of pipelines

In the interests of safety, we recommend that pipelines are marked to show the substances flowing through them. Especially at complex places or where there are several pipes with different contents.
In every case, the identification must be done according to DIN 2403

Laying on bitumen sheets

Solvent-containing bitumen sheets or coatings must be completely dry before TECElogo pipes are laid on them. The manufacturer’s setting times must be observed.

Arrangement of pipelines

If cold and hot water pipes are to be laid one above the other, the pipe carrying the hot water must be laid above the cold water pipe.

Contact with solvents

Direct contact of TECElogo components with solvents or solvent-containing varnishes, paints, sprays, adhesive strips, etc. must be prevented. The solvents can attack the plastic components of the system.

Potential equalization

TECElogo composite pipes must not be used as an earth conductor for electrical systems according to VDE 0100. For this reason, if metal pipes in an installation are partly being changed for a pipe from the TECElogo range (e.g. during renovation work), a check must be made that there is a proper earth.

Protection against frost

Filled TECElogo pipes must be protected against frost. TECElogo system is suitable for the following anti-freeze agents and concentrations:

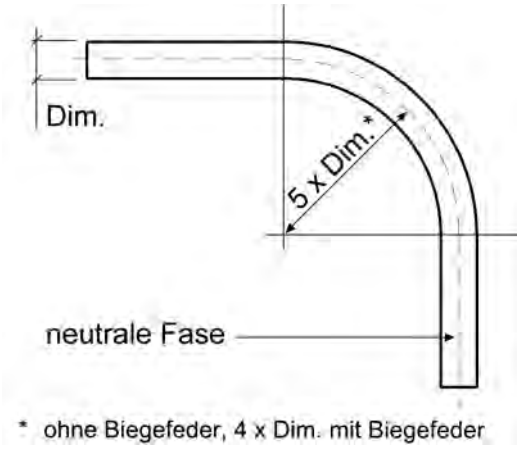
- Ethylene glycol (Antifrogen N): May be used up to a concentration of 50% maximum. TECE recommends restricting the concentration to 35%. A concentration of 50% Antifrogen N is equivalent to frost protection down to a temperature of -38 °C. A concentration of 35% Antifrogen N is equivalent to frost protection down to -22 °C. If the concentration of Antifrogen N is more than 50%, the frost protection reverses. At temperatures below -25° Celsius, slush is produced.
- Propylene glycol: May be used up to a maximum concentration of 25%. Propylene glycol is used primarily by the food-processing industry. A concentration of 25% provides frost protection down to -10 °C. At higher concentrations of propylene glycol, stress cracks may occur in the PE-RT material.

Trace heating

Trace heating as well as self-regulating heat tapes, which are approved by the manufacturers for plastic pipe systems in the sanitary area, can be used for TECElogo. In order to ensure perfect heat transmission, the heat tapes are attached to the TECElogo pipes over the entire surface with a broad adhesive aluminium tape. The specifications of the manufacturer must be observed.

Bending radii

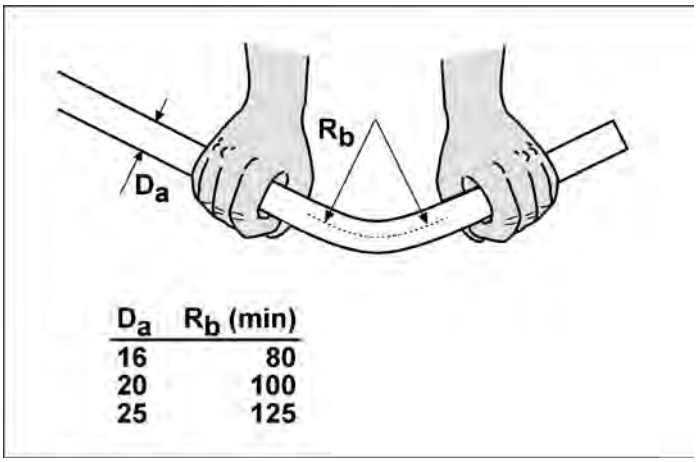
Up to the 20 mm size, TECElogo composite pipes can be bent by hand; from the 25 mm size, standard bending tools must be used.
The pipes can be bent with a minimum bending radius – corresponding to five times the pipe dimension basically - in the neutral phase.
If bending springs are used to install TECElogo pipes, the minimum bending radius can be reduced to four times the pipe size:



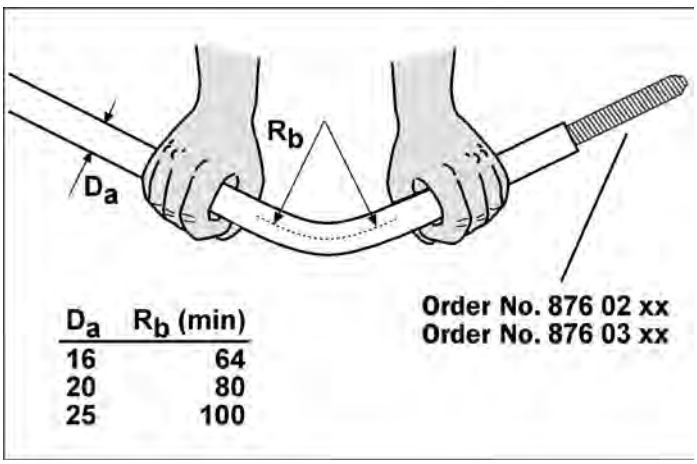
Minimum bending radius of the TECElogo composite pipes

Size	Minimum bending radius (mm)	
	w/o bending spring	with bending spring
16	80	64
20	100	80
25	125	100
32	160	–
40	200	–
50	250	–

Bending radii of TECElogo pipes



Bending radii – without using bending springs



Bending radii – using bending springs

Thermal linear expansion

Materials expand when heated and contract again when cooling down. Due to the large differences in temperature in the system, the pipes in a hot water and heating system must be fixed in such a way that linear expansion is compensated for in curves or special expansion bends.

Calculation of the thermal linear expansion

The thermal linear expansion is calculated using the following equation:

$\Delta l = \alpha \cdot l \cdot \Delta t$

Δl thermal linear expansion of pipe (mm)
α coefficient of linear expansion of TECElogo pipe
l initial length of pipe (m)
Δt temperature difference (K)*

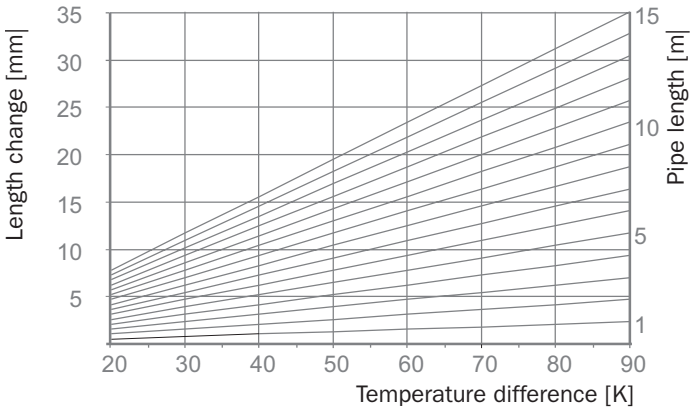
* K = Kelvin, the SI unit of temperature and relates to absolute zero.
(0 °C = 273.16 K)

Coefficient of expansion of the TECElogo pipes:
Composite pipes $\alpha = 0.026$ mm/(mK)

Example: A 12 metre long TECElogo heating pipe made of composite pipe is installed in winter at 5 °C.
Under operating conditions, 70 °C can occur.

l 12 m
Δt 70 K - 5 K = 65 K
α 0.026 mm/mK
$\Delta l = 0.026$ mm/mK · 12 m · 65 K = 20.28 mm

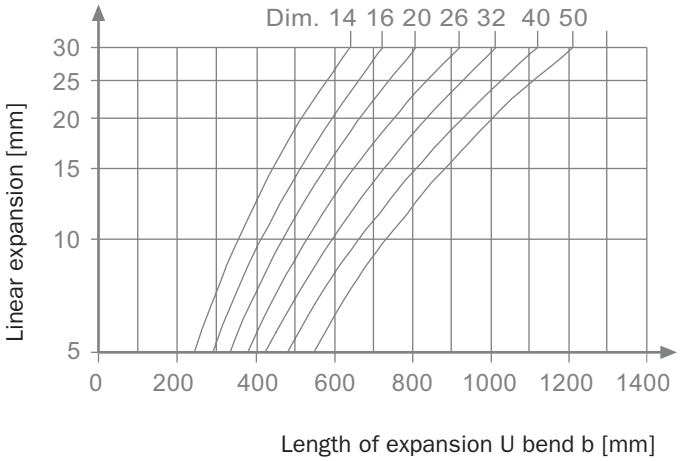
Result: The pipe will expand by about 20 mm.
The expansion must be compensated for by the structural conditions.
As an alternative, the thermal linear expansion can be looked up in the following diagram.



Thermal linear expansion of TECElogo composite pipes.

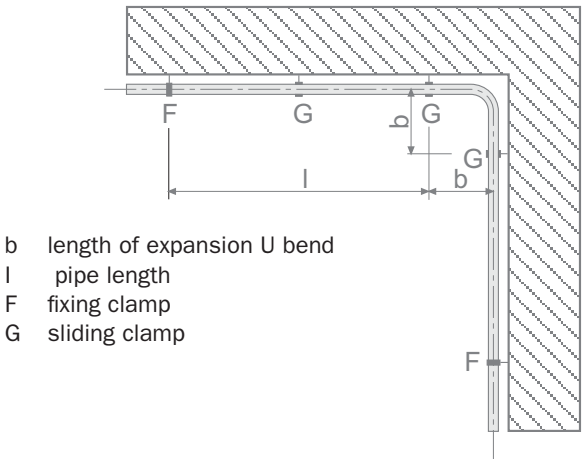
Calculation of the length of the expansion U bend

The length of the expansion U bend (b) can be taken from the following chart.



Length of the expansion U bend for TECElogo pipes

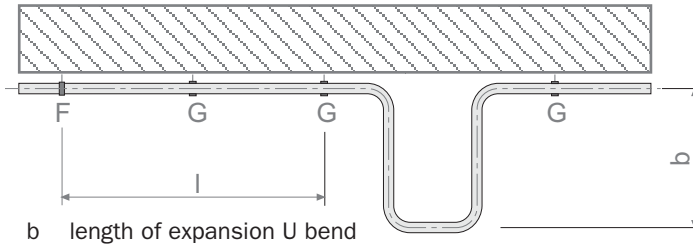
The pipe lengths in question may be limited by fixing and sliding clamps.



b length of expansion U bend
l pipe length
F fixing clamp
G sliding clamp

Compensation for the thermal linear expansion in a change of direction

In hot water or heating systems in particular, it is possible that the planned pipe layout does not allow enough movement space to take up the thermal linear expansion. In this case, compensation U bends must be planned, which reflect the length of the expansion U bend.



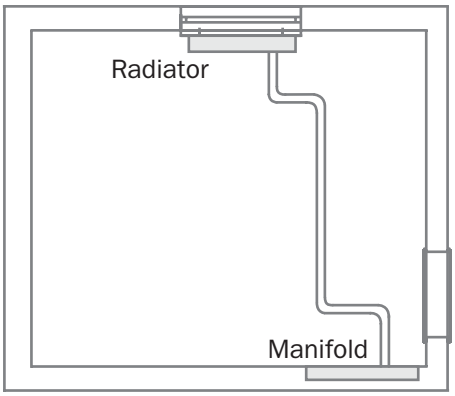
b length of expansion U bend
l pipe length
F fixing clamp
G sliding clamp

Compensation of the thermal expansion in length with an expansion bend

Example: The increase in length of the pipe calculated in the previous example is about 20 mm. The chart above can be used to determine the length of the expansion U bend b. For a TECElogo pipe of 20 mm size, a value of 670 mm is calculated. If a sliding clamp is fitted at least 670 mm in front of a bend, no additional expansion bend is required.

Special installation instructions with respect to linear expansion

- Make sure there is enough space to fit an expansion bend when connecting radiators to the pipes coming out of the floor or wall.
- The connection should always be made in a curve towards the radiator.



Example of laying, taking account of the linear expansion.

Attaching of pipes

Only the pipe clamps approved for the specific purpose may be used to fix TECElogo pipelines. Commercially available wall plugs can be used to fix the clamps, provided the components have sufficient mechanical strength. TECElogo pipes must not be secured to other pipe systems.

Layout of TECElogo pipes carrying water

The pipe layout of TECElogo pipes must be in compliance with the recognised rules of engineering. The quality of the potable water must not be affected by the pipe layout.

TECElogo surface-mounted pipework

The type of attachment and the spacing depends on the structural conditions on site. From the structural point of view, the pipework should be fixed in accordance with the recognised rules of engineering, taking into account full and insulated pipes.

TECElogo size	Spacing of attachment (m)
16	1
20	1.15
25	1.3
32	1.5
40	1.8
50	2.0

Spacing of attachments for surface-mounted TECElogo pipework.

TECElogo size	Pipe weight when full (kg/m)
16	0.22
20	0.34
25	0.53
32	0.86
40	1.35
50	2.08

Weights of TECElogo pipes

The pipes must be laid in such a way that moisture, drips or condensed water from other installations cannot affect them.

TECElogo concealed pipework

Depending on the wall structure or the quality of the masonry, the thermal expansion of a concealed TECElogo composite pipe may cause damage to the wall.
For this reason, TECE recommends providing all concealed TECElogo composite pipes with a pipe insulation. For this application, the company offers pre-insulated TECElogo pipes (PE-Xc only).

If no insulation is required, the composite pipes can be laid in corrugated pipe sheathings as an alternative. These pipes are also part of the TECElogo range.

Suitable sheathing must always be used to protect TECElogo fittings from contact with masonry, plaster, cement, screed, rapid binders or similar. Direct contact with the structural shell must be prevented because of the sound insulation requirements in accordance with German standard DIN 4109 and guideline VDI 4100.

TECElogo pipes in concrete or screed

The pipes are firmly encapsulated in concrete or screed so that the linear expansion of the pipe material is towards the inside. In this case, special measures are not required to compensate for the thermal linear expansion. If, however, the pipes are laid in the insulation layer between concrete and screed, they should be laid in such a way that the linear expansion to be expected is compensated for by the insulation or by a pipe layout incorporating a bend.
It is vital that the requirements relating to thermal protection and impact sound are observed. The applicable standards and guidelines must be adhered to. For this reason, it is advisable to lay the TECElogo pipes in a suitable compensating channel. The additional assembly height must be taken into account during planning. The fittings must be protected against corrosion.
A mounting distance of one metre maximum applies for TECElogo pipes, which are laid on unfinished floor or in the concrete floor. It must be ensured that the TECElogo pipes laid on the unfinished floor are not damaged by ladders, scaffolding, wheel-barrows, continuously being walked on or similar after they have been laid. The pipes must be checked immediately before the screed is laid.

TECElogo pipes passing through expansion joints

If pipes are passed through expansion joints of buildings, they must be laid in corrugated sheathing. The corrugated sheathing must protrude by at least 25 cm on either side. Pipe insulation with a wall thickness of at least 6 mm may be used as an alternative to the corrugated sheathing.

Pipe runs in the floor structure

For planning and laying of pipes in floor structures, the screed laying trade body has described how pipe-runs have to be carried out, in the guidelines "Pipes, cable and cable channels on unfinished floors". "Pipes laid in a floor must not cross, must be as straight as possible, must be laid parallel to each other and parallel to the wall. During the planning, heating and potable water pipes shall be given priority over electric cables and conduits."

- The pipes in a run should be arranged as close to each other as possible.
- The run for parallel pipes including pipe insulation should have a width of no more than 30 cm.
- A minimum distance of 20 cm must be maintained between the individual runs. The minimum distance between a run and a wall is 20 cm.
- The dimensions given above should be maintained in front of distribution cabinets if possible.
- In the area of doors, the distance to the reveal should be at least 10 cm.

Pipes of different diameters or other assemblies within a run must be evened out in such a way that a flat support area is created for impact-sound insulation.

Sound insulation

German standard DIN 4109 defines rooms requiring sound insulation as being those rooms in which persons have to be protected against outside noise, noise from neighbouring rooms and noises caused by building service facilities.

Relevant standards

German standard DIN 4109 entitled "Sound insulation in building constructions" dated November 1989:

- Governs the requirements for structural sound insulation
- Sound insulation does not mean that noise must be completely prevented
- Requirements are different depending on the building use and the room use

German standard DIN 4109/A1 (change A1) dated January 2001:

- The requirements relating to installation noise have been made stricter:
  Living rooms and bedrooms 30 dB(A)
  Teaching rooms and offices 35 dB(A).
- Individual short-term noise peaks during actuation of fittings and devices (opening, closing, resetting, interruption, etc.) are not taken into consideration

Note:

DIN 4109 is no longer valid as an accepted technical regulation! For this reason, VDI 4100 is hereby referred to.

VDI 4100 "Sound insulation of dwellings" dated August 2007 was issued as supplementary to DIN 4109.
DIN 4109 has gained legitimate public significance because of the building authority introduction.
Implementations according to VDI 4100 are therefore to be understood as a private law agreement between the building owner and those persons involved in the construction.

- VDI 4100 makes a distinction between 3 sound insulation levels (SSt)
- SSt 1 corresponds to the requirements of DIN 4109, this is regarded as the absolutely minimum value for sound insulation in dwellings.
- SSt 2 to 3 describe higher requirements for sound insulation in dwellings.

The constructional sound insulation should be agreed contractually. At least SSt 2 is recommended

Space requiring sound insulation

The plumbing noise level requirements according to DIN 4109 refer to the "room needing protection" in a third-party living area.
The following are classified as requiring sound insulation:

- Living spaces (including hall-cum-living rooms)
- Bedrooms (including hotels and care homes).
- Classrooms and
- Offices (except open-plan offices)

Not needing protection in the sense of DIN 4109 (only for plumbing noise) include for instance:

- Own living area
- The room in which the sanitary item causing the noise is located
- "Loud" rooms in third-party living areas (e.g. bathroom, kitchen),
- Rooms in which people are not expected to stay constantly (such as cellars, storage rooms) and
- Open-plan offices.

Sound-insulated installation of the TECElogo system

For a water-bearing pipe, the main attention must be given to structure-borne noise. For this reason, the installation has to be decoupled from the building.

- Use of pipe attachments that insulate structure-borne noise.
- Pipes that pass through screed or are laid in masonry must be provided with an insulation of at least 9 mm. The TECElogo range offers suitably pre-insulated pipes up to the 20 mm size (only PE-Xc). Corrugated pipe sheathings used for protection do not offer sufficient sound insulation.
- Compared to building walls, dry-wall curtain wall installations, such as TECEprofil, offer improved sound insulation for sanitary objects as they are decoupled from the building.
- Group 1 fittings – with a noise level of Lap ≤ 20 db(A) as defined by German standard DIN 52218 – should be given preference over group 2 fittings.
- Install potable water and heating systems on sufficiently heavy walls with a weight of at least 220 kg/m².
- A pressure at rest of 5 bar should not be exceeded.
- The permitted discharge rate for for fittings should be adhered to.
- Whenever possible, water-bearing pipes should not be installed on walls of rooms requiring sound insulation.

Fire protection

Wherever fire protection regulations have to be observed, pipes may be passed through walls, ceilings, etc. only if there is no danger of the transfer of fire and smoke or precautions have been taken to avoid this happening (Model Building Regulations, MBO § 37).
In these constructions, only approved pipe feedthroughs or insulation materials may be used.
These prerequisites are met if the requirements of the model pipe system guideline is met.
Only non-combustible insulation materials of material class A1 and A2, flame-retardant building materials B1 and normally flammable building materials B2 may be used. Easily flammable building materials B3 are forbidden.
TECE recommends the fire protection solutions produced by the companies Armacell and Rockwool. These are sufficiently described in the respective processing instructions. For more information, please refer to the websites www.armacell.de and www.rockwool.de.
If and when required, seek advice from the competent fire protection officer or engineer to clarify detailed questions.

Planning and layout

TECElogo system can be used for potable water and heating systems. Every application puts special demands on the installation system, and this must be given due consideration during the planning phase.

Insulation of potable water and heating pipes

The insulation of pipe systems, fittings and devices has to meet requirements concerning heat dissipation, heat absorption, sound insulation, protection against corrosion, fire protection and, if and when applicable, the compensation of thermal linear expansion, among other things. The insulation has to be chosen so as to meet the respective purposes.
No insulating materials may be used which may cause chemical corrosion or contact corrosion in fittings or pipes.

Insulation against frost

If water-bearing pipe systems are passed through areas prone to frost, they have to be insulated at least in accordance with the German Energy Saving Ordinance (EnEV). If longer stagnation occurs, the pipes may freeze despite insulation. Trace heating should be used here, if and when applicable.

Insulation against heating

Cold water-bearing potable water systems have to be protected against being heated in accordance with German standard DIN 1988-2. At the tapping points, the temperature of the potable water must not exceed 25° C. If and when required, the pipes have to be protected against condensation.
If there is a risk of dampness penetrating the insulating materials, such as condensate in cold-water pipe systems, diffusion-tight insulating materials have to be used.
The potable water pipes must be laid a sufficient distance away from any warm pipes. The installation on warm structural elements, such as a chimney or a heated wall, should be avoided.

Under the usual operating conditions in housing construction, the insulation thicknesses mentioned in the table below can be used. In case of long stagnation periods, however, they do not offer any protection against warming up of the potable water. The insulation thicknesses shown in the table are also suitable for protection against condensation at a potable water temperature of 10 °C. Protection against condensation is not required if the TECElogo pipe-in-pipe system is used. The TECElogo range offers pre-insulated pipes with insulation thicknesses of 9 mm and 13 mm.

Laying conditions of the pipe system	Insulation thickness at λ = 0.040 W/(mK)*
Exposed, in unheated rooms	4 mm
Freely laid in heated rooms	9 mm
In a channel without heated pipes	4 mm
In a channel next to heated pipes	13 mm
In recesses next to heated pipes	4 mm
In recesses next to heated pipes	13 mm
On concrete ceilings	4 mm
For other thermal conductivities, the insulation thicknesses must be calculated accordingly, relative to diameter d = 20 mm.	

Guideline values for minimum insulation thicknesses for insulating potable water pipe systems (cold).

Insulation of hot water and heat distribution lines

Hot-water-bearing pipe systems have to be protected against heat dissipation. The requirements relating to insulation are defined in the German Energy Saving Ordinance (EnEV), attachment 5.

Excerpt from the German Energy Saving Ordinance (EnEV), attachment 5:

"1. The heat dissipation of heat distribution lines and hot-water lines as well as fittings has to be limited by insulation in compliance with Table 1."

If the pipes for central heating systems as described in lines 1 to 4 are in heated spaces or in components between a user's heated spaces and their heat dissipation can be influenced by a freely accessible shut-down device, no requirements are specified for the minimum thickness of the insulation. This also applies for TECElogo hot water lines in flats up to a size of 25 mm which are neither included in the circulation system nor are fitted with an electric trace heating.

"3. In the case of materials with thermal conductivities other than 0.035 W/(m·K) the minimum insulation thicknesses have to be calculated correspondingly."

The pre-insulated TECElogo PE-Xc pipes with 9 mm or 13 mm insulation thicknesses (only up to size 20 mm) correspond to the insulation required in line 7."

Line	Type of pipe system / fittings	Minimum thickness of the insulation relative to a thermal conductivity of 0.035 W/(m·K)
1	Internal diameter up to 22 mm	20 mm
2	Internal diameter over 22 mm to 35 mm	30 mm
3	Internal diameter over 35 mm to 100 mm	same as internal diameter
4	Internal diameter over 100 mm	100 mm
5	Pipe systems and fittings in conformity with lines (1) to (4) in wall and ceiling breakthroughs, in the intersection area of pipe systems, at pipe joining point, in central distribution lines	½ of the requirements specified in lines 1 to 4
6	Pipe systems and fittings in conformity with lines (1) to (4), which are laid in building parts between heated rooms of different users after the effective date of this ordinance	½ of the requirements specified in lines 1 to 4
7	Pipes according to line (6) in floor construction	6 mm
8	Cooling distribution pipes and cold water pipes as well as fittings of ventilation and air-conditioning systems	6 mm

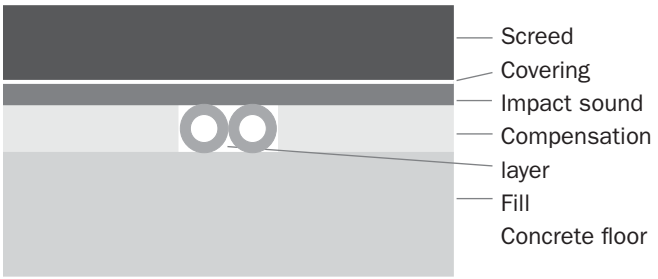
EnEV 2009 attachment 5, table 1: Heat insulation of heat distribution pipes and hot water pipes, cooling distribution pipes and cold water pipes as well as fittings

Type of pipe	Multi-family house	Rooms of a user, also detached house	Commercial building, several users
Potable water - hot			
Hot water in circulation system or with trace heating; pipes of all nominal widths, concealed or exposed	100%, lines 1 to 4	100%, lines 1 to 4	100%, lines 1 to 4
Circulation systems, concealed or exposed	100%, lines 1 to 4	100%, lines 1 to 4	100%, lines 1 to 4
Hot water without circulation and without trade heating; pipes up to size 22 mm, concealed or exposed (in accordance with DVGW worksheet W 551 maximum pipe contents 3 litres)	Without insulation requirements in accordance with EnEV; sheathing may be required for other reasons	Without insulation requirements in accordance with EnEV; sheathing may be required for other reasons	100%, lines 1 to 4
	Recommendation: Consultation, information of the building owner, conclusion of contractual agreement		
Pipes and fittings in wall and ceiling openings, in the intersection area of pipelines, at line connection points, in central line distributors	50%, line (5)	50%, line (5)	50%, line (5)
Heating			
Pipe system exposed/surface-mounted in heated spaces	100%, lines 1 to 4	Without insulation no. 1, paragraph below Table 1	100%, lines 1 to 4
Pipe system in channel/concealed between heated spaces of different users	50%, line (6)		50%, line (6)
Pipe system exposed/in channel/concealed in unheated spaces and in building parts adjacent to unheated spaces	100%, lines 1 to 4	100%, lines 1 to 4	100%, lines 1 to 4
Pipes laid in flooring, also radiator connection lines between heated spaces	6 mm, line 7 Note: for the usual insulation materials with λ 0.04 . 9 mm	Without insulation Section no. 1 below table (1)	6 mm, line 7 Note: for the usual insulation materials with λ 0.04 . 9 mm
Pipes laid in flooring, also radiator connection lines between ground / heated rooms	100%, lines 1 to 4	100%, lines 1 to 4	100%, lines 1 to 4

Application example for insulation of hot-water and heating pipe systems against heat loss.

Insulation of pipes laid in the floor structure

German standard DIN 18560-2 stipulates that impact sound insulation has to be laid over the entire area and without interruptions. If the pipes are laid on the bare concrete, a suitable compensation layer has to be applied up to the height of the upper edge of the pipe including pipe insulation. The impact sound insulation can then be laid on top of this.



Application example for a TECElogo pipe system in the floor structure

Example:
According to Table 1, attachment 5 of the German Energy Saving Ordinance (EnEV), heating pipes in the floor structure have to be provided with 6 mm of insulation. Thus, a TECElogo pipe with a diameter of 16 mm would have an outside diameter of 28 mm. In this case, a compensating insulation EPS 035 DEO dh 30 mm (previously PS 20 WLG 035 or: heat-insulation board made of quality-assured polystyrene foam in accordance with DIN EN 13163 and DIN 4108; compression strain at 10% compression ≥ 150 kPa; B building material class B1 in accordance with DIN 4102) or an alternative insulating material may be used. The heat-insulation boards are laid up to the pipework. The spaces between have to be filled with a suitable fill. The impact sound insulation can then be laid on top of this construction. For example, an EPS insulation of type DR 30-2 is suitable. It is to be ensured that an impact-sound layer only is applied. In order to minimize the effect of thermal bridges, the insulating material has to be applied in a joint-tight layer.
If the TECElogo heating pipes can be laid in a compensation layer, they can also be laid in the impact-sound insulation as the insulation of the pre-insulated TECElogo pipes have been provided with a proof of suitability in accordance with German standard DIN 18560-2.
This can be downloaded from the website www.tece.com.
If other insulating materials are used, a corresponding proof of suitability has to be obtained from the supplier of the insulating material.

Dimensioning of potable water systems

DIN 1988, DIN EN 806, DVGW worksheets W551 and W553 as well as VDI 6063 apply for planning and setting up potable water systems. The potable water systems have to be designed in such a way that they meet hygienic and hydraulic specifications.

Hygienic requirements

A potable water system has to ensure that the water removed at the tapping point meets the requirements of the German Ordinance on Potable Water. If the potable water parameters meet the requirements of the German Ordinance on Potable Water (please also refer to the chapter titled "Potable water installation"), it is improbable that metallic ions have been dissolved into the potable water by the TECElogo fittings. The biological suitability of the TECElogo system is substantiated by the type approval of the German Technical and Scientific Association for Gas and Water (DVGW). The technical measures to be taken to reduce the growth of Legionella as well as the planning, operation and restoration of potable water systems are described in the DVGW Worksheet W 551.
The following points have to be observed during planning work:

Documentation

DVGW Worksheet W551 requires documentation of the potable water system. This has to be prepared for new systems as well as for modifications to existing systems. If no documents are available for potential restoration work, an inventory has to be carried out. The documentation has to comprise installation inventories, plant descriptions, plant data and the maintenance and operating instructions. It has to be handed over to the plant operator when the potable water system is started up.

Circulation lines

Circulation lines must always be planned if the water volume of the line from the water heater to the tapping point is greater than three litres. Storey feeds and/or individual feeds with water volume of up to three litres can be constructed without a circulation line. The "three-litre rule" is considered the upper limit; smaller volumes are to be aimed for.

TECElogo ∅ (mm)	Water volume per metre (litres)	Pipe length with a volume of 3 litres (m)
16	0.11	27.27
20	0.19	15.79
25	0.31	9.68
32	0.53	5.66
40	0.80	3.75
50	1.31	2.29

Water volume of TECElogo pipe systems

Circulation lines are to be laid directly up to the straight-way mixer taps.

Circulation systems and self-regulating trace heating systems must be operated so that the water temperature in the system is not more than 5 K below the hot water outlet temperature of the water heater. For reasons of hygiene, a water outlet temperature at the water heater of 60° C should be aimed for. A high water temperature could reduce the service life of the PE-RT pipes over the long term. In this case, we recommend the use of PE-Xc composite pipes which offer sufficient long-term performance in potable water circulation lines. In hygienically perfect conditions, circulation systems can be operated at lower temperatures for a maximum of 8 hours every 24 hours in order to save energy.
Gravity circulation systems are not recommended for hygiene reasons.

Pipework systems
The hot-water system must be designed so that nowhere in the whole system does the temperature fall below 55 °C.
Pipework not required should be severed directly at the outlet. It is necessary to check whether hot-water lines for rarely used tapping points can be disconnected and these tapping points can be supplied by decentralized water heaters.
Shut-off fittings in drain lines have to be fitted directly on the main line. Connecting pipes to vents and breathers should be disconnected in the case of collector-unit backflow prevention systems. Fittings with single-unit backflow prevention should be installed.
In order to achieve the necessary temperature in pipework with a circulation system, control valves are usually required for hydraulic compensation.

Connection to flow heaters and water heaters
Unregulated or hydraulically controlled flow heaters may damage the connected TECElogo pipe through high pressure and excess temperatures.
TECElogo must only be directly connected to electronically controlled devices. In case of uncontrolled devices, a metal pipe with a minimum length of one metre must be fitted in between. The manufacturer’s instructions of the flow heaters must be observed.

Caution: Hot-water tanks heated by a solar system or solid-fuelled boilers may reach temperatures above 100° C ! In this case, a temperature-limiting safety fitting must be installed upstream of the TECElogo pipework.

Hydraulic set-up

Potable water systems using TECElogo should be dimensioned and planned on the basis of German standard DIN 1988, Part 3 entitled "Technical Rules for Potable Water Installations – Determination of Pipe Diameters, Technical Rules of DVGW". For product-specific data, please refer to the illustrations and tables below. The first table shows the loss coefficient values for TECElogo fittings, the second table shows the minimum flow pressures and calculation flow rates of conventional water withdrawal fittings.

Type of potable water withdrawal point	DN	Minimum flow pressure	In case of dual-purpose water withdrawal each		In case of withdrawal of cold or
		$P_{min\ FL}$ [bar]	cold $\dot{V}_R$ FL [l/s]	hot $\dot{V}_R$ [l/s]	hot water $\dot{V}_R$ [l/s]
Kitchen fittings					
Sink mixer tap	15	1	0.07	0.07	-
Household washing machine	15	1	-	-	0.25
Household dishwasher	10	1	-	-	0.15
Tap with aerator	10	1	-	-	0.15
Tap with aerator	15	1	-	-	0.15
Bathroom fittings					
Bathtub mixer tap	15	1	0.15	0.15	-
Shower mixer tap	15	1	0.15	0.15	-
Shower heads for cleaning showers	15	1	0.1	0.1	0.2
Washbasin mixer tap	15	1	0.07	0.07	-
Bidet mixer tap	15	1	0.07	0.07	-
Toilet flush handles					
Cistern (in acc. with German standard DIN 19542)	15	0.5	-	-	0.13
Flush valve (to DIN 3265 part 1)	15	1.2	-	-	0.7
Flush valve (to DIN 3265 part 1)	20	1.2	-	-	1
Flush valve (to DIN 3265 part 1)	25	0.4	-	-	1
Urinal flush valve	15	1	-	-	0.3
Individual potable water heater					
Electric water boiler	15	1	-	-	0.1
Special fittings					
Taps without aerator	15	0.5	-	-	0.3
Taps without aerator	20	0.5	-	-	0.5
Taps without aerator	25	0.5	-	-	1
Mixer tap	20	1	0.3	0.3	-

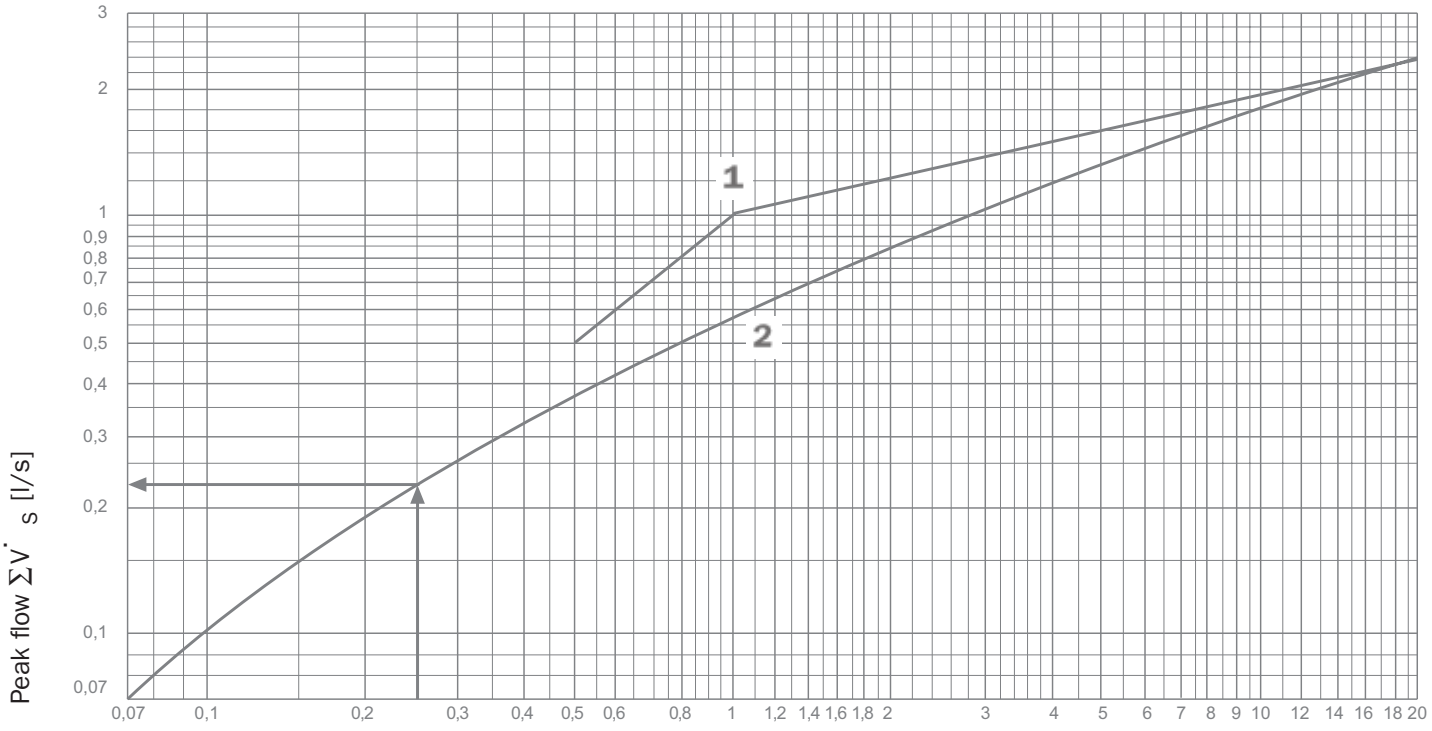
Minimum flow pressures and calculation flow rates of conventional water withdrawal fittings (if fittings are not listed, see manufacturer's specifications)

The following illustration shows the loss coefficients of TECElogo fittings:

Fitting	Version	Zeta value	Equivalent pipe length (m)
Reducing fitting	16 mm	1.8	0.8
Coupler	16 mm	1.2	0.6
Elbow	16 mm	4.4	2.0
Tee DG	16 mm	1.2	0.6
Tee AG	16 mm	5.2	2.4
Reducing fitting	20 mm	1.2	0.8
Coupler	20 mm	0.8	0.5
Elbow	20 mm	3.0	1.9
Tee DG	20 mm	0.8	0.5
Tee AG	20 mm	3.6	2.3
Reducing fitting	25 mm	1.1	1.0
Coupler	25 mm	0.8	0.7
Elbow	25 mm	2.8	2.4
Tee DG	25 mm	0.8	0.7
Tee AG	25 mm	3.2	2.7

Loss coefficients of TECElogo fittings

The illustration below shows the performance map for calculating the peak flows ($\dot{V}_S$) from the cumulative flow ($\dot{V}_R$) for residential buildings, office and administration buildings up to a cumulative flow ($\Sigma\dot{V}_R$) of 20 l/sec.



1 for calculation flow rate $\dot{V}_R \geq 0.5$ l/s applicable for flush valves

2 for calculation flow rate $\dot{V}_R < 5$ l/s applicable for cisterns

Pressure loss tables in potable water installations – sizes 16 / 20 / 25 mm

TECElogo composite pipes – pressure losses caused by pipe resistance in potable water installations									
Water velocity	Size 16			Size 20			Size 25		
	V	m	R	V	m	R	V	m	R
			hPa/m			hPa/m			hPa/m
m/s	l/s	kg/h	mbar/m	l/s	kg/h	mbar/m	l/s	kg/h	mbar/m
0.10	0.011	40.7	0.3	0.019	67.9	0.2	0.031	113.1	0.1
0.20	0.023	81.4	0.6	0.038	135.9	0.6	0.063	226.2	0.4
0.30	0.034	122.1	1.7	0.057	203.8	1.2	0.094	339.3	0.9
0.40	0.045	162.9	2.8	0.075	271.7	2.0	0.126	452.4	1.4
0.50	0.057	203.6	4.1	0.094	339.6	2.9	0.157	565.5	2.1
0.60	0.068	244.3	5.6	0.113	407.6	4.0	0.188	678.6	2.9
0.70	0.079	285.0	7.3	0.132	475.5	5.2	0.220	791.7	3.8
0.80	0.090	325.7	9.2	0.151	543.4	6.6	0.251	904.8	4.8
0.90	0.102	366.4	11.2	0.170	611.4	8.1	0.283	1017.9	5.9
1.00	0.113	407.2	13.5	0.189	679.3	9.8	0.314	1131.0	7.1
1.10	0.124	447.9	16.0	0.208	747.2	11.6	0.346	1244.1	8.4
1.20	0.136	488.6	18.6	0.226	815.1	13.5	0.377	1357.2	9.8
1.30	0.147	529.3	21.4	0.245	883.1	15.5	0.408	1470.3	11.3
1.40	0.158	570.0	24.4	0.264	951.0	17.7	0.440	1583.4	12.9
1.50	0.170	610.7	27.6	0.283	1018.9	20.0	0.471	1696.5	14.5
1.60	0.181	651.4	31.0	0.302	1086.9	22.4	0.503	1809.6	16.3
1.70	0.192	692.2	34.5	0.321	1154.8	25.0	0.534	1922.7	18.2
1.80	0.204	732.9	38.2	0.340	1222.7	27.7	0.565	2035.8	20.1
1.90	0.215	773.6	42.0	0.359	1290.7	30.5	0.597	2148.8	22.2
2.00	0.226	814.3	46.0	0.377	1358.6	33.4	0.628	2261.9	24.3
2.10	0.238	855.0	50.2	0.396	1426.5	36.4	0.660	2375.0	26.5
2.20	0.249	895.7	54.6	0.415	1494.4	39.6	0.691	2488.1	28.8
2.30	0.260	936.4	59.1	0.434	1562.4	42.9	0.723	2601.2	31.2
2.40	0.271	977.2	63.8	0.453	1630.3	46.3	0.754	2714.3	33.7
2.50	0.283	1017.9	68.6	0.472	1698.2	49.8	0.785	2827.4	36.3
2.60	0.294	1058.6	73.6	0.491	1766.2	53.5	0.817	2940.5	39.0
2.70	0.305	1099.3	78.8	0.509	1834.1	57.2	0.848	3053.6	41.7
2.80	0.317	1140.0	84.1	0.528	1902.0	61.1	0.880	3166.7	44.6
2.90	0.328	1180.7	89.6	0.547	1969.9	65.1	0.911	3279.8	47.5
3.00	0.339	1221.5	95.3	0.566	2037.9	69.2	0.942	3392.9	50.5
3.10	0.351	1262.2	101.1	0.585	2105.8	73.5	0.974	3506.0	53.6
3.20	0.362	1302.9	107.0	0.604	2173.7	77.8	1.005	3619.1	56.8
3.30	0.373	1343.6	113.1	0.623	2241.7	82.3	1.037	3732.2	60.0
3.40	0.385	1384.3	119.4	0.642	2309.6	86.9	1.068	3845.3	63.4
3.50	0.396	1425.0	125.9	0.660	2377.5	91.6	1.100	3958.4	66.8
3.60	0.407	1465.7	132.5	0.679	2445.4	96.4	1.131	4071.5	70.3
3.70	0.418	1506.5	139.2	0.698	2513.4	101.3	1.162	4184.6	73.9
3.80	0.430	1547.2	146.1	0.717	2581.3	106.3	1.194	4297.7	77.6
3.90	0.441	1587.9	153.2	0.736	2649.2	111.5	1.225	4410.8	81.4
4.00	0.452	1628.6	160.4	0.755	2717.2	116.7	1.257	4523.9	85.2
4.10	0.464	1669.3	167.8	0.774	2785.1	122.1	1.288	4637.0	89.1
4.20	0.475	1710.0	175.3	0.793	2853.0	127.6	1.319	4750.1	93.2
4.30	0.486	1750.7	183.0	0.811	2921.0	133.2	1.351	4863.2	97.3
4.40	0.498	1791.5	190.8	0.830	2988.9	138.9	1.382	4976.3	101.4
4.50	0.509	1832.2	198.8	0.849	3056.8	144.7	1.414	5089.4	105.7
4.60	0.520	1872.9	206.9	0.868	3124.7	150.7	1.445	5202.5	110.0
4.70	0.532	1913.6	215.2	0.887	3192.7	156.7	1.477	5315.6	114.5
4.80	0.543	1954.3	223.7	0.906	3260.6	162.9	1.508	5428.7	119.0
4.90	0.554	1995.0	232.3	0.925	3328.5	169.2	1.539	5541.8	123.6
5.00	0.565	2035.8	241.0	0.943	3396.5	175.5	1.571	5654.9	128.2

Pressure loss tables in potable water installations – sizes 32 / 40 / 50 mm

TECElogo composite pipes – pressure losses caused by pipe resistance in potable water installations									
Water velocity	Size 32			Size 40			Size 50		
	V	m	R	V	m	R	V	m	R
			hPa/m			hPa/m			hPa/m
m/s	l/s	kg/h	mbar/m	l/s	kg/h	mbar/m	l/s	kg/h	mbar/m
0.10	0.053	191.1	0.1	0.080	289.5	0.1	0.132	475.3	0.1
0.15	0.080	286.7	0.2	0.121	434.3	0.1	0.198	712.9	0.1
0.20	0.106	382.3	0.3	0.161	579.1	0.2	0.264	950.6	0.2
0.25	0.133	477.8	0.5	0.201	723.8	0.3	0.330	1188.2	0.3
0.30	0.159	573.4	0.6	0.241	868.6	0.5	0.396	1425.9	0.3
0.35	0.186	669.0	0.8	0.281	1013.4	0.6	0.462	1663.5	0.5
0.40	0.212	764.5	1.0	0.322	1158.1	0.8	0.528	1901.2	0.6
0.45	0.239	860.1	1.3	0.362	1302.9	1.0	0.594	2138.8	0.7
0.50	0.265	955.7	1.5	0.402	1447.6	1.2	0.660	2376.5	0.8
0.55	0.292	1051.2	1.8	0.442	1592.4	1.4	0.726	2614.1	1.0
0.60	0.319	1146.8	2.1	0.483	1737.2	1.6	0.792	2851.7	1.2
0.65	0.345	1242.4	2.4	0.523	1881.9	1.8	0.858	3089.4	1.3
0.70	0.372	1337.9	2.7	0.563	2026.7	2.1	0.924	3327.0	1.5
0.75	0.398	1433.5	3.1	0.603	2171.5	2.4	0.990	3564.7	1.7
0.80	0.425	1529.1	3.4	0.643	2316.2	2.6	1.056	3802.3	1.9
0.85	0.451	1624.6	3.8	0.684	2461.0	2.9	1.122	4040.0	2.2
0.90	0.478	1720.2	4.2	0.724	2605.8	3.3	1.188	4277.6	2.4
0.95	0.504	1815.8	4.7	0.764	2750.5	3.6	1.254	4515.3	2.6
1.00	0.531	1911.3	5.1	0.804	2895.3	3.9	1.320	4752.9	2.9
1.05	0.557	2006.9	5.6	0.844	3040.1	4.3	1.386	4990.6	3.2
1.20	0.637	2293.6	7.0	0.965	3474.4	5.4	1.584	5703.5	4.0
1.30	0.690	2484.7	8.1	1.046	3763.9	6.3	1.716	6178.8	4.6
1.43	0.761	2739.6	9.7	1.153	4149.9	7.5	1.892	6812.5	5.5
1.50	0.796	2867.0	10.5	1.206	4342.9	8.1	1.980	7129.4	6.0
1.60	0.849	3058.2	11.8	1.287	4632.5	9.1	2.112	7604.7	6.7
1.70	0.903	3249.3	13.1	1.367	4922.0	10.1	2.244	8080.0	7.5
1.80	0.956	3440.4	14.5	1.448	5211.5	11.2	2.376	8555.2	8.3
1.90	1.009	3631.6	16.0	1.528	5501.1	12.4	2.508	9030.5	9.1
2.00	1.062	3822.7	17.6	1.608	5790.6	13.6	2.641	9505.8	10.0
2.10	1.115	4013.8	19.2	1.689	6080.1	14.8	2.773	9981.1	11.0
2.20	1.168	4205.0	20.8	1.769	6369.6	16.1	2.905	10456.4	11.9
2.30	1.221	4396.1	22.6	1.850	6659.2	17.5	3.037	10931.7	12.9
2.40	1.274	4587.2	24.4	1.930	6948.7	18.9	3.169	11407.0	13.9
2.50	1.327	4778.4	26.3	2.011	7238.2	20.3	3.301	11882.3	15.0
2.60	1.380	4969.5	28.2	2.091	7527.8	21.8	3.433	12357.6	16.1
2.70	1.434	5160.6	30.2	2.171	7817.3	23.4	3.565	12832.9	17.3
2.80	1.487	5351.8	32.2	2.252	8106.8	25.0	3.697	13308.2	18.5
2.90	1.540	5542.9	34.4	2.332	8396.3	26.6	3.829	13783.5	19.7
3.00	1.593	5734.0	36.5	2.413	8685.9	28.3	3.961	14258.7	20.9
3.60	1.911	6880.8	50.9	2.895	10423.1	39.5	4.753	17110.5	29.2
4.00	2.124	7645.4	61.7	3.217	11581.2	47.9	5.281	19011.7	35.4
4.60	2.442	8792.2	79.8	3.700	13318.3	61.9	6.073	21863.4	45.8
5.00	2.655	9556.7	93.0	4.021	14476.5	72.2	6.601	23764.6	53.4

Pressure loss tables in heating installations – sizes 16 / 20 / 25 mm

TECElogo composite pipes – pressure loss caused by pipe resistance in heating installations										
Connected load (W)				Mass flow	Size 16		Size 20		Size 25	
					v	R	v	R	v	R
Spread (K)						hPa/m		hPa/m		hPa/m
20 K	15 K	10 K	5 K	kg/h	m/s	mbar/m	m/s	mbar/m	m/s	mbar/m
200	150	100	50	8.60	0.02	0.06				
300	225	150	75	12.90	0.03	0.09				
400	300	200	100	17.20	0.04	0.12				
600	450	300	150	25.80	0.06	0.18				
800	600	400	200	34.39	0.08	0.25				
1000	750	500	250	42.99	0.11	0.31				
1200	900	600	300	51.59	0.13	0.37				
1400	1050	700	350	60.19	0.15	0.43				
1600	1200	800	400	68.79	0.17	0.49				
1800	1350	900	450	77.39	0.19	0.55				
2000	1500	1000	500	85.98	0.21	0.61	0.13	0.22		
2300	1725	1150	575	98.88	0.24	0.71	0.15	0.25		
2800	2100	1400	700	120.38	0.30	1.65	0.18	0.31		
3000	2250	1500	750	128.98	0.32	1.86	0.19	0.33		
3500	2625	1750	875	150.47	0.37	2.42	0.22	0.72		
4000	3000	2000	1000	171.97	0.42	3.04	0.25	0.91	0.15	0.27
4500	3375	2250	1125	193.47	0.48	3.72	0.28	1.11	0.17	0.33
5000	3750	2500	1250	214.96	0.53	4.46	0.32	1.33	0.19	0.40
5500	4125	2750	1375	236.46	0.58	5.26	0.35	1.56	0.21	0.47
6000	4500	3000	1500	257.95	0.63	6.11	0.38	1.82	0.23	0.55
6500	4875	3250	1625	279.45	0.69	7.02	0.41	2.08	0.25	0.63
7000	5250	3500	1750	300.95	0.74	7.98	0.44	2.37	0.27	0.71
7500	5625	3750	1875	322.44	0.79	9.00	0.47	2.67	0.29	0.80
8000	6000	4000	2000	343.94	0.85	10.07	0.51	2.98	0.30	0.89
8500	6375	4250	2125	365.43	0.90	11.20	0.54	3.31	0.32	0.99
9000	6750	4500	2250	386.93	0.95	12.37	0.57	3.66	0.34	1.09
9500	7125	4750	2375	408.43	1.00	13.60	0.60	4.02	0.36	1.20
10000	7500	5000	2500	429.92			0.63	4.39	0.38	1.31
10500	7875	5250	2625	451.42			0.66	4.78	0.40	1.42
11000	8250	5500	2750	472.91			0.70	5.18	0.42	1.54
11500	8625	5750	2875	494.41			0.73	5.60	0.44	1.67
12500	9375	6250	3125	537.40			0.79	6.48	0.48	1.93
13000	9750	6500	3250	558.90			0.82	6.94	0.49	2.06
14000	10500	7000	3500	601.89			0.89	7.90	0.53	2.35
15000	11250	7500	3750	644.88					0.57	2.65
16000	12000	8000	4000	687.88					0.61	2.96
17000	12750	8500	4250	730.87					0.65	3.29
18000	13500	9000	4500	773.86					0.68	3.64
19000	14250	9500	4750	816.85					0.72	4.00
20000	15000	10000	5000	859.85					0.76	4.37
22000	16500	11000	5500	945.83					0.84	5.17

Pressure loss tables in heating installations – sizes 32 / 40 / 50 mm

TECElogo composite pipes – pressure loss caused by pipe resistance in heating installations										
Connected load (W)				Mass flow	Size 32		Size 40		Size 50	
					v	R	v	R	v	R
Spread (K)						hPa/m		hPa/m		hPa/m
20 K	15 K	10 K	5 K	kg/h	m/s	mbar/m	m/s	mbar/m	m/s	mbar/m
7000	5250	3500	1750	300.95	0.18	0.30				
7500	5625	3750	1875	322.44	0.20	0.34				
8000	6000	4000	2000	343.94	0.21	0.38				
8500	6375	4250	2125	365.43	0.22	0.42				
9000	6750	4500	2250	386.93	0.24	0.46				
9500	7125	4750	2375	408.43	0.25	0.51				
10000	7500	5000	2500	429.92	0.26	0.55				
10500	7875	5250	2625	451.42	0.28	0.60				
11000	8250	5500	2750	472.91	0.29	0.65	0.16	0.17		
11500	8625	5750	2875	494.41	0.30	0.70	0.17	0.18		
12500	9375	6250	3125	537.40	0.33	0.81	0.19	0.21		
13000	9750	6500	3250	558.90	0.34	0.87	0.19	0.22		
14000	10500	7000	3500	601.89	0.37	0.99	0.21	0.25		
15000	11250	7500	3750	644.88	0.40	1.11	0.22	0.28		
16000	12000	8000	4000	687.88	0.42	1.24	0.24	0.32		
17000	12750	8500	4250	730.87	0.45	1.38	0.25	0.35		
18000	13500	9000	4500	773.86	0.48	1.53	0.27	0.39		
19000	14250	9500	4750	816.85	0.50	1.68	0.28	0.43		
20000	15000	10000	5000	859.85	0.53	1.84	0.30	0.47		
22000	16500	11000	5500	945.83	0.58	2.17	0.33	0.55		
24000	18000	12000	6000	1031.81	0.63	2.52	0.36	0.64		
26000	19500	13000	6500	1117.80	0.69	2.90	0.39	0.74		
28000	21000	14000	7000	1203.78	0.74	3.31	0.42	0.84		
30000	22500	15000	7500	1289.77	0.79	3.73	0.45	0.95	0.27	0.29
32000	24000	16000	8000	1375.75	0.85	4.19	0.48	1.06	0.29	0.33
34000	25500	17000	8500	1461.74	0.90	4.66	0.51	1.18	0.31	0.36
36000	27000	18000	9000	1547.72	0.95	5.15	0.53	1.30	0.33	0.40
38000	28500	19000	9500	1633.71	1.00	5.67	0.56	1.43	0.34	0.44
40000	30000	20000	10000	1719.69			0.59	1.57	0.36	0.48
42000	31500	21000	10500	1805.67			0.62	1.71	0.38	0.52
44000	33000	22000	11000	1891.66			0.65	1.85	0.40	0.57
46000	34500	23000	11500	1977.64			0.68	2.01	0.42	0.62
48000	36000	24000	12000	2063.63			0.71	2.16	0.43	0.66
50000	37500	25000	12500	2149.61			0.74	2.32	0.45	0.71
52000	39000	26000	13000	2235.60			0.77	2.49	0.47	0.76
54000	40500	27000	13500	2321.58			0.80	2.66	0.49	0.81
56000	42000	28000	14000	2407.57			0.83	2.84	0.51	0.87
58000	43500	29000	14500	2493.55			0.86	3.02	0.52	0.92
60000	45000	30000	15000	2579.54			0.89	3.21	0.54	0.98
62000	46500	31000	15500	2665.52			0.92	3.40	0.56	1.04
64000	48000	32000	16000	2751.50			0.95	3.60	0.58	1.10
66000	49500	33000	16500	2837.49			0.98	3.80	0.60	1.16
68000	51000	34000	17000	2923.47			1.01	4.00	0.62	1.22
70000	52500	35000	17500	3009.46			1.04	4.22	0.63	1.29
72000	54000	36000	18000	3095.44			1.07	4.43	0.65	1.35
76000	57000	38000	19000	3267.41					0.69	1.49
80000	60000	40000	20000	3439.38					0.72	1.63
84000	63000	42000	21000	3611.35					0.76	1.78
88000	66000	44000	22000	3783.32					0.80	1.93
92000	69000	46000	23000	3955.29					0.83	2.09
96000	72000	48000	24000	4127.26					0.87	2.25
100000	75000	50000	25000	4299.23					0.90	2.42
104000	78000	52000	26000	4471.20					0.94	2.59
108000	81000	54000	27000	4643.16					0.98	2.77
112000	84000	56000	28000	4815.13					1.01	2.96
116000	87000	58000	29000	4987.10					1.05	3.15
120000	90000	60000	30000	5159.07					1.09	3.35

Flushing potable water systems

German standard DIN 1988, Part 2, describes a complex flushing system using an air/water mixture. This flushing method is stipulated for metal pipe systems as shavings, rust or flux may be produced when processing a metal installation. These substances may cause hygiene problems or corrosion of the pipe in metal pipelines. Provided it is certain that no contamination has been introduced into the pipework during installation, then thorough flushing of the TECElogo pipes is sufficient, in accordance with the ZVSHK information sheet "Flushing, disinfecting and commissioning of potable water installations", issue October 2004.

Pressure test

In order to ensure potable water hygiene as well as to protect against corrosion and frost, potable water installations should be filled only shortly before the intended use. Long retention time for the water in a filled or partially filled system may have negative effects and has to be prevented for this reason. Thus, a leakage test with water in accordance with German standard DIN 1988-2, section 11.1 must be performed only under certain circumstances, for example when the leakage test is carried out immediately before initial start-up.
Guideline 6023 of the Association of German Engineers (VDI) makes reference to **the ZVSHK leaflet entitled "Leakage tests in potable water installations using compressed air, inert gas or water"** as a recognized rule of engineering for the execution of the testing procedure. For safety reasons (compressibility of air), the responsible German Employers' Liability Insurance Association limits the testing pressure with compressed air and inert gas in potable water installations to a maximum of 3 bar as was already the case in the tests for gas lines in accordance with DVGW TRGI.

The pressure test comprises a leakage and strength test. The leakage test always has to be carried out first.
The following specifications must be observed when carrying out the test with compressed air or inert gas:

- Leakage test at 110 mbar
- Load test with a maximum of 3 bar
- Divide into small testing sections (small pressure/litre product).

Leakage test with oil-free compressed air or inert gas

Prior to the leakage test the pipe connections have to undergo a visual inspection. Component parts fitted in the pipe system have to be suitable for the testing pressures or have to be removed prior to the line test or have to be replaced by a suitable piece of pipe or have to be tested separately at the pipe ends in the line section.
After applying the testing pressure, the testing time has to be at least thirty minutes up to a line volume of 100 litres. The testing time has to be increased by ten minutes for each additional 100 litres of line volume.

The test commences after the testing pressure has been reached, taking into consideration a corresponding waiting time for the stabilization of the media and ambient temperature. The tightness is established by the conformity of the initial and final testing pressures - disregarding the normal variations caused by the media temperature and the pressure on the pressure gauge.
The pressure gauge used has to ensure a reading with an accuracy of 1 mbar (10 mmWC) for the pressures to be measured. For this purpose, the U tube pressure gauges or standpipes with 110 mm used in the TRGI tests can also be used here.

Load test

The purpose of this test is to identify faults which may lead to a fracture or opening of a joint in the pipeline under normal operating conditions. The strength test is combined with a visual inspection of all pipe connections. The pipeline to be tested is filled with a medium under pressure, the maximum pressure being 3 bar.
The load test shall be carried out with a higher pressure of

- a maximum of 3 bar for nominal widths of up to DN 50 and
- a maximum of 1 bar for nominal widths of over DN 50 (up to DN 100).

After applying the testing pressure, the testing time has to be at least thirty minutes up to a line volume of 100 litres. The testing time has to be increased by ten minutes for each additional 100 litres of line volume.

During the testing period, the pressure gauge reading has to remain constant. In case of TECElogo installations, the equilibrium condition has to be waited for. In case of other materials, the required temperature constancy in the line system has to be established prior to the test. The pressure gauge used has to ensure a reading with an accuracy of 0.1 bar (10 mmWC).

Leakage test with potable water in accordance with German standard DIN 1988

German standard DIN 1988, Part 2, stipulates that a leakage test is mandatory for pipelines. Constant temperature conditions are required for a correct leakage test. The pressure gauge should have a reading accuracy of 0.5 bar. Hygienically clean water must be used for the leakage test. The testing equipment must not adversely affect the hygiene of the water used for testing.

The leakage test with potable water according to DIN 1988 is done in three stages:
Step 1 – Fill and bleed the pipework.
Step 2 – Pre-test: The pressure to be applied for the preliminary test is the maximum permissible operating pressure plus 5 bar. As a rule a preliminary test is carried out with 15 bar. Within the first thirty minutes after filling, the pressure may be adjusted every ten minutes. This is considered to be a temperature equalization. The actual preliminary test starts after this period and lasts for thirty minutes. During this period the pressure may drop by a maximum of 0.6 bar. There must be no leaks in the installation.
Step 3 – Main test: After the preliminary test has been passed, the main test is carried out immediately.
The testing pressure of the preliminary test is not lowered. During the following two hours, the pressure may drop by a maximum of 0.2 bar, and there must be no leaks.

Note:

To prevent potable water from stagnating in the system, TECE emphasises that the leakage test according to DIN 1988 part 2 section 11.1 must only be used when the leakage test is performed immediately before the system is put into operation for the first time.

Heating installations

Prior to the initial use, a heating installation has to be flushed thoroughly in order to remove any metal residues or flux. The TECElogo system is not sensitive to these impurities, but metal components of the heating system – such as radiators or heat-generating devices – may be damaged by galvanic corrosion processes.
The leakage test is performed in a similar way to the leakage test for potable water installations. However, the test pressure shall be 1.3 times the operating pressure.

Documentation

ATV DIN 18381 (VOB part C: General technical contract conditions for building work) requires that a report on the leakage test is made and handed over to the ordering party as necessary proof.

Note: In keeping with German law the leakage test is considered a necessary work auxiliary to the accomplishment of the contract, which is part of the contractual service to be rendered by the contractor even without being mentioned in the description of the work auxiliary.

Commissioning and briefing report for the potable water system (page 1 of 2)

Building project: _____

Client/representative: _____

Contractor/representative: _____

In the presence of the above persons, these were briefed in the use of the following system components and these were put into operation:

No.	System component, device	Inspection carried out	Comments	n/a
1	Building connection	❒		❒
2	Main shut-off fittings	❒		❒
3	Non-return valve	❒		❒
4	Backflow preventer	❒		❒
5	Filter	❒		❒
6	Pressure relief equipment	❒		❒
7	Distribution pipes	❒		❒
8	Risers/shut-off fittings	❒		❒
9	Storey pipe systems/shut-off fittings	❒		❒
10	Riser pipe vents/dripping water pipe	❒		❒
11	Collector-unit backflow prevention system dripping water pipe	❒		❒
12	Tapping points with single-unit backflow prevention	❒		❒
13	Water heating/drinking water heater	❒		❒
14	Safety valves/pressure relief lines	❒		❒
15	Circulation pipe/circulation pump	❒		❒
16	Metering system	❒		❒
17	Water softening plant	❒		❒
18	Pressure booster system	❒		❒
19	Fire extinguishing systems and fire protection systems	❒		❒
20	Swimming pool inflow	❒		❒
21	Tapping fittings	❒		❒
22	Consumption devices	❒		❒
23	Potable water containers	❒		❒
24		❒		❒
25		❒		❒
26		❒		❒
27		❒		❒

Commissioning and briefing report for the potable water system (page 2 of 2)

Supplementary comments by the client:

Supplementary comments by the contractor:

The briefing for operating the system has taken place, the necessary operating documents and the existing operating and maintenance documents according to the above mentioned list were handed over. Attention was drawn to the fact that, despite careful planning and implementation of the installation, potable water of perfect quality can only be present at all tapping points if a regular and complete change of water takes place in all areas of the installation.

Duties of the operator: Measures for longer periods of absence

Absence	Measures before the absence	Measure for the return
> 3 days	Apartments: Close the storey shut-off fittings Single-family house: Close the shut-off fitting after the water meter	After opening the shut-off fitting, allow the water which has been standing to flow out of all tapping points for 5 minutes (fully open)
> 4 weeks	Apartments: Close the storey shut-off fittings Single-family house: Close the shut-off fitting after the water meter	It is recommended that arrangements are made to flush the house installation
> 6 months	Arrange to close the main shut-off (building connection). Fully drain pipes	Arrange for the house installation to be flushed
> 1 year	Disconnect the connection pipe from the supply pipe	Reconnection by the water supply company or professional plumber

_____ _____

Place Date

_____ _____

Ordering party/representative (Signature)

Contractor/plumber (Signature)

Pressure test report for potable water installations – according to VDI-6023
(with oil-free compressed air or inert gas as test medium)

Building project: _____

Client: _____

Contractor/fitter: _____

Material of the pipe system: _____

Type of connection: _____

System pressure: _____ bar

Ambient temperature _____ °C Temperature of test medium _____ °C

Test medium: ❒ oil-free compressed air ❒ nitrogen ❒ carbon dioxide ❒ _____

The potable water system was tested as: ❒ whole system ❒ in _____ sections

Leakage test

Testing pressure: 110 mbar

Test period up to 100 litres pipe volume: at least 30 minutes
(for each further 100 litres, increase test period by 10 minutes)

Pipe volume: _____ litres

Test period: _____ minutes

Temperature balance and equilibrium must be reached, only then does the test period start.

❒ No drop in pressure detected during test period.

Strength test with increased pressure

Test pressure up to and including DN 50: 3 bar
Test pressure above DN 50 to DN 100: 1 bar

Test period up to 100 litres pipe volume: at least 30 minutes
(for each further 100 litres, increase test period by 10 minutes)

Test period: _____ minutes

Temperature balance and equilibrium must be reached, only then does the test period start.

❒ No drop in pressure detected during test period.

❒ The pipe system is free of leaks.

_____ _____

Place Date

_____ _____

Ordering Party
(Signature)

Contractor / Plumber
(Stamp / Signature)

Pressure test report for potable water installations – in accordance with DIN 1988, Part 2 (with potable water as test medium)

Building project: _____

Client: _____

Plumber: _____

Size range from _____ mm to _____ mm

Pipe length approx. _____ m

Water temperature: _____ °C

Ambient temperature: _____ °C

Preliminary test

Test period: 60 minutes	test pressure: 15 bar
Pressure after 30 minutes	_____ bar
Pressure after 60 minutes	_____ bar
Pressure loss during the last 30 minutes	_____ bar (maximum 0.6 bar)
Outcome of preliminary test	_____

Main test **at same test pressure as preliminary test**

Test period: 120 minutes	max. permitted pressure drop: 0.2 bar
Pressure at start of test	_____ bar
Pressure after 120 minutes	_____ bar
Pressure drop during test period	_____ bar (max. 0.2 mbar)
Outcome of the main test:	_____

_____ _____

Start of test End of test

_____ _____

Place Date

_____ _____

Ordering Party
(Signature)

Contractor / Plumber
(Stamp / Signature)

Pressure test report for heating systems – according to DIN 18380 (VOB)

Building project: _____

Client: _____

Plumber: _____

Size range from _____ mm to _____ mm

Pipe length approx. _____ m

Water temperature: _____ °C

Ambient temperature: _____ °C

Preliminary test

Test period: 60 minutes	test pressure: 1.3 x operating pressure (bar)
Pressure after 30 minutes	_____ bar
Pressure after 60 minutes	_____ bar
Pressure loss during the last 30 minutes	_____ bar (maximum 0.6 bar)
Outcome of preliminary test	_____

Main test **at same test pressure as preliminary test**

Test period: 120 minutes	max. permitted pressure drop: 0.2 bar
Pressure at start of test	_____ bar
Pressure after 120 minutes	_____ bar
Pressure drop during test period	_____ bar (max. 0.2 mbar)
Outcome of the main test:	_____

_____ _____

Start of test End of test

_____ _____

City Date

_____ _____

Ordering Party
(Signature)

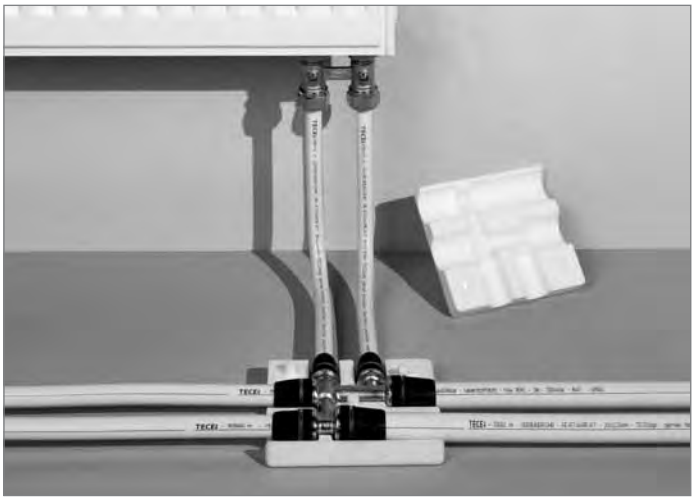
Contractor / Plumber
(Stamp / Signature)

Radiator connection

The TECElogo system offers an extensive range of fittings for the efficient connection of radiators in most of the usual on-site situations.

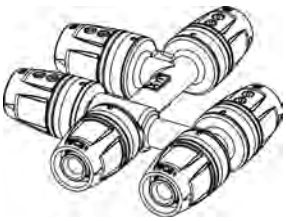
Cross-fitting

A cross-fitting permits the branching of flow and return lines of two main lines that run in parallel. The height of the fittings with insulation box is just 35 mm.

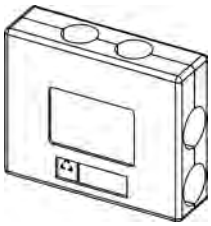


Radiator connection with cross-fitting

By using a cross-fitting, the mounting time is reduced and the risk of damage to crossed pipes caused by wheelbarrows, flattening by foot or similar is avoided.



Cross-fitting
(Order No.. 874 01 01/...02/...03)



Protection box
(Order No. 874 01 00)

Connection out of the floor

TECElogo composite pipes can be used to directly connect the radiator to the pipe rising from the screed. In order to prevent "cracking noises", the linear extension of the pipes has to be compensated. For this reason the pipes must be fitted with an insulating tube of at least 6 mm in thickness.

In addition, it is advisable to attach a protective sleeve to the visible part of the pipe. Damage to the pipes caused by hoovering, for example, can be prevented in this way. A lead-in elbow must be used where the TECElogo composite pipes come out of the screed.

Lead-in elbow
(Order No. 718005)

Radiator connection with mounting tees/elbows

For more luxurious demands, the TECElogo range offers mounting tees made of nickel-plated copper. Because of its right-angled shape, the radiator can be connected from flow and return flow pipes running in parallel.

Radiator connection with radiator mounting tee

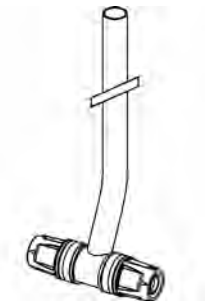
The nickel-plated copper pipes are connected to the valves of the radiator using compression fittings.

TECElogo radiator mounting tee length 330 mm:

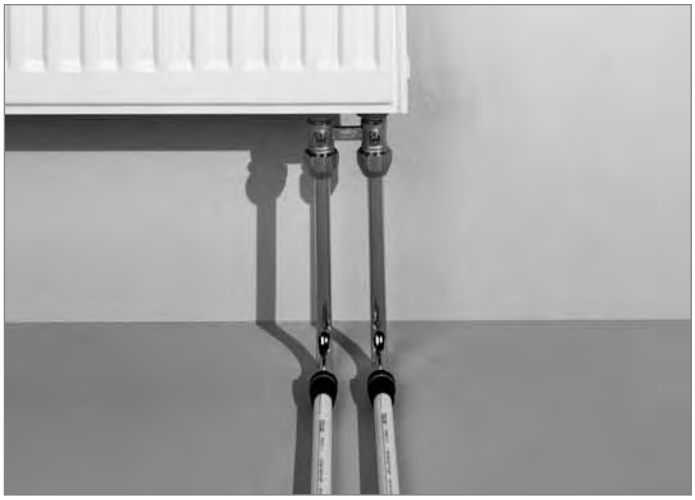
Size 16 × 15 mm Cu
(Order No.: 874 04 03)

Size 20 × 15 mm Cu
(Order No.: 874 04 04)

Compression fitting 15 mm x 1/2":
(Order No.: 7 175 01)



If the flow and return flow pipes do not pass underneath the radiator, radiator mounting elbows made of nickel-plated copper can be used as an alternative.



Radiator connection with radiator mounting elbow

TECElogo radiator mounting elbow
Length 330 mm:

Size 16 × 15 mm Cu
(Order No.: 874 04 01)

Size 20 × 15 mm Cu
(Order No.: 874 04 02)

Compression fitting 15 mm x 1/2":
(Order No.: 7 175 01)

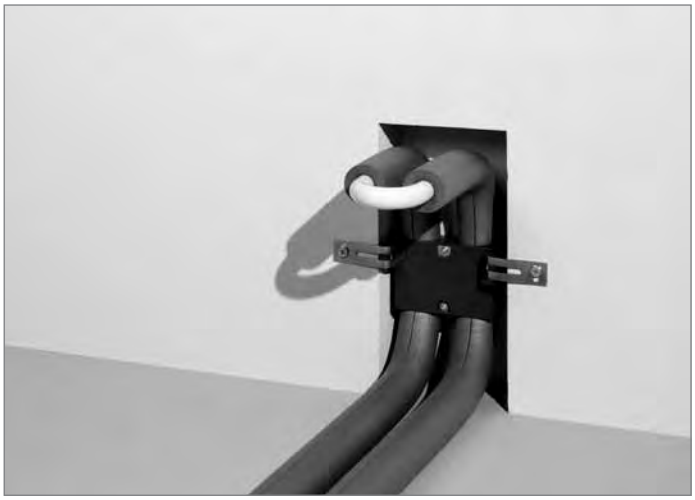
Connection to pipe coming out of the wall

The special bending properties of TECElogo composite pipe permit a connection of the radiator directly to the pipe coming out of the wall. The chase has to be set up in such a way that the minimum bending radii of the TECElogo pipe can be maintained.

Connection of radiator to pipe coming out of the wall

Connection to pipe coming out of the wall using mounting unit

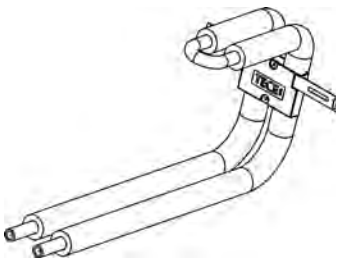
For a perfect connection to pipes coming out of the wall, the radiator mounting unit with pre-insulated pipes can be used. Another special feature is the particularly tight radii of the TECElogo pipe.



Radiator connection using mounting unit – ready for pressure testing

Radiator connection using mounting unit – connected up to the radiator valve

TECElogo radiator mounting unit
Length 500 mm
(Order No.: 874 05 50)



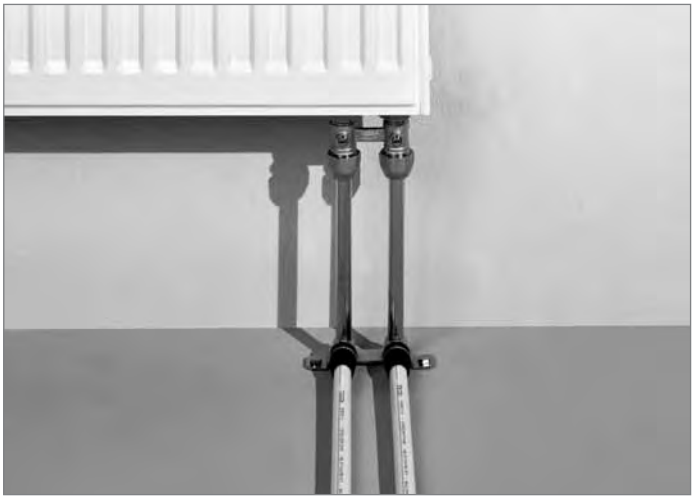
Radiator connection using the radiator mounting unit for connecting compact radiators up to pipes coming out of the wall

The radiator mounting unit has been provided with stable mounting straps for safe attachment to the chase. TECElogo connection technique permits pipes to be connected directly in the chase.

Radiator connection with radiator mounting unit, wall-mounted – ready for pressure test

Radiator connection with radiator mounting unit, floor-mounted – ready for pressure test

Radiator connection using mounting unit, wall-mounted – connected to the radiator valve

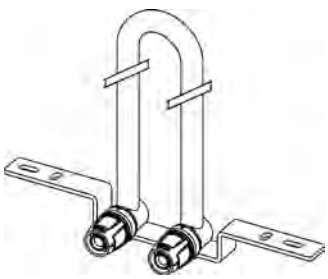


Radiator connection with radiator mounting unit, floor-mounted – connected to the radiator valve

Because of the connection between flow and return flow pipe, the heating system can be pressure-tested without installing building plugs. To mount the radiator, the U tube is cut to length and connected to the valve block by means of a pinch screw connection.

TECElogo radiator mounting unit
size 16 x 15 mm CU
wall-mounted
Length 333 mm
(Order No.: 874 04 06)

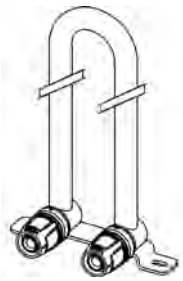
Compression fitting
15 mm x 1/2"
(Order No.: 7 175 01)



As an alternative, a radiator mounting unit is available for connection to pipes rising from the floor. It is also fitted with a U pipe and permits pressure testing without building plugs.

TECElogo radiator mounting unit
size 16 x 15 mm CU
floor-mounted
Length 333 mm
(Order No.: 874 04 05)

Compression fitting
15 mm x 1/2"
(Order No.: 7 175 01)



Appendix

PPSU resistance list

Brand name	Date	Concentration	Manufacturer	Use
Refrigerant oil				
Castrol nonol refrigerant oil		100 %	Castrol	Forbidden
Rocol RTD		100 %		Forbidden
Refrigerant oil M200 No. 1	June 2009	100 %		Forbidden
Disinfectant				
FINKTEC FT-99 CIP		6 %	Finktec GmbH	Forbidden
Mikro Quat		100 %	Ecolab	Forbidden
Mikrobac forte		1 %, 23 °C	Bode Chemie	Permitted
Hydrogen peroxide		35 %, 23 °C		Permitted
Potassium permanganate KMnO4		15 mg/l, 23 °C		Permitted
Sodium hypochlorite NaOCl		> 6 %, 23 °C		Permitted
Calcium hypochlorite Ca(ClO)2		50 mg/l, 23 °C		Permitted
Chlorine dioxide ClO2		6 mg/l, 23 °C		Permitted
Aniosteril D2M	June 2009	5 %	Laboratoires Anios	Permitted
Aniosteril Contact	June 2009	1 %	Laboratoires Anios	Permitted
Witty W4		2 %, 23 °C, 4 h		Permitted
Descaler (Entkalker)				
DS-40		4 %		Forbidden
Boiler noise control (Kessellärmschutz)		0.20 %		Permitted
Calcolith DP		10 %, 40 °C, 24 h		Permitted
Calcolith TIN-BE		5 %, 80 °C, 24 h		Permitted
Household descaler (rapid descaler) (Haushaltsentkalker (Schnellentkalker))		20 %		Permitted
LS1		0.60 %		Permitted
MB1		4 %		Permitted
Super Concentrate		0.20 %		Permitted
Superfloc		2 %		Permitted
Cleaning agent (Reinigungsmittel)				
Arkopal 110		5 %	Hoescht	Forbidden
ANTIKAL		100 %	P & G	Forbidden
BREF - Bath (Bad)		100 %	Henkel	Permitted
BREF - Fresh Shower (Frische Dusche)		100 %	Henkel	Permitted
CAROLIN - Gloss Cleaner (Glanzreiniger)		1.80 %	Boltom Belgium	Permitted
CAROLIN - active fresh (aktiv frisch)		1.90 %	Boltom Belgium	Permitted
CAROLIN - with linseed oil (mit Leinsamenöl)		1.90 %	Boltom Belgium	Permitted
CAROLIN - Marseille Soap (Seife)		1.80 %	Boltom Belgium	Permitted
Meister Proper - Lemon (Zitrone)		3.40 %	P & G	Forbidden
Meister Proper - Extra Hygiene		3.50 %	P & G	Permitted
Meister Proper - sensitive surfaces (empfindliche Oberflächen)		2.40 %	P & G	Forbidden
Meister Proper - Orange Zest (Orangenschale)		3.40 %	P & G	Forbidden
Meister Proper - Winter Fresh (Winterfrisch)		3.40 %	P & G	Forbidden
TERRA - Stone Floors (Steinböden)		12 %	Henkel	Permitted
TERRA - Parquet (Parkett)		3.20 %	Henkel	Permitted

Brand name	Date	Concentration	Manufacturer	Use
TERRA - High Gloss Floors (Hochglanzböden)	June 2009	100 %	Henkel	Permitted
Seals				
Cimberio Loxeal 58 11 PTFE thread seal (Gewindedichtung)		100 %		Forbidden
Dreibond 5331		100 %, 23 °C	Dreibond	Forbidden
EPDM rubber O-ring		100 %	Join de France	Permitted
Easyfit (Griffon)	June 2009	100 %	Bison International	Forbidden
Everseal pipe thread seal (Rohrgewindedichtung)		100 %, 82 °C	Federal Process Corp.	Forbidden
FACOT PTFE SEAL (PTFE Dichtung)		100 %		Forbidden
Filjoint	June 2009	100 %	GEB	Forbidden
FILETPLAST POTABLE WATER (EAU POTABLE)	June 2009	100 %	GEB	Permitted
GEBATOUT 2	June 2009	100 %	GEB	Permitted
GEBETANCHE 82 (EX-GEB)	June 2009	100 %	GEB	Forbidden
Griffon installation kit (Montagekit)		100 %	Verhagen-Herlitzius BV.	Permitted
Kolmat joint paste (- 30 to + 135 °C)		100 %	Denso	Permitted
Locher Special Paste (Paste Spezial)		100 %	Locher & Co AG	Permitted
Loctite 5061		100 %	Loctite	Permitted
Loctite 518 gasket eliminator (Dichtungseliminator)		100 %, 82 °C	Loctite	Forbidden
Loctite 5331	June 2009	100 %	Loctite	Permitted
Loctite 5366 silicomet AS-310		100 %	Loctite	Permitted
Loctite 542		100 %, 23 °C	Loctite	Forbidden
Loctite 55	June 2009	100 %	Loctite	Forbidden
Loctite 572 thread seal (Gewindedichtung)	June 2009	100 %, 60 °C	Loctite	Forbidden
Loctite 577		100 %, 23 °C	Loctite	Forbidden
Loctite Dryseal	Sep. 2008	100 %	Loctite	Permitted
Manta Tape		100 %		Permitted
Multipak		100 %		Permitted
Neo-Fermit		100 %	Nissen & Volk	Permitted
Neo-Fermit Universal 2000		100 %	Nissen & Volk	Permitted
Plastic Fermit - seal (Dichtung)		100 %	Nissen & Volk	Permitted
Precote 4		100 %	Omnifit	Forbidden
Precote 80		100 %	Omnifit	Forbidden
RectorSeal # 5		100 %, 82 °C	RectorSeal Corp.	Forbidden
Red Silicone Sealant (- 65 to + 315 °C) (Silikon-Dichtungsmittel)		100 %	Loctite	Permitted
Rite-Lok		100 %	Chemence	Forbidden
Scotch-Grip rubber and sealing adhesive (Kautschuk & Dichtungskleber) # 1300		100 %, 82 °C	3M	Forbidden
Scotch-Grip rubber and sealing adhesive (Kautschuk & Dichtungskleber) # 2141		100 %, 82 °C	3M	Forbidden
Scotch-Grip rubber and sealing adhesive (Kautschuk & Dichtungskleber) # 847		100 %, 82 °C	3M	Forbidden
Selet Unyte		100 %, 82 °C	Whitman	Forbidden
Tangit metalock	Apr. 2007	100 %	Henkel	Forbidden
Tangit Racoretanche	June 2009	100 %	Loctite	Permitted
Tangit Unilock	June 2009	100 %	Henkel	Forbidden
TWINEFLO (PTFE band) + processing agent (Verarbeitungsmittel)		100 %	Resitape / Ulith	Permitted
Twineflon	March 2009	100 %	Unith	Permitted

Brand name	Date	Concentration	Manufacturer	Use
Unipack	May 2006	100 %		Forbidden
Unipack Packsalve		100 %		Permitted
Viscotex Locher Paste 2000		100 %		Permitted
Adhesives				
Atmosfix	July 2009	100 %	Atmos	Forbidden
ARMAFLEX 520 KLEBER ADHESIVE	Dec. 2008	100 %, 50 °C		Forbidden
ARMAFLEX HT 625	Dec. 2009	100 %, 50 °C		Forbidden
BISON SANITARY SILICONES KIT (SILIKONENKIT SANITAIR)		100 %		Permitted
Bison-Tix contact adhesive (Kontaktkleber)		100 %, 23 °C	Perfecta International	Forbidden
CFS SILICONE SEALANT S-200 (Silikon Dichtungsmittel)		100 %		Permitted
Colle Mastic high performance (hautes Performances)	June 2009	100 %	Orapi	Permitted
Epoxy ST100	July 2007	100 %		Forbidden
GENKEM CONTACT ADHESIVE (KONTAKTKLEBER)		100 %		Forbidden
GOLD CIRCLE SILICONE KIT BOUW TRANSPARENT		100 %		Permitted
Knauf sanitary silicone kit (Sanitär-Silikonkit)		100 %		Permitted
Knauf silicone kit for acrylic (Siliconkit für Acryl)	July 2009	100 %	Henkel	Permitted
Pattex rigid adhesive PVC (colle rigide)		100 %		Forbidden
PEKAY GB480 (Vidoglue) adhesive (Kleber)		100 %		Forbidden
PEKAY GB685 (Insulglue) adhesive (Kleber)		100 %		Permitted
Repa R 200		100 %		Permitted
RUBSON SILIKON SANITÄR TRANSPARENT SET		100 %	Rubson	Permitted
RUBSON SILIKON SANITÄR TRANSPARENT SET		100 %	Rubson	Permitted
Water-repellent wood glue		100 %		Permitted
Foams				
BISON PURE FOAM (PUR SCHAUM)	March 2009	100 %		Forbidden
Boxer installation foam (Montageschaum)	Feb. 2007	100 %		Forbidden
Gunfoam - Winter - Den Braven East sp. z o.o.	Feb. 2007	100 %		Forbidden
Gunfoam Proby	Feb. 2007	100 %		Forbidden
Hercusal	Feb. 2007	100 %		Forbidden
MODIPUR HS 539	July 2009	100 %	Wickes	Forbidden
MODIPUR US 24 PART 2 (TEIL 2)	July 2009	100 %		Forbidden
MODIPUR HS 539 / US 24 PART 2 (1/1) (TEIL 2)	July 2009	100 %		Forbidden
PUR foam (Schaum) (contains diphenylmethane-4,4-di-isocyanate)		100 %		Forbidden
O.K. - 1 K PUR		100 %		Forbidden
Omega Faum - Foam (Schaum)	Feb. 2007	100 %		Forbidden
Proby installation foam (Montageschaum)	Feb. 2007	100 %		Forbidden
PURATEC - 1 K PUR		100 %		Forbidden
PURATEC - 2 K PUR		100 %		Forbidden
Ramsauer PU foam (Schaum)	July 2009	100 %		Forbidden
Klima plus duct and standpipe foam (Schacht- und Brunnenschaum)		100 %		Forbidden
Soudal installation foam for low temperatures (Montageschaum für tiefe Temperaturen)	Feb. 2007	100 %		Forbidden
SOUDAL gun foam (Pistolenschaum) Soudalfoam -10	Feb. 2007	100 %		Forbidden
SOUDAL PU foam (Schaum)	July 2009	100 %		Forbidden
2-K Klima plus door installation foam (Türmontageschaum)		100 %		Permitted

Brand name	Date	Concentration	Manufacturer	Use
TYTAN Professional Winter gun foam (Pistolenschaum)	Feb. 2007	100 %		Forbidden
TYTAN Professional for PCV gun foam (Pistolenschaum)	Feb. 2007	100 %		Forbidden
TYTAN Professional Lexy 60 low pressure (Niederdruck)	Feb. 2007	100 %		Forbidden
TYTAN Euro-Line installation foam (Montageschaum)	Feb. 2007	100 %		Forbidden
TYTAN Professional for PCV installation foam (Montageschaum)	Feb. 2007	100 %		Forbidden
ZIMOWA SUPER PLUS - installation foam (Montageschaum)	Feb. 2007	100 %		Forbidden
Greases				
BAYSILONE ÖL M 1000		100 %		Permitted
BECHEM BERUSOFT 30		100 %	bechem	Permitted
Bechem Berulube Sihaf 2	May 2008	100 %	bechem	Permitted
Dansoll Silec Blue Silicone Spray (Silikon-Spray)		100 %	dansoll	Permitted
Dansoll Super Silec sanitary installation paste (Sanitär-Montagepaste)		100 %	dansoll	Permitted
Hempseed oil		100 %		Permitted
Kluber Proba 270		100 %	Kluber	Permitted
Kluber Paralig GTE 703		100 %, 80 °C, 96 h	Kluber	Permitted
Kluber Syntheso glep1		100 %, 135 °C, 120 h	Kluber	Forbidden
KLÜBERSYNTH VR 69-252		100 %	Kluber	Permitted
Kluber Unislikikone L641		100 %	Kluber	Permitted
Kluber Unislikikone TKM 1012		100 %, 80 °C, 96 h	Kluber	Permitted
OKS 462 / 0956409		100 %	Kluber	Permitted
OKS 477 TAP GREASE (HAHNFETT)		100 %	Kluber	Permitted
Laureat Zloty Installator		100 %		Permitted
Luga Spray (Leif Koch)		100 %	Leif Koch	Permitted
Rhodorsil 47 V 1000		100 %, 80 °C, 96 h		Permitted
SiliKon Spray (Motip)		100 %	Motip	Permitted
silicona lubricante SDP ref S-255		100 %		Permitted
Silkonöl M 10 - M 100000		100 %		Permitted
Silikonöl M 5		100 %		Permitted
Turmisilon GL 320 1-2		100 %		Permitted
UNISILIKON L250L	June 2008	100 %		Permitted
Wacker Silikon		50 %, 95 °C, 96 h	Wacker	Forbidden
Metals				
Copper ions (Cu 2+)		50 ppm		Permitted
Soldering flux S 39	June 2009	100 %		Permitted
Soldering flux S 65	July 2009	100 %		Forbidden
YORKSHIRE FLUX		100 %		Forbidden
Degussa Degufit 3000		100 %	Degussa	Permitted
Aluminium ions (Al 3+)		50 ppm		Permitted
Atmosflux	July 2008	100 %		Permitted
Paints				
Sigma Superprimer TI		100 %	Sigma Coatings	Permitted

Brand name	Date	Concentration	Manufacturer	Use
Sigma Amarol		100 %	Sigma Coatings	Permitted
Decalux		100 %	De Keyn Paint	Permitted
Permaline		100 %	ITI-Trimetal	Permitted
Silvatane		100 %	ITI-Trimetal	Permitted
DULUX water-based high gloss paint		100 %	ICI	Forbidden
DULUX water-based silk gloss paint, satin		100 %	ICI	Forbidden
DULUX for microporous wood, silk gloss		100 %	ICI	Permitted
DULUX floor paint, very hard-wearing, silk gloss		100 %	ICI	Permitted
DULUX metal paint, anti-corrosion, high gloss		100 %	ICI	Permitted
Hammerite white, silk gloss		100 %	ICI	Permitted
Hammerite white, high gloss, based on xylene		100 %	ICI	Forbidden
Hammerite silver grey high gloss, based on xylene		100 %	ICI	Permitted
Boss Satin		100 %	BOSSPAINTS	Permitted
Hydrosatin Interior		100 %	BOSSPAINTS	Permitted
Carat		100 %	BOSSPAINTS	Permitted
Bolatex		100 %	BOSSPAINTS	Permitted
Optiprim		100 %	BOSSPAINTS	Permitted
Elastoprim		100 %	BOSSPAINTS	Permitted
Plastiprop		100 %	BOSSPAINTS	Forbidden
Formule MC		100 %	BOSSPAINTS	Forbidden
MAPEGRUNT		100 %	Mapei	Permitted
DULUX PRIMER		100 %	ICI	Permitted
UNI-GRUNT		100 %	Atlas	Permitted
Wall filler and construction products				
Bituperl (insulating filler with bitumen)		100 %		Permitted
Insulating paint with bitumen		100 %		Permitted
Cold adhesive for bitumen paper		100 %		Permitted
Climacoll adhesive for pipe insulation foam		100 %		Forbidden
Compactuna		6 %		Permitted
FERROCLEAN 9390	Feb 2008	100 %		Permitted
FT-extra		100 %		Permitted
Giso base primer		100 %		Forbidden
KNAUF STUC PRIMER	July 2009	100 %		Permitted
Mellerud mould killer (Schimmelvernichter)		100 %		Permitted
Mineral wool insulation with barrier layer against metal vapour	July 2007	100 %		Forbidden
Nivoperl insulating filler (isolierender Füllstoff)		100 %		Permitted
PCI LASTOGUM	Feb 2008	100 %		Permitted
PCI Seccoral 1K	Feb 2008	100 %		Permitted
Perfax fills all (Rebouche tout)	July 2009	100 %		Permitted
PE pipe insulation foam (Rohr Isolierungsschaum)		100 %		Permitted
Polyfilla interior filler (Innenwand-Füllstoff)		100 %	Polyfilla	Permitted
Porion ready to use filler (Sofortspachtel)		100 %	Henkel	Permitted
Porion Mörtel für Reparaturen		100 %	Henkel	Forbidden
Portland Cement - Zement		100 %	CBR	Permitted
RIKOMBI KONTAKT (RIGIPS)		100 %		Permitted

Brand name	Date	Concentration	Manufacturer	Use
PE foam self-adhesive insulation (wrapping tape) (Selbstklebende Isolierung PE-Schaum (Wickelband))		100 %		Forbidden
SOPRO FDH 525 liquid film (Flüssigfolie)	Sep. 2008	100 %		Permitted
Stucal plaster (Putz)		100 %	Gyproc	Permitted
TANGIT CLEANER (REINIGER)	July 2007	100 %		Forbidden
TANGIT special cleaner (Spezialreiniger)	July 2007	100 %		Permitted
Tile adhesive		100 %		Permitted
Universal primer (Universalgrundierung)		100 %		Permitted
Wood-concrete Multiplex Bruynzeel (fumes from ...)		100 %		Forbidden
Wood pine (fumes from ...)		100 %		Forbidden
Wood MDF medium density fibreboard (fumes from ...)		100 %		Forbidden
Wood Multiplex waterproof glued (fumes from ...)		100 %		Forbidden
Anti-Termite				
Aripyreth Oil Solution		100 %, 23 °C		Permitted
Baktop MC		100 %, 23 °C		Permitted
Ecolofen CW		100 %, 23 °C		Permitted
Ecolofen Emulsifiable Concentrate - Emulgierbares Konzentrat		100 %, 23 °C		Permitted
Ecolofen Oil Solution - Öllösung		100 %, 23 °C		Permitted
Grenade MC		100 %, 23 °C		Permitted
Hachikusan 20WE/AC		100 %, 23 °C		Permitted
Hachikusan FL		100 %, 23 °C		Permitted
Kareit Oil Solution - Öllösung		100 %		Permitted
Rarap MC		100 %, 23 °C		Permitted
Corrosion inhibitors				
BAYROFILM T 185		0.30 %		Permitted
Copal corrosion inhibitor	April 2007	100 %		Permitted
KAN-THERM	Sep. 2008	100 %		Permitted
INIBAL PLUS	Sep. 2008	100 %		Permitted
NALCO VARIDOS 1PLUS1	Jan. 2009	2 %, 23 & 95 °C		Permitted
Gas leak sprays				
LIQUI MOLY leak finding spray (Lecksuchspray)		100 %, 23 °C		Permitted
Multitek gas leak spray (Gaslecksprayl)		100 %		Forbidden
Sherlock gas leak warner (Gasleckmelder)		100 %		Permitted
Ulith leak detector spray (Leckdetektorspray)	Sep. 2008	100 %		Permitted
LEAK FINDER SPRAY (LECK-SUCH-SPRAY) 400ML (ITEM. 3350)	Jan. 2009	100 %, 23 °C & 95 °C		Permitted
LEAK FINDER SPRAY (LECK-SUCH-SPRAY) 400ML (ITEM. 1809)	Jan. 2009	100 %, 23 °C & 95 °C		Permitted
LEAK FINDER PLUS (LECKSUCHER PLUS) (ITEM 890-27)	Jan. 2009	100 %, 23 °C & 95 °C		Permitted
LEAK FINDER (LECKSUCHER) 400 ML (ITEM 890-20)	Jan. 2009	100 %, 23 °C & 95 °C		Permitted
LEAK FINDER SPRAY (LECKSUCHERSPRAY) ROTEST	Jan. 2009	100 %, 23 °C & 95 °C		Permitted
GUPOFLEX LEAK-SEEKER (ITEM 301)	Jan. 2009	100 %, 23 °C & 95 °C		Permitted
LEAK FINDER (LECKSUCHER) 5 L (ITEM 4120)	Jan. 2009	100 %, 23 °C & 95 °C		Permitted

Brand name	Date	Concentration	Manufacturer	Use
GUEPO LEAK-SEEKER ETL (ITEM 121)	Jan. 2009	100 %, 23 °C & 95 °C		Permitted
GUEPO LEAK-SEEKER SOAPLESS (ITEM 131) leak finder without soap	Jan. 2009	100 %, 23 °C & 95 °C		Permitted
GASLEAK DETECTOR (GRIFFON)	June 2009	100 %, 60 °C		Permitted
GASLEAK DETECTOR KZ	June 2009	100 %, 60 °C		Permitted

The data in this table is correct to the best of our knowledge and is for general information. The results in the table show typical average values from a representative number of individual measurements. The values must not be taken as specifications under any circumstances.
Furthermore, TECE does not accept any liability for the use of products which are not listed in this table.

TECEfloor
Technical Guidelines

TECE
Intelligente Haustechnik

Table of contents

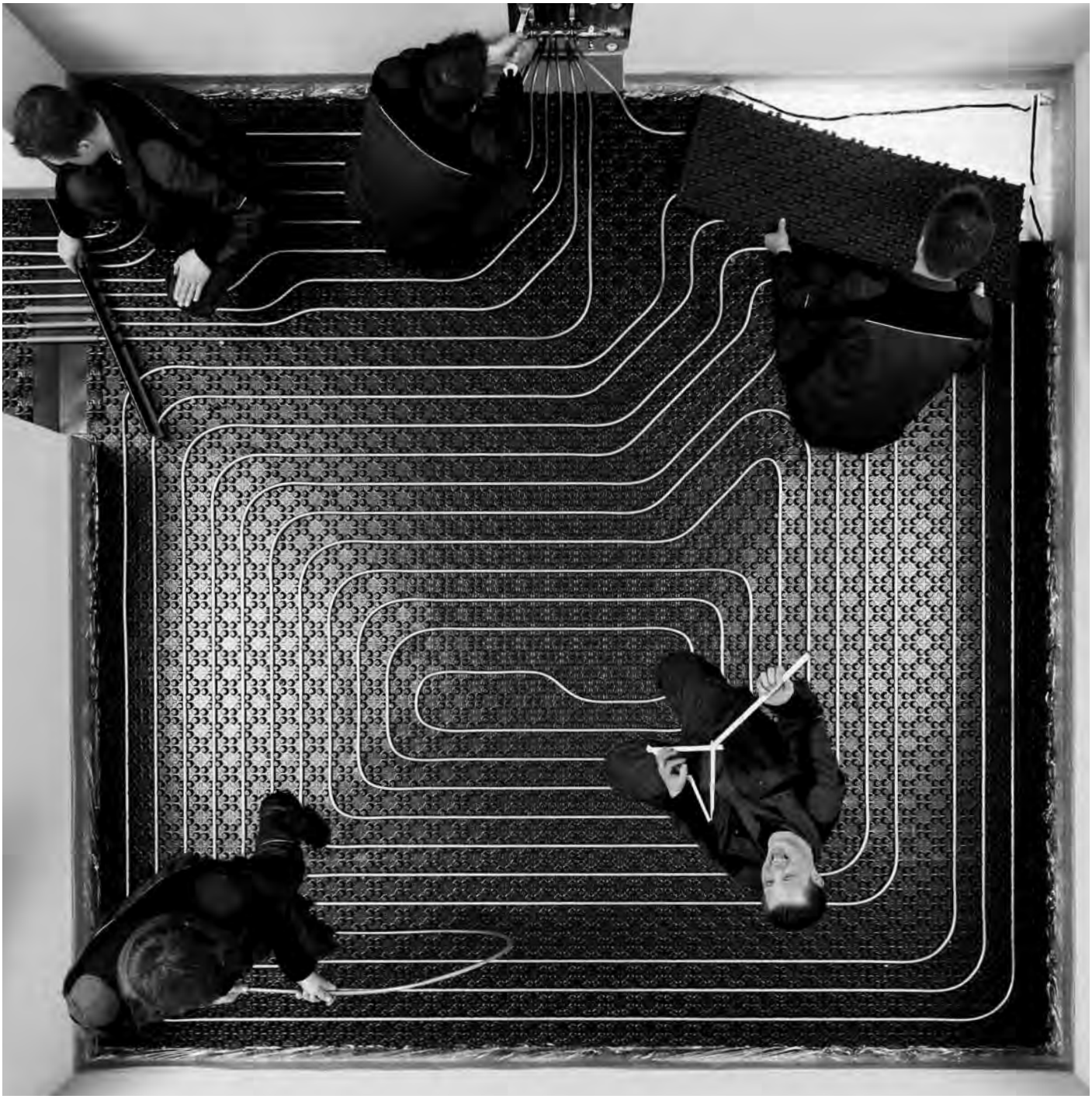
Description of the system

TECEfloor floor heating is used as a low-temperature heat distribution system to heat rooms in new and renovated buildings. The heat is distributed evenly across the whole floor and thus provides an optimum indoor climate. Because of the high heat radiation compared to static heating systems, an optimum feeling of comfort is achieved, even at very low room temperatures. This permits an energy saving of 6 % to 12 %.

Key advantages

- Low investment and operating costs
- High comfort
- Flexible room design
- Low-temperature system (efficient use with regenerative energies)

TECEfloor floor heating offers comfort, energy efficiency and cost effectiveness. It is characterized by high flexibility and simple installation. The consistently high quality of the individual components and the system as a whole meet the respective standards.



The TECEfloor complete system

TECEfloor, the new floor heating system from TECE

When it comes to floor heating, TECE has long been a specialist: In the 1980s, the company launched the first diffusion-tight composite aluminium pipes on the market. Now TECE is back with the TECEfloor programme for floor heating.

TECEfloor is a complete system

It consists of heating pipes, laying accessories, manifolds and controls.

TECEfloor is based on quality

All components are carefully selected and have been tested for 100 percent compatibility.

SLQ "Silver Line Quality"

The high quality standard is reflected in the "Silver Line Quality" (SLQ) label. It stands for tested quality and the guaranteed compatibility of all components.

SLQ standard for parts that transfer water and that provide functions

The tight production tolerances of the heating pipes in TECEfloor are perfectly tailored to the support and clamping ring of the clamped joint. The O-ring of the clamped joint provides accurately dimensioned sealing in the manifold's Eurocone. In the servomotor, not only the union nut but also the lifting and closing dimensions are adjusted to match the valve insert of the manifold.

Planning information

Standards and guidelines

In the planning and laying of TECEfloor floor heating systems, sections of the following standards and guidelines must be observed:

- DIN EN 1264, Water based surface embedded heating and cooling systems
- DIN 4108, Thermal protection in buildings
- German Energy Saving Ordinance (EnEV)
- DIN 18202, Tolerances in buildings
- DIN 18195, Building waterproofing
- DIN EN 13163-13171, Thermal insulation materials for buildings
- DIN 4109, Sound insulation in building construction
- VDI 4100, Sound insulation in dwellings
- DIN 18560, Floor screed in building construction
- EN 15377, Heating systems in buildings
- DIN 1055-3, Imposed loads on buildings
- DIN 4102, Fire protection in building construction

Structural prerequisites

Prior to installation of the TECEfloor floor heating, the following structural prerequisites have to be met:

- The rooms are roofed, windows and doors are built in
- Interior plasterwork has been completed
- Layout has been marked in all rooms
- Power and water connections have been fitted
- Load-bearing flooring is sufficient solid and dry.
- Flatness tolerances in accordance with German standard DIN 18202 are observed
- Recesses for heating circuit manifolds and heating pipes have been created
- A joint plan (if required) exists

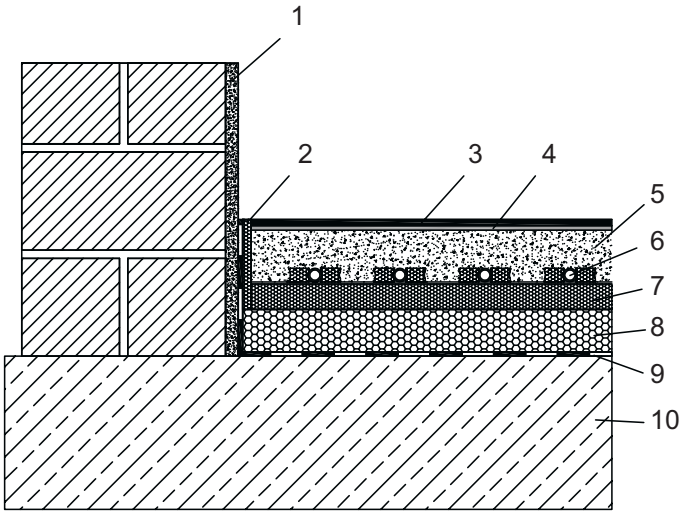
Note: For a clear distribution of tasks and to prevent overlapping of trades, it is advisable to use the specifications which the German Panel Heating Federation (Bundesverband Flächenheizungen) has defined in its specialist leaflet entitled "Interface co-ordination in heated floor constructions" (April 2010 edition).

Floor construction, brick-wall construction method

General

The use of TECEfloor floor heating is possible for all the buildings specified in DIN EN 1264 – residential, office and commercial buildings, and other buildings whose use corresponds to, or is similar to, residential buildings. During planning, structural requirements for the floor structure must be taken into account, in addition to the thermal and sound insulation requirements. Depending on the type of use, it is necessary to plan the appropriate TECEfloor system, any required additional insulation materials and screed thickness and qualities for the type of use. The following table provides an overview of the usual imposed loads for various types of use.

Type of use	Vertical imposed loads for ceilings in accordance with DIN 1055-3 (DIN EN 1991-1-1)
Residential areas	2.0 kN/sqm.
Office areas, schools, cafes, restaurants	3.0 kN/sqm.
Retail businesses, conference rooms, lecture halls, churches	4.0 kN/sqm.
Department stores, exhibition rooms, museums, concert halls, gymnasiums, access areas, public buildings	5.0 kN/sqm.



1 Interior plaster
2 Edge insulation strip
3 Floor covering
4 Mortar bed/adhesive
5 Screed
6 Heating pipe
7 System panel
8 Additional thermal insulation
9 Building waterproofing (if required)
10 Bare floor (floor slab)

General floor heating structure in brick-wall construction

Building waterproofing

Floors that adjoin the ground must be waterproofed in accordance with DIN 18195 dependent on the load. The type and arrangement of building waterproofing must be defined by the building planner. Waterproofing is executed in accordance with DIN 18336.
If PVC or solvent-containing waterproofing is used under polystyrene insulating materials, there must be a separating layer (e.g. PE foil) between these structural layers to prevent the migration of plasticizer, which could destroy the polystyrene insulating materials.

If damp-proofing against surface water is planned for the building in wet rooms (bathrooms, showers etc.), the damp-proofing must be integrated above the load distribution layer. This automatically protects the screed and ensures a separation of the trades.

Thermal and impact sound insulation

Thermal insulation requirements in accordance with EnEV and DIN EN 1264

The thermal requirements for the building shell are defined in the German Energy Saving Ordinance (EnEV) and are shown in the energy performance certificate created for the building. Irrespective of the thermal building shell shown in the energy performance certificate, additional minimum thermal resistance values (see table below) must be taken into account for the use of panel heating adjacent to the ground, with outside air temperature below, or adjacent to unheated rooms.

Application case	Minimum thermal resistance
Heated room below	R 0.75 (m²·K)/W
Unheated or occasionally heated room below or directly on the ground (groundwater > 5 m)*	R 1.25 (m²·K)/W
Outside air below (-5 °C > Td -15 °C)	R 2.00 (m²·K)/W

* With a groundwater level of 5 m, a higher R value should be used.

According to specifications from the German Institute for Building Technology (DIBt), in the case of thermal insulation with a thermal resistance of at least 2.0 m^2K/W between heating surface and the outside construction element or the construction element adjacent to an unheated room, the additional specific transmission heat loss of the panel heating can be disregarded and therefore do not need to be taken into consideration when calculating the annual energy requirement (in accordance with DIN V 4108-6).

Impact sound insulation requirements

The sound insulation in a building has a significant impact on the indoor environment quality. It is therefore necessary to plan and execute measures for impact sound insulation. The minimum requirements for sound insulation are defined in DIN 4109.
Suggestions for higher sound insulation can be found in supplement 2 of DIN 4109. If they are applied, this must be expressly agreed between the building client and the designer.
If the adjusted, valuated standard impact sound level of the floor structure meets the requirements of DIN 4109 or VDI 4100, use of the selected impact sound insulation is sufficient.

The following applies for calculating a specified floor construction:

$$L_{n,w,R} = L_{n,w,eq,R} - \Delta L_{w,R} + 2\ dB$$

with

$L_{n,w,R}$	adjusted, valuated standard impact sound level
$L_{n,w,eq,R}$	equivalent, valuated standard impact level (of the bare floor)
$\Delta L_{w,R}$	Impact sound improvement of the screed/ insulating layer
2 dB	Correction value (safety margin)

Further information on thermal and impact sound insulation

- Incorporating more than two impact sound insulation layers in a floor structure is not permitted.
- The compressibility of all insulating layers used must not exceed 5 mm with area loads 3 kN/m^2 or 3 mm with area loads 5 kN/m^2
- Conduits or other pipes must be laid in the compensating insulation layer. The height of the compensating insulation layer corresponds to the height of the conduits or pipes.
- Conduits or other pipes must not penetrate the required impact sound insulation layer.

Edge insulation strip requirements

Edge insulation strips play an important role between the screed and adjacent components. In addition to absorbing the thermal expansion of the load distribution layer, the edge insulation strip, if set correctly, improves the sound impact insulation properties of the floating heating screed and prevents the thermal bridge to adjacent components. DIN 18560 for screed requires freedom of movement of 5 mm for edge insulation strips. Edge insulation strips with a thickness of 7 to 8 mm are usually sufficient for this. Information for flowing calcium sulphate screeds states that edge insulation strips with a thickness of 10 mm must be used in flowing screed structures.
Edge insulation strips must be applied on the last additional insulating layer. Uninterrupted attachment along the door frames, steps or supports and installed elements (e.g. pillars) has to be ensured. Overhanging remnants of the edge insulation strip must not be removed until the floor coverings have been laid.

Load distribution layers

In terms of their mortar composition, screeds of heated floor constructions do not differ in any way from heated screeds in residential buildings. The screed can be created as a construction site screed on a cement or calcium sulphate basis with the corresponding stability values in accordance with DIN 18560 part 2, tab. 1–4. The screed thicknesses are also defined in DIN 18560 and the outer diameter of the pipes (d) must be added to them (see table below).

Minimum screed thicknesses in accordance with DIN 18560-2

Area load	C	CT F4	CT F5	CAF F4	CAF F5
2 kN/sqm.	5 mm	45 + d	40 + d	40 + d	35 + d
3 kN/sqm.	5 mm	65 + d	55 + d	50 + d	45 + d
4 kN/sqm.	3 mm	70 + d	60 + d	60 + d	50 + d
5 kN/sqm.	3 mm	75 + d	65 + d	65 + d	55 + d

C = max. permitted compressibility of insulation layers
CT F4/CT F5 = cement screed CT of bending tensile strength F4/F5
CAF F4/CAF F5 = calcium sulphate flowing screed of bending tensile strength F4/F5
d = outer diameter of heating pipes or dimple height

In addition, heating screeds must enclose the pipe well (for reliable heat transfer) and have a temperature resistance of up to 55 °C.

Cement screed and conventional calcium sulphate screed

Cement screeds and conventional calcium sulphate screeds should be installed in a soft-plastic consistency to ensure the heating pipe is enclosed evenly and completely, thus ensuring optimum heat transfer. The plasticity of screeds with earth-moist consistency can be improved by using a suitable additive.

Calcium sulphate flowing screed

Flowing screeds are used in both residential and commercial buildings. They can be processed quickly and easily thanks to their high flowability. However, it is necessary to note here that because of the highly fluid consistency, the edge joint area must be sealed carefully and there must be no gaps between heat-insulation boards.
Calcium sulphate flowing screed must be produced in accordance with DIN 18560 and installed in accordance with manufacturer instructions. Manufacturers' processing guidelines must be observed in particular for the planning of joint section sizes, use in wet and damp rooms and temperature resistance. In the case of calcium sulphate flowing screed, no additives are added.

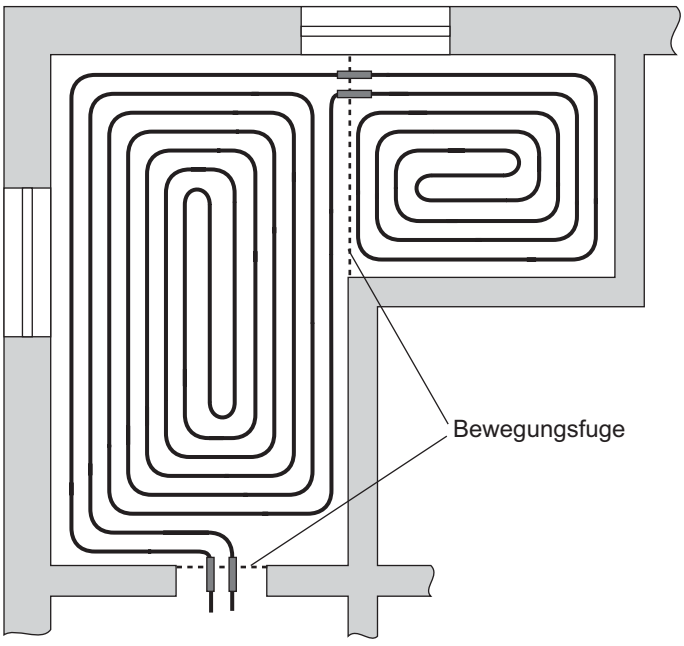
Movement joints

Movement joints are joints in the screed that separate the screed completely through to the insulation layer. According to DIN 18560 and DIN EN 1264, the building planner must draw up a joint plan and present this to the contractor as part of the specification of services. Heating screeds are to be separated by joints at the following points, in addition to the circumferential separation through edge insulation strips:

- For screed areas > 40 m² or
- For side lengths > 8 m or
- For side ratio a/b > 1/2
- Via movement joints in the building
- In the case of strongly projecting sections
- In door lintels and passages

Movement joints must be included in such a way that at least 5 mm of compressible space exists between the screed sections. They must not be bridged by reinforcement mats or carrier masses. After completion, they must be elastically filled or closed with joint profiles. During the planning of heating screeds, the heating circuits and movement joints must be aligned to each other as follows:

- The heating circuits are to be planned and laid in such a way that they under no circumstances run through joints.
- Only connection pipes can cross the joints.
- In these areas, the heating pipes must be protected against shear stress over an area of 15 cm on either side of the joint by a protective pipe.



Position of the movement joints and position of the protective pipes

Function heating

According to EN 1264, cement screed and calcium sulphate flowing screeds must be heated up before the the floor covering is laid. The following minimum time period must elapse between screed laying and function heating:

- 21 days for cement screeds
- 7 days for calcium sulphate flowing screeds
- Or according to manufacturer information

When the floor heating is turned off after the heat-up phase, the screed must be protected against draughts and from cooling down too fast.

Floor coverings

Before laying, the heating must be switched off or the flow temperature reduced to such an extent that the screed surface temperature is no more than 15 to 18 °C.
Only materials designated by the manufacturer as "suitable for floor heating" and that are temperature-resistant can be used as primers, fillers and adhesives. These materials must be resistant to a permanent temperature load of 50 °C.

The following floor covering types can be laid if the maximum thermal resistance of $R_{\lambda,B}$ 0,15 (m²·K)/W is met and they are approved by the manufacturer for laying on a heating screed.

Stone, brick, ceramics

Stone, brick and other ceramic surfaces are best suited for floor heating systems. The laying methods common in the tiling and slab-laying trade can be used without restrictions:

- Thin-bed method on hardened screed
- Thick-bed method on hardened screed
- Mortar bed on separating layer

Parquet

It is appropriate to glue the wooden parquet coverings suitable for floor heating. Care must be taken to ensure that the wood and screed dampness during laying corresponds to the value permitted in the standard and that the adhesive remains permanently elastic.

Plastic coverings

Plastic coverings are also suitable in principle for floor heating systems. The gluing of plastic panels or plastic lengths is recommended.

Textile floor coverings

Carpets should be glued in order to achieve better heat transfer. The carpet should be no thicker than 10 mm.

Floor covering material	Thickness in mm	Heat conductivity λ in W/mK	Thermal resistance $R_{\lambda,B}$ in (m²·K)/W
Ceramic tiles	13	1.05	0.012
Natural stone slabs	12	1.20	0.010
Marble	15	2.10	0.007
Carpet			0.070-0.170
Needle-punched floor covering	6.5	0.54	0.120
Linoleum	2.5	0.17	0.015
PVC coverings	2.0	0.20	0.010
Mosaic parquet	8.0	0.20	0.040
Strip parquet	16.0	0.20	0.080
Laminate	9.0	0.17	0.053

Planning guidelines for floor coverings glued over entire surface

Check on the readiness for covering

The residual moisture content of the screed required for readiness for covering must be determined by a top surface specialist company using a suitable means of measurement. If necessary, the client must commission a heating process to make the screed ready for covering to achieve the required residual moisture (special service according to VOB).

Maximum moisture content of the screed in % permitted for readiness for laying the floor covering, calculated with the CM device:

Surface	Cement screed target (%)	Calcium sulphate screed target (%)
Textile coverings and elastic coverings	1.8	0.3
Parquet	1.8	0.3
Laminate flooring	1.8	0.3
Ceramic tiles or natural/concrete stones	2.0	0.3

The specialist information "interface coordination in the event of heating floor constructions" provides information on the preparatory measures for laying surface coverings, the CM measuring and the heating of the screed for readiness for covering with particular requirements relating to the max. moisture content.

System pipes

The quality of panel heating system depends to a large degree on the quality of the pipes used. They must be resistant to the formation of cracks, oxygen-tight and corrosion-free.

Thanks to a permanent quality control in the recognized TECE testing laboratory, TECE also offers a high level of safety and reliability for all heating pipes, ensuring that the heating pipes continue to function perfectly even after many years of use.

Four types of heating pipes are available for use in panel heating systems:

- Cross-linked SLQ PE-Xc floor heating pipes
- Non-cross-linked SLQ PE-RT type 2 floor heating pipes
- SLQ PE-RT/AL/PE composite metal pipes
- Cross-linked PE-MDXc five-layer floor heating pipes

These four pipe types are characterized e.g. by a long life, corrosion and incrustation resistance, chemical resistance and flexibility, and are particularly easy to lay.

SLQ PE-Xc floor heating pipe

The SLQ PE-Xc floor heating pipes made of high-density electron beam cross-linked polyethylene are manufactured in accordance with DIN 16892 and are oxygen diffusion-tight in accordance with DIN 4726.
The special physical cross-linking of the molecule chains ensures high temperature and pressure resistance. Crack propagation on notches and grooves is reliably avoided.

The heating pipes are offered in dimensions 14 x 2 mm, 16 x 2 mm and 17 x 2 mm. The minimum bending radius is 5 x d.

Classification in accordance with DIN EN ISO 15875-2:

Dimension	Class 4	Class 5
14 x 2 mm	10 bar, Tmax 70 °C	10 bar, Tmax 90 °C
16 x 2 mm	10 bar, Tmax 70 °C	8 bar, Tmax 90 °C
17 x 2 mm	10 bar, Tmax 70 °C	8 bar, Tmax 90 °C

SLQ PE-RT type 2 floor heating pipe

The SLQ PE-RT floor heating pipes made of non-cross-linked polyethylene are manufactured in accordance with DIN 16833 and are oxygen diffusion-tight in accordance with DIN 4726. For PE-RT heating pipes, a specially modified polyethylene is used, the molecular structure and composition of which guarantee excellent thermal stability and high mechanical stability at temperatures of up to 90 °C.

The heating pipes are offered in dimensions 14 x 2 mm, 16 x 2 mm, 17 x 2 mm and 20 x 2 mm. The minimum bending radius is 5 x d.

Classification in accordance with DIN EN ISO 22391-2:

Dimension	Class 4	Class 5
14 x 2 mm	10 bar, Tmax 70 °C	8 bar, Tmax 90 °C
16 x 2 mm	8 bar, Tmax 70 °C	8 bar, Tmax 90 °C
17 x 2 mm	8 bar, Tmax 70 °C	6 bar, Tmax 90 °C
20 x 2 mm	6 bar, Tmax 70 °C	6 bar, Tmax 90 °C

SLQ PE-RT/AL/PE composite metal pipes

The five-layer SLQ PE-RT/AL/PE composite metal pipes consist of a non-cross-linked PE-RT type 2 inner pipe, a bonding agent layer, a butt-welded aluminium core pipe, another bonding agent layer and a PE outer sheath. They are manufactured in accordance with DIN 16836 and are 100 % oxygen diffusion-tight. In practical use, composite metal heating pipes are dimensionally stable but can still be flexibly laid.
In addition to these optimum laying properties, they offer a very low coefficient of linear expansion.
Particularly suited for dry construction, dimpled sheets and wall heating.

The heating pipes are offered in dimension 16 x 2 mm. The minimum bending radius is 5 x d.

Pressure/temperature load: 6 bar / Tmax 60 °C

SLQ PE-MDXc five-layer floor heating pipe

The PE-MDXc five-layer floor heating pipe – in accordance with German standard DIN 16894/95 – is a further development of the PE-Xc pipe with special properties for use in floor heating. It is electron beam cross-linked like a PE-Xc pipe, but has excellent flexibility thanks to the use of MD-PE.
The PE-MDXc heating pipe is constructed using the five-layer technology. The oxygen barrier layer is in the middle of the pipe sheathing and is therefore effectively protected against
damage.

Classification in accordance with DIN EN ISO 21003:

Dimension	Class 4	Class 5
16.25 x 2.1 mm	6 bar, Tmax 70 °C	6 bar, Tmax 90 °C

Application classes and classification of operating conditions in accordance with ISO 10508

Application class	Calculated temperature T_D °C	Operating duration[b] at T_D Years [a]	T_{max} °C	Operating duration at T_{max} Years	T_{mal} °C	Operating duration at T_{mal} Hours	Typical application area
1 [a]	60	49	80	1	95	100	Hot water supply (60 °C)
2 [a]	70	49	80	1	95	100	Hot water supply (70 °C)
3 [c]	20	0.5	50	4.5	65	100	Low-temperature floor heating
	30	20					
	40	25					
4 [b]	20	2.5	70	2.5	100	100	Floor heating and low-temperature radiator connection
	40	20					
	60	25					
5 [b]	20	14	90	1	100	100	High-temperature radiator connection
	60	25					
	80	10					

T_D = temperature for which the pipe system is designed.
T_{max} = maximum temperature that can occur for a short time
T_{mal} = maximum possible temperature that can occur occasionally in the event of a fault (max. 100 hours in 50 years)

[a] A country can select either class 1 or class 2 in accordance with its national regulations.

[b] If, for an application class, there is more than one calculated temperature for the operating duration and the temperature associated with it, the related times of the operating duration should be added. "Plus cumulative" in the table implies a temperature combination of the specified temperature for an operating duration (e.g. the temperature combination for a duration of 50 years for class 5 comprises: 20 °C over 14 years, followed by 60 °C over 25 years, followed by 80 °C over 10 years, followed by 90 °C over 1 year, followed by 100 °C over 100 h).

[c] Only permitted if the temperature during a fault cannot rise above 65 °C.

Connection technology

All fittings and screw connections for connecting the SLQ floor heating pipes are carefully designed, adjusted and extensively checked in accordance with all test requirements prior to market launch. Ongoing quality monitoring is naturally carried out on pipes and connection technology by an external institute. This ensures the permanent and reliable functionality in the best possible way.

Connections in the screed

During the installation of floor heating, the question of whether connections in the screed are permitted comes up again and again. Surprisingly, pipe connections below the screed, e.g. in the case of radiator connection or potable water installation, are not questioned.

According to DIN 18380:2010-04 (VOB, part C, 3.2.7), connections that can be undone and that are not permanently tight must be accessible. Conversely, permanently tight connections can be installed in the building structure. This is common practice for radiator connection and potable water installation.

The testing procedure of the respective pipe standards indicates whether a connection is permanently tight. For PE-Xc pipes, for example, DIN EN ISO 15875-5 "Plastics piping systems for hot and cold water installations. Cross-linked polyethylene (PE-X). Fitness for purpose of the system". Here, part 4 describes the testing requirements for pipes with connectors. If these conditions are met, the connection is regarded as permanently tight within the framework of this standard.

The results of an independent test can be confirmed as part of a certification, e.g. "DIN CERTCO". The system is then subject to regular monitoring by an independent institute.

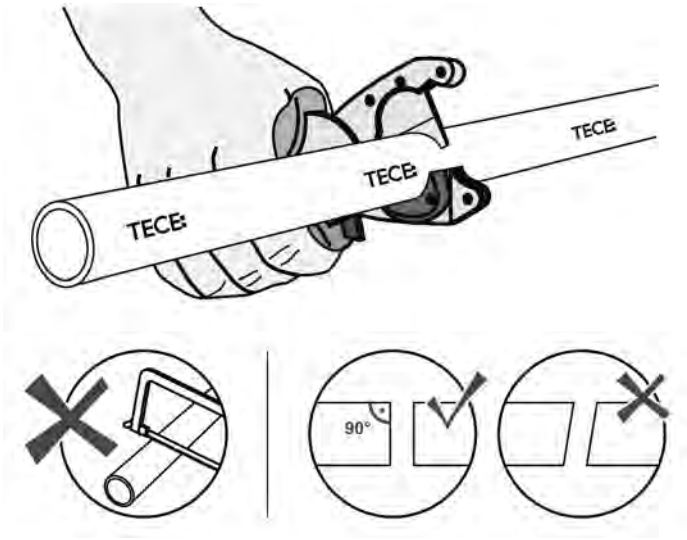
Metal connections must be protected against materials that could have a destructive effect. According to DIN 18380 (VOB, part C, 3.1.9), the use of these materials is not permitted, but is still advisable to mask connections in the screed as a preventive measure and thus protect them against contact with potentially destructive materials, such as plaster or rapid-cementing agents containing chloride.
According to DIN EN 1264-4, the position of all connections in the screed must then be defined in an inspection drawing.

SLQ Eurocone clamping ring connection

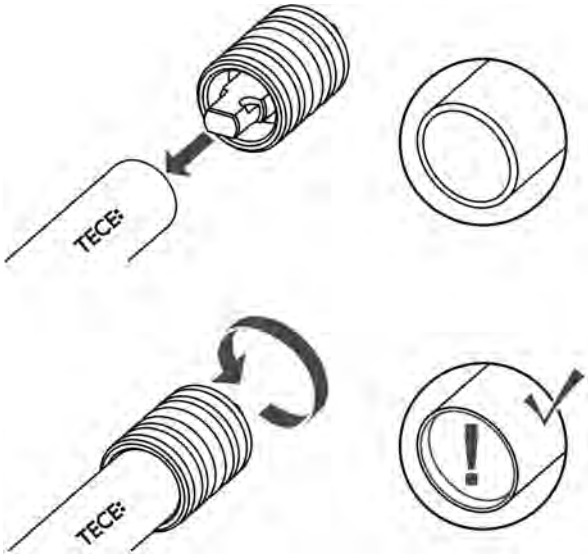
The quality-monitored, compatibility-tested SLQ Eurocone clamping ring connections are fitted with a plastic clamping ring. This prevents damage to the pipe end caused by sharp edges and burr. The screw connection is designed with a "fixed" stop point. This reliably prevents overtightening and overpinching. The nickel-plated union nuts of the SLQ Eurocone clamping ring connection are marked with a system ID and dimension information (e.g. SLQ 16). This prevents use with other pipe systems and pipe dimensions by mistake.
The tested SLQ system also includes a calibrator specially designed for the SLQ range and optimally adapted to the pipe and clamped joint.

Installation

- Cut the pipe at a right angle with a pipe cutter.



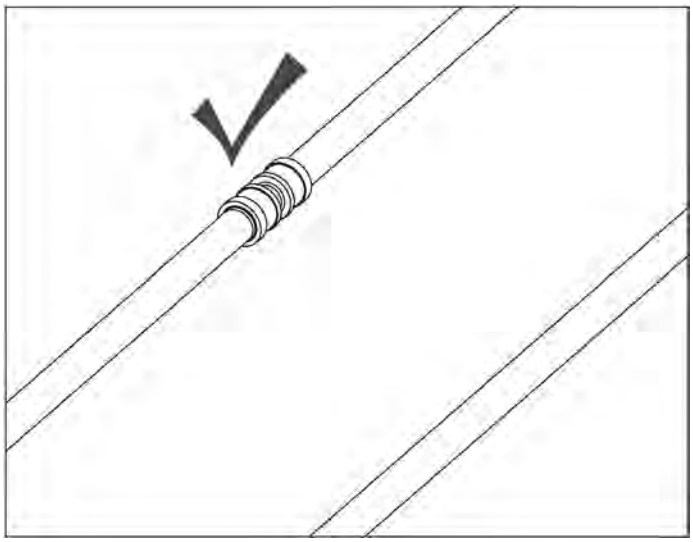
- Deburr and calibrate the pipe end prior to installation.



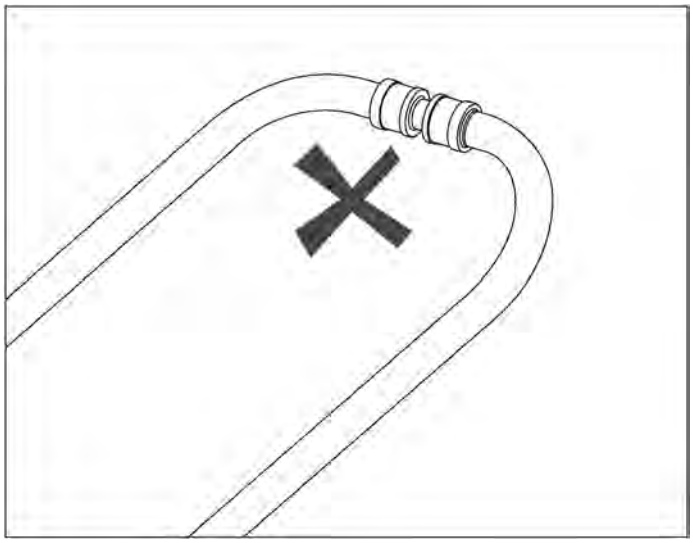
- Fit the union nut with clamping ring.
- Carefully fit the grommet on the pipe with a turning motion.
- Tighten the union nut as far as it will go, SW 27.
- Connection pipes must be vertical or horizontal to the screw connection.
- If necessary, align pipe and fix.

SLQ pressure sleeve coupling for all-plastic pipes

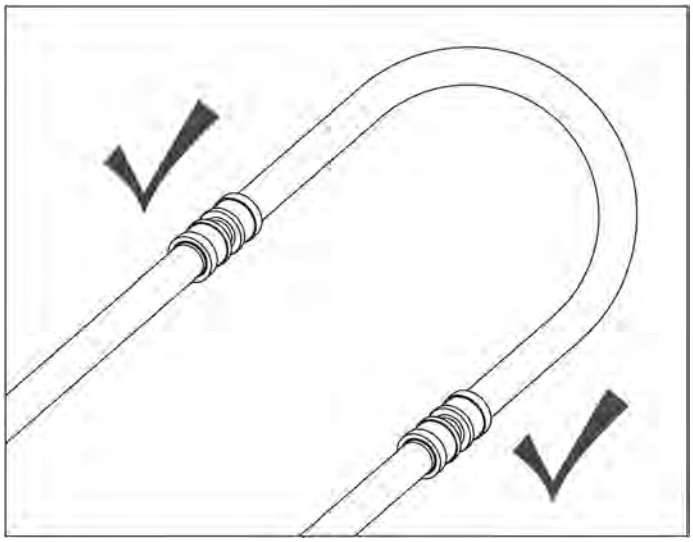
The both reliable and easy-to-process SLQ pressure sleeve coupling uses the long proven TECEflex technology.
The expansion tool and crimping pliers from the TECEflex range can therefore be used. The SQL range contains special expanding heads for the 17 x 2.0 mm and 20 x 2.0 mm pipes.



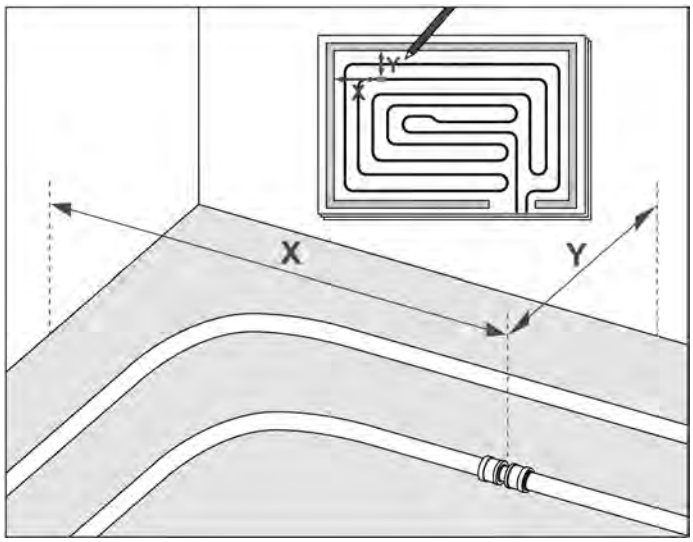
The expansion of the pipe ends hardly restricts the clear pipe cross-section in the coupling. Couplings should not be installed in elbows or bends:



If necessary, in the event of a leak specifically in the reversal bends, two couplings should be used:



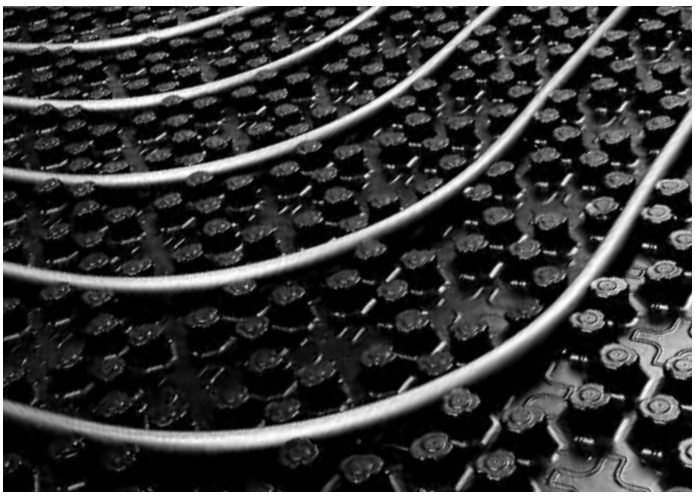
As described earlier in the section "Connections in the screed" the position of the couplings must be marked in the inspection plan.



System panels

Dimpled panel system

Three versions of the TECEfloor dimpled panel system are available. The dimpled panel 30-2 with 30 mm thick impact sound insulation on the underside, the 11 dimpled panel with an 11 mm thick thermal insulation on the underside, and the dimpled sheet without insulation on the underside. All three versions consist of a polystyrene multifunctional cover foil on the top, which ensures excellent pipe support, excellent walk-on stability and a reliable barrier against screed mixing water and moisture. The special dimple contour permits laying distances (spacing) of 6 cm and multiples thereof and can hold heating pipes of dimensions 14, 16 and 17 mm. The dimpled panels/ sheets are installed in the floor structure below the load distribution layer of cement or calcium sulphate screed.



Dimpled panel 30-2

Dimpled panel 30-2 is a highly effective heat and sound impact system. It meets the minimum insulation requirements of DIN EN 1264-4 for partition ceiling against heated rooms and achieves an impact sound improvement of 28 dB. Higher insulation requirements in accordance with EnEV (German Energy Savings Ordinance) or higher impact sound requirements should be investigated and implemented on the construction site. The maximum permitted moveable load of dimpled panel 30-2 is 5 kN/m².

Dimpled panel 11

Dimpled panel 11 is used for high moveable loads of up to 30 kN/m². It has 11 mm thermal insulation on the underside without impact sound properties. The thermal resistance of the panel is R = 0.31 m²K/W. Higher insulation requirements in accordance with DIN 1264-4 or EnEV and impact sound requirements in accordance with DIN 4109 should be investigated and implemented on the construction site.

Dimpled sheet

The dimpled sheet is designed to be laid on insulation installed by the customer. Insulation requirements in accordance with DIN 1264-4 or EnEV and impact sound requirements in accordance with DIN 4109 should be investigated and implemented on the construction site.

Technical data

	Dimpled panel 30-2	**Dimpled panel 11**	**Dimpled sheet**
Insulation material	EPS 040 DES sg	EPS 035 DEO	-
Multifunctional foil material	PS foil	PS foil	PS foil
Installation dimension (length x width)	1440 x 840	1440 x 840	1440 x 840
Insulation layer thickness under heating pipe	30 mm	11 mm	-
Laying distances	6 cm grid	6 cm grid	6 cm grid
Thermal resistance	0.75 m²K/W	0.31 m²K/W	-
Impact sound improvement**	28 dB	-	-
Building material class in accordance with DIN 4102	B2	B2	B2
Area load max.	5 kN/sqm.	30 kN/sqm.	*

* depending on the insulation used

** in the case of a solid floor slab and a screed on the impact sound insulation with a mass of ≥ 70 kg/m²

Tacking sheets

Two versions of the TECEfloor tacking sheet system are available: As roll insulation 30-2 and roll insulation 30-3 with a 30 mm thick impact sound insulation. Both versions consist of a insulation panel, slit at intervals, on the underside, and a composite foil applied on the top side. The tacking cover layer consisting of a strip woven film is the basis for straightforward, fast and reliable laying of the heating pipes. A grid is printed on the upper surface of the foil, enabling laying distances (spacing) of 5 cm and multiples thereof.
Heating pipes in dimensions 14 x 2 mm, 16 x 2 mm and 17 x 2 mm can be laid using special tacking pins. The sheets are installed in the floor structure below the load distribution layer of cement or calcium sulphate screed.

Roll insulation 30-2

Roll insulation 30-2 is a highly effective heat and sound impact system. It meets the minimum insulation requirements of DIN EN 1264-4 for partition ceiling against heated rooms and achieves an impact sound improvement of 28 dB. Higher insulation requirements in accordance with EnEV or higher impact sound requirements should be investigated and implemented on the construction site. The maximum permitted moveable load of tacking sheet 30-2 is 5 kN/m².

Roll insulation 30-3

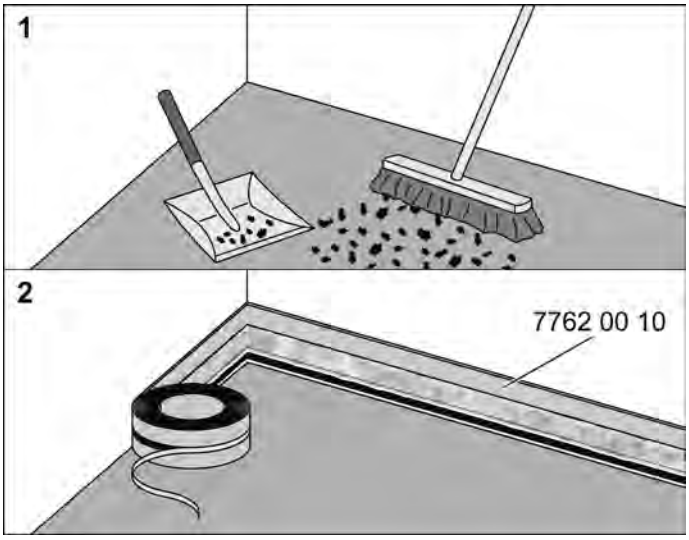
Roll insulation 30-3 can be used where additional thermal insulation is required by the customer. With a thermal resistance of 0.67 m²K/W , this roll insulation alone does not meet the minimum insulation requirements of DIN EN 1264. Roll insulation 30-3 achieves impact sound improvement of 29 dB. . The maximum permitted moveable load of tacking sheet 30-2 is 4 kN/m².

Technical data

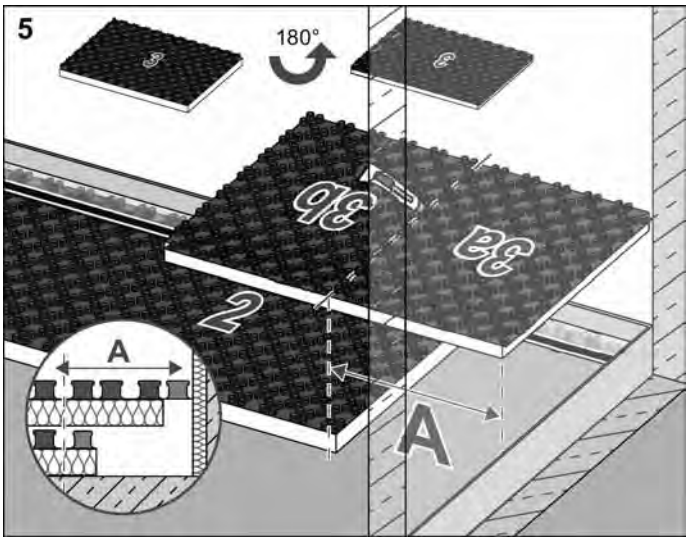
	Roll insulation 30-2	**Roll insulation 30-3**
Insulation material	EPS 040 DES sg	EPS 045 DES sm
Webbing woven film	PE	PE
Installation dimension (length x width)	10 x 1 m	10 x 1 m
Insulation layer thickness under heating pipe	30 mm	30 mm
Laying distances	5 cm grid	5 cm grid
Thermal resistance	0.75 m²K/W	0.67 m²K/W
Impact sound improvement**	28 dB	29 dB
Building material class in accordance with DIN 4102	B2	B2
Area load max.	5.0 kN/sqm.	4.0 kN/sqm.

* depending on the insulation used
** in the case of a solid floor slab and a screed on the impact sound insulation with a mass of ≥ 70 kg/m²

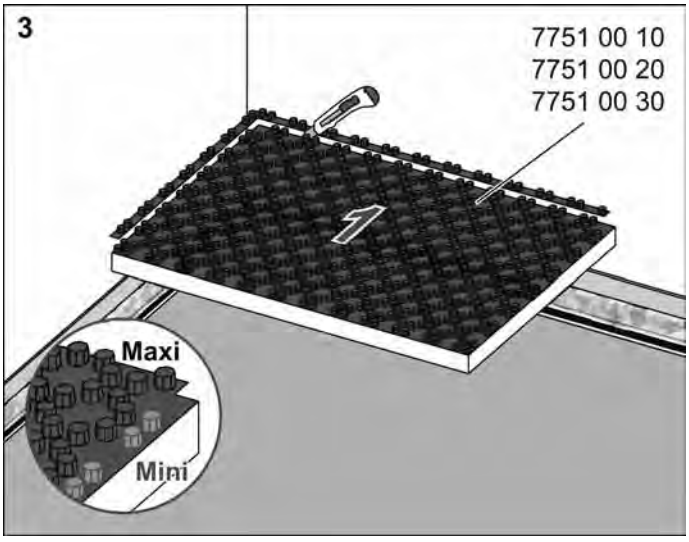
Installation instructions for dimpled panels



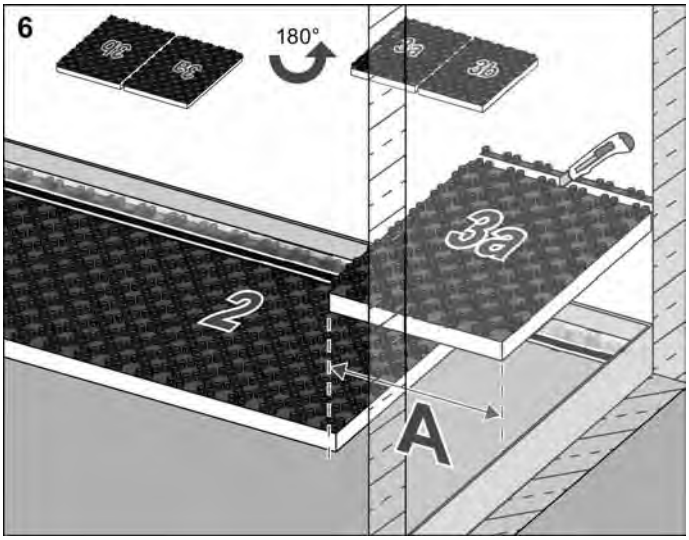
Clean the bare floor and attach the edge insulation strips.



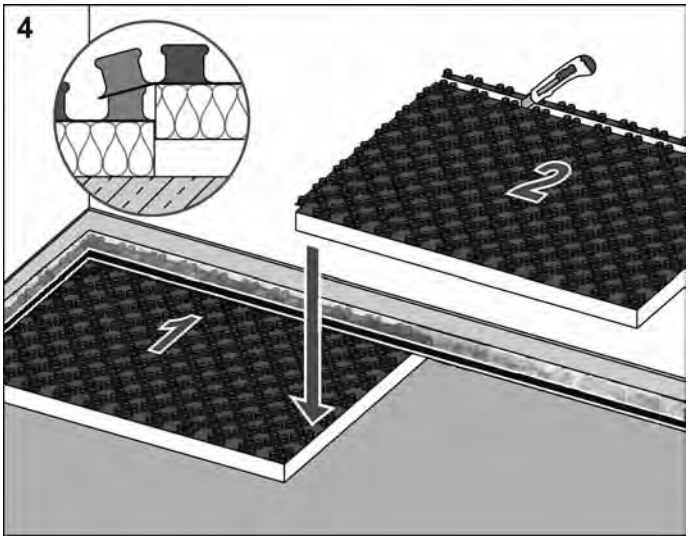
Rotate the last panel around 180° to determine dimension "A" (see detail).



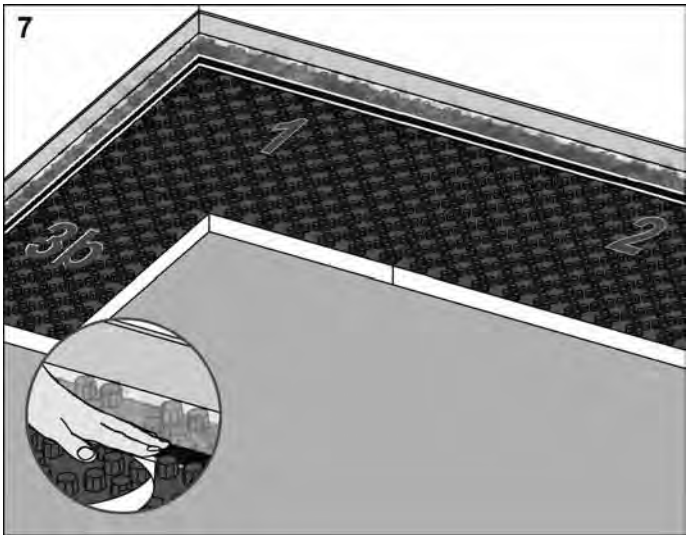
Cut off the overlap of the first dimpled panel as shown.



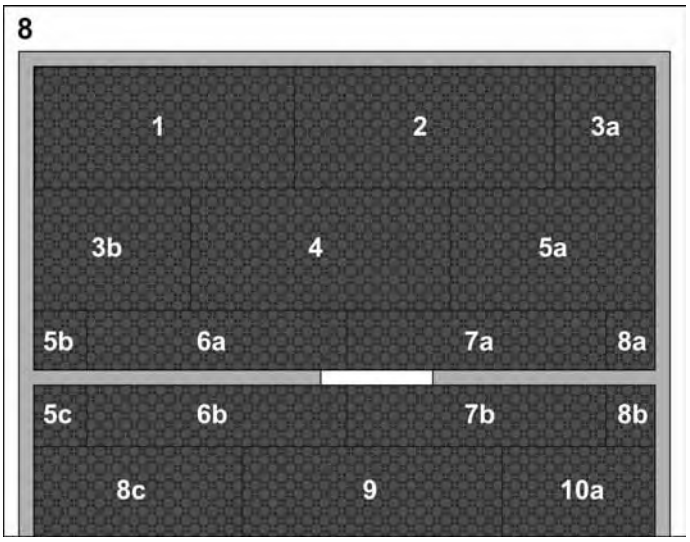
Turn the panel back, cut off the overlap and connect as before.



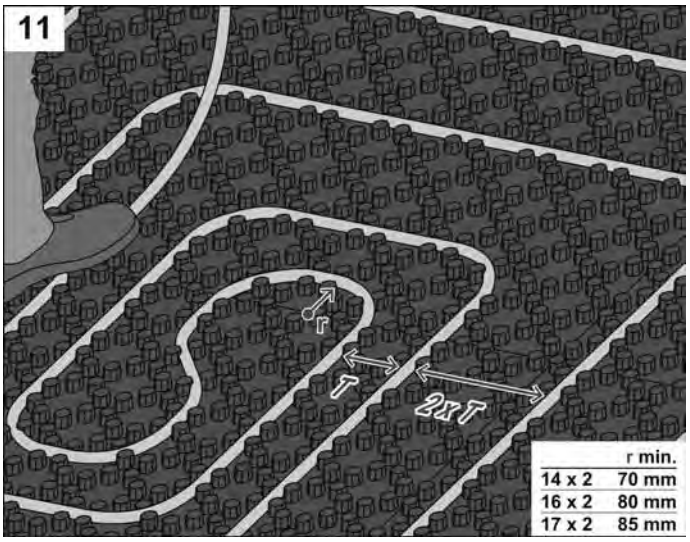
Cut of the overlap of the second and other dimpled panels of the first row on the long side and connect them using the press stud principle.



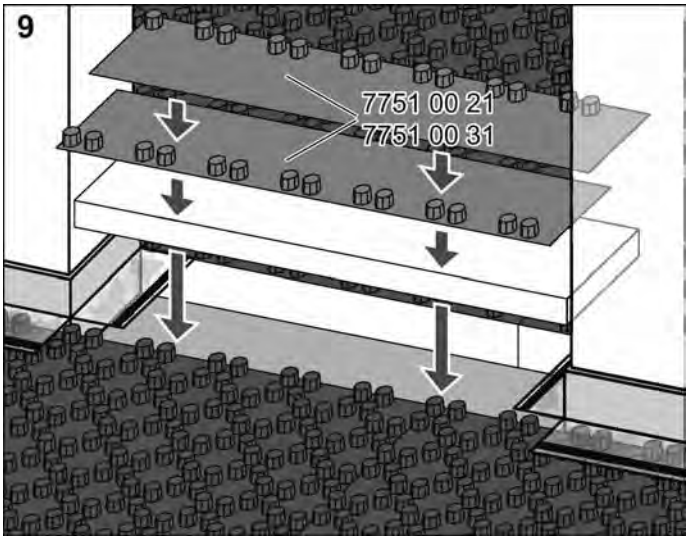
Start the second row with an offcut.



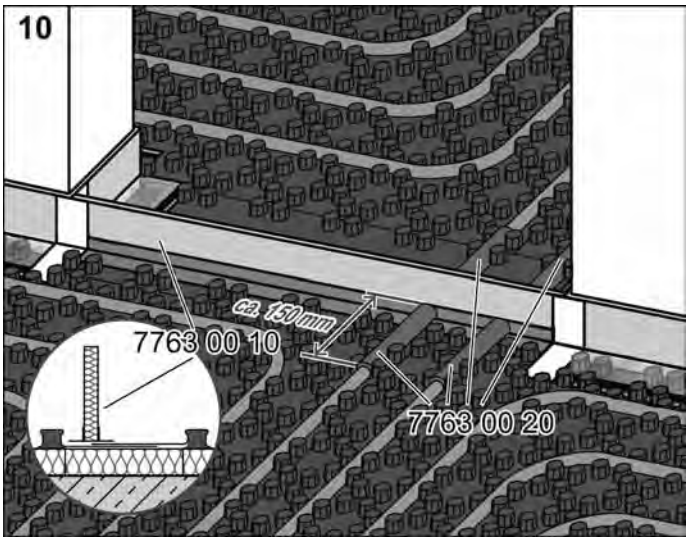
Cover the area with dimpled panels as shown. Use offcuts where possible in other spaces.



Lay the pipe in accordance with the plans, take account of bending radii.

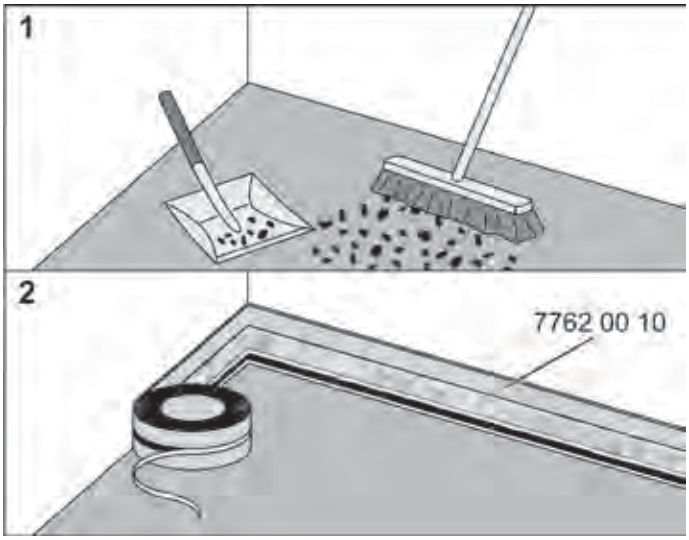


Lay compensating elements overlapping on the customer-installed insulating strips.

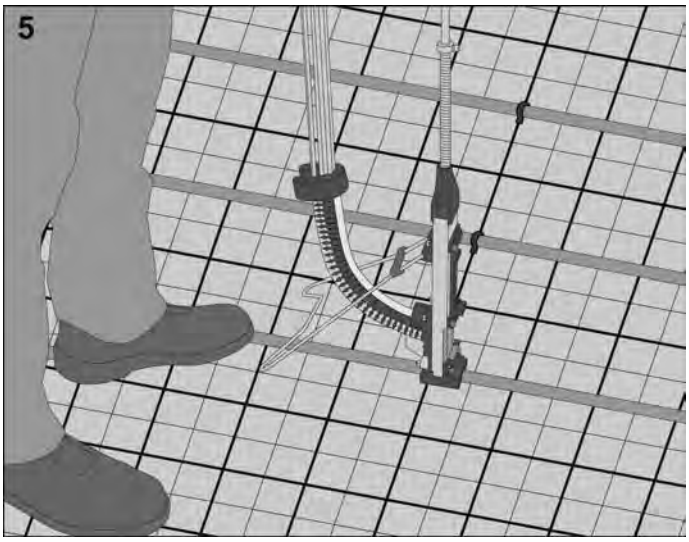


Place joint pipe protection and expansion joint profile in transitions and between the screed sections.

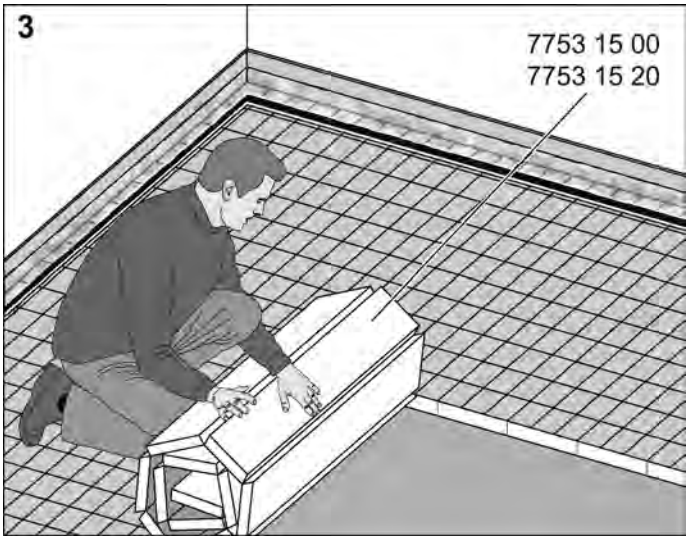
Installation instructions for tacking sheet system



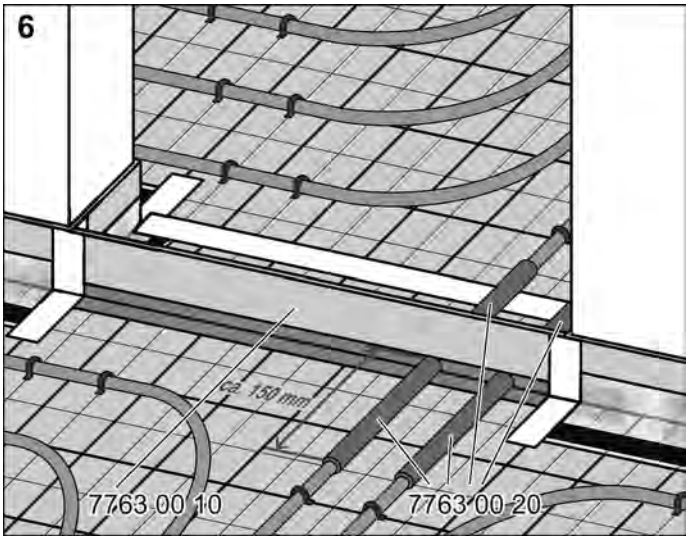
Clean the bare floor and attach the edge insulation strips.



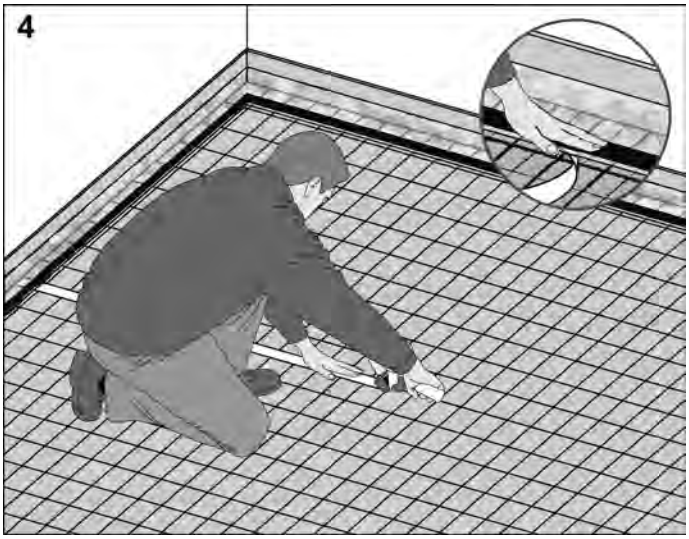
Lay pipes in accordance with the plans and fix to the roll insulation using tacking pins (distance apart in the case of cement screed max. 500 mm, for calcium sulphate screed max. 300 mm).



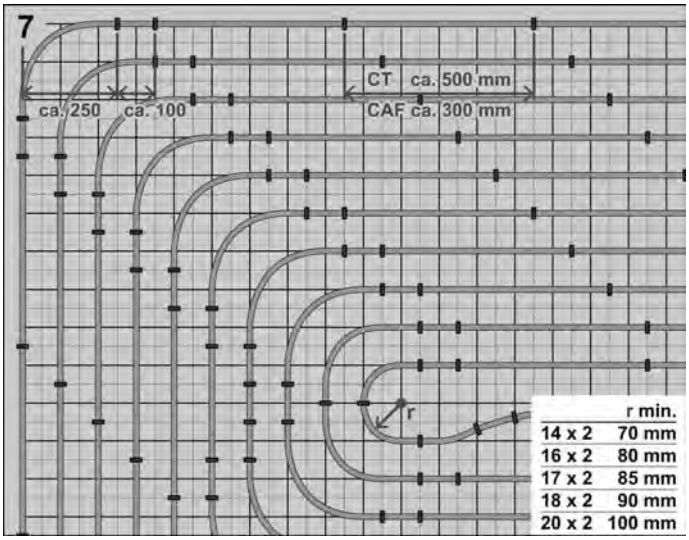
Roll out the roll insulation, apply additional insulation first, if necessary.



Place joint pipe protection and expansion joint profile in transitions and between the screed sections.

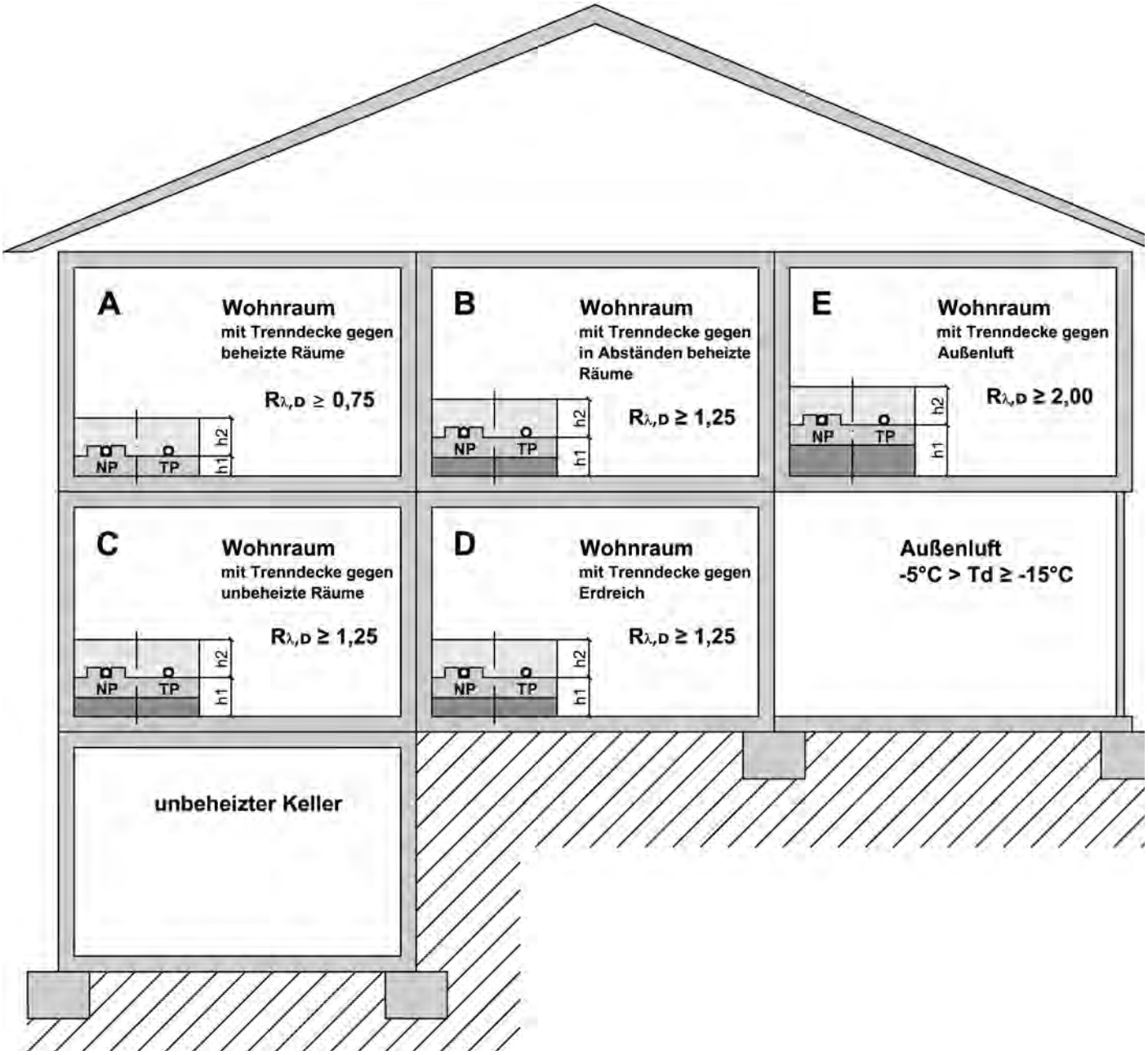


Tightly mask abutting edges and transitions to edge insulation strips.



Further fixing distances etc. in accordance with the installation instructions.

Minimum insulation requirement in accordance with DIN EN 1264-4



Note:

Irrespective of the minimum requirements of DIN 1264-4, the higher insulation requirements of EnEV must be taken into account for application cases B, C, D and E.

Minimum screed thicknesses h_2 in accordance with DIN 18560-2

Area load	C	CT F4	CT F5	CAF F4	CAF F5
≤ 2 kN/m²	≤ 5 mm	45 + d	40 + d	40 + d	35 + d
≤ 3 kN/m²	≤ 5 mm	65 + d	55 + d	50 + d	45 + d
≤ 4 kN/m²	≤ 3 mm	70 + d	60 + d	60 + d	50 + d
≤ 5 kN/m²	≤ 3 mm	75 + d	65 + d	65 + d	55 + d

C = max. permitted compressibility of insulation layers
CT F4/CT F5 = cement screed CT of bending tensile strength F4/F5
CAF F4/CAF F5 = calcium sulphate flowing screed of bending tensile strength F4/F5
d = outer diameter of heating pipes or dimple height

Minimum insulation thickness h_1 (in accordance with DIN 1264-4)

	Application case		
System	**A**	**B, C and D**	**E**
TECEfloor dimpled panel 30-2	30 mm	30 mm	30 mm
Minimum additional insulation in accordance with DIN EN 1264-2 (by the customer)	-	e.g. 20 mm EPS WLG 040	e.g. 50 mm EPS WLG 040
Thermal resistance $R_{\lambda,D}$	0.75 m²K/W	1.25 m²K/W	2.00 m²K/W
Minimum insulation thickness h_1	30 mm	50 mm	80 mm
TECEfloor dimpled panel 11*	11 mm	11 mm	11 mm
Minimum additional insulation in accordance with DIN EN 1264-2 (by the customer)	e.g. 20 mm EPS WLG 040	e.g. 40 mm EPS WLG 040	e.g. 70 mm EPS WLG 040
Thermal resistance $R_{\lambda,D}$	0.81 m²K/W	1.31 m²K/W	2.06 m²K/W
Minimum insulation thickness h_1	31 mm	51 mm	81 mm
TECEfloor dimpled sheet*	-	-	-
Minimum additional insulation in accordance with DIN EN 1264-2 (by the customer)	e.g. 30 mm EPS WLG 040	e.g. 50 mm EPS WLG 040	e.g. 80 mm EPS WLG 040
Thermal resistance $R_{\lambda,D}$	0.75 m²K/W	1.25 m²K/W	2.00 m²K/W
Minimum insulation thickness h_1	30 mm	50 mm	80 mm
TECEfloor tacking sheet 30-2	30 mm	30 mm	30 mm
Minimum additional insulation in accordance with DIN EN 1264-2 (by the customer)	-	e.g. 20 mm EPS WLG 040	e.g. 50 mm EPS WLG 040
Thermal resistance $R_{\lambda,D}$	0.75 m²K/W	1.25 m²K/W	2.00 m²K/W
Minimum insulation thickness h_1	30 mm	50 mm	80 mm
TECEfloor tacking sheet 30-3	30 mm	30 mm	30 mm
Minimum additional insulation in accordance with DIN EN 1264-2 (by the customer)	e.g. 5 mm EPS WLG 040	e.g. 25 mm EPS WLG 040	e.g. 55 mm EPS WLG 040
Thermal resistance $R_{\lambda,D}$	0.795 m²K/W	1.29 m²K/W	2.71 m²K/W
Minimum insulation thickness h_1	35 mm	55 mm	85 mm

* no impact sound (include additional insulation in the event of impact sound requirement)

Thermal conductivity group (TCG): The classification of insulating materials by thermal conductivity groups (TCG) is based on the measured value of thermal conductivity and aims to provide simplification in calculation and application. The thermal conductivity group is based directly on the measured value λ(R): λ(R) with 0.040 W/(m·K) = TCG 040.

Thermal resistance R_λ of the TECEfloor system panels

TECEfloor system panels	Thermal resistance R_λ
Dimpled panel 30-2	$R_{\lambda,SP}$ = 0.75 W/m²K
Dimpled panel 11	$R_{\lambda,SP}$ = 0.31 W/m²K
Dimpled sheet	$R_{\lambda,SP}$ = 0.00 W/m²K
Tacking sheet 30-2	$R_{\lambda,SP}$ = 0.75 W/m²K
Tacking sheet 30-3	$R_{\lambda,SP}$ = 0.67 W/m²K

Note:

When selecting additional insulation, the minimum requirements in accordance with EN 1264 are to be taken into consideration in conjunction with the TECEfloor system panel. Requirements resulting from the overall consideration of the building in accordance with EnEV must be specified by the building planner. The complete insulation construction of the floor heating must be appropriately adjusted to the building-specific requirements.

Example:

Single-family home with floor heating system TECEfloor dimpled panel 30-2, pipe dimension 14 x 2 mm
Architect's specification:

- Partition ceiling upper floor against heated ground floor:
  No requirements according to EnEV
- Floor slab ground floor (against ground):
  U value according to energy performance certificate:
  0.28 W/m²K
  ⇒ $R_{\lambda,D}$ = 1/U = 1/0.28 W/m²K = 3,57 m²K/W
- Floor slab thickness: 160 mm top of screed

Calculation of the required additional insulation or thermal conductivity group (TCG):

1. Partition ceiling upper floor against heated ground floor

   $R_{\lambda,D}$ total thermal insulation: 0.75 m²K/W
   (in accordance with DIN 1264-4)
   $R_{\lambda,SP}$ TECEfloor dimpled panel 30-2: - 0,75 m²K/W
   $R_{\lambda,ZD}$ additional thermal insulation: = 0 m²K/W

   ⇒ no additional thermal insulation required

2. Floor slab ground floor (against ground)

   Floor structure:
   160 mm top of screed
   - 60 mm heating screed
   - 30 mm TECEfloor dimpled panel 30-2
   = 70 mm additional insulation

   $R_{\lambda,D}$ total thermal insulation: 3.57 m²K/W
   $R_{\lambda,SP}$ TECEfloor dimpled panel 30-2: - 0,75 m²K/W
   $R_{\lambda,ZD}$ additional thermal insulation: = 2.82 m²K/W

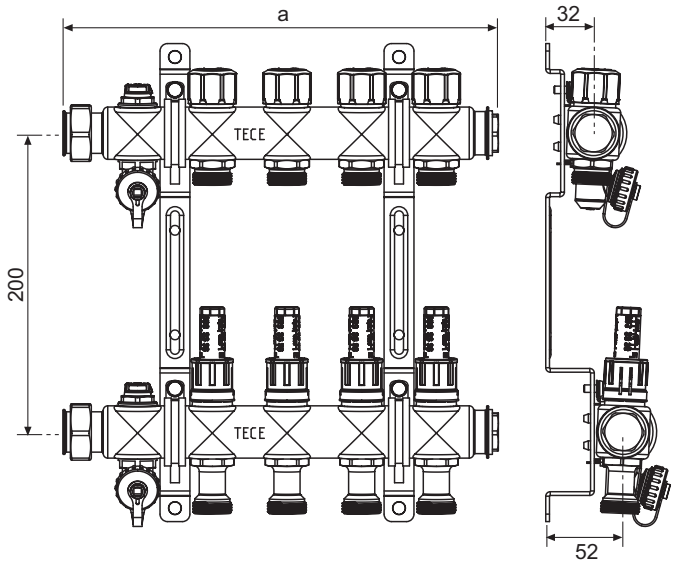
   $R_{\lambda,ZD} = d_{ZD} / \lambda_{ZD}$
   => $\lambda_{ZD} = d_{ZD} / R_{\lambda,ZD}$ = 0.07 /2.82 = 0.0248 W/mK

   ⇒ selected thermal insulation:
   70 mm PUR, TCG 025

$R_{\lambda,D}$ required thermal resistance of insulation total in m²K/W (in accordance with DIN EN 1264-4 or EnEV energy performance certificate)
$R_{\lambda,SP}$ thermal resistance of TECEfloor system panel in m²K/W
$R_{\lambda,ZD}$ required thermal resistance of additional thermal insulation in m²K/W
d_{ZD} thickness of additional thermal insulation in m
λ_{ZD} thermal conductivity of additional insulation in W/mK

Heating circuit manifolds and manifold housings

SLQ stainless steel heating circuit manifold with flow rate display



Heating circuits	Manifold width a in mm
2	190
3	240
4	290
5	340
6	390
7	440
8	490
9	540
10	590
11	640
12	690

As a complete manifold, the SLQ stainless steel heating circuit manifold consists of a two-part stainless steel special profile with integrated valve technology. Flat-sealing on the primary side with union nut G1 and on the secondary side ¾" Eurocone connection. With two rotatable fill/drain taps and two air bleed valves for manual bleeding.
Flow with flow metre, with shut-off and extra-fine control (0–5 l/min). Return with valve cores M 30 x 1.5 mm (supplied with protective cap), suitable for holding thermoelectric servomotors.

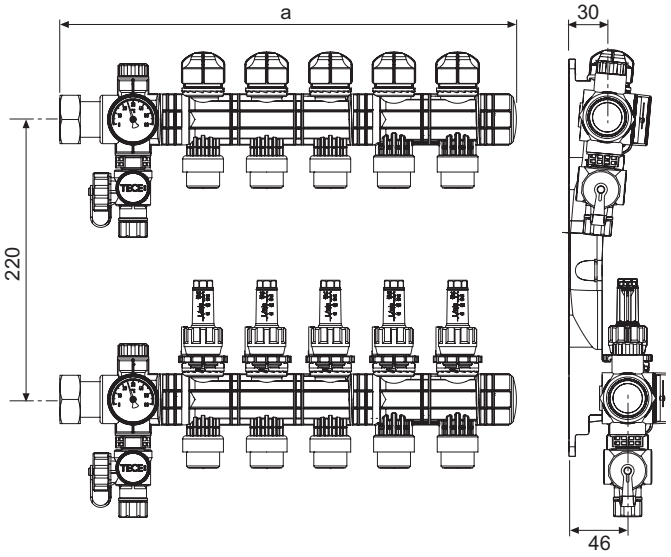
Kvs value flow/return valve: 1.12 /2.56 m³/h
Heating circuit distance: 50 mm

Incl. manifold wall mount with sound insulation inserts in accordance with DIN 4109 and attachment set.

Operating conditions:

Max. operating pressure: 6 bar
Max. operating temperature: 70 °C
Min. operating temperature: 6 °C
Max. testing pressure: 10 bar (< 30 °C)

SLQ plastic heating circuit manifold with flow rate display



The SLQ plastic heating circuit manifold consists of a basic module and one or more 2-way or 3-way connection modules with integrated valve technology.
Basic module flat-sealing on the primary side with union nut G1, flow and return thermometer, two rotatable fill/drain units and two air bleed valves for manual bleeding. Incl. manifold wall mount with sound insulation inserts in accordance with DIN 4109 and attachment set.
Connection module with with flow metre, with shut-off and extra-fine control (0–3.5 l/min) in the flow and thermostat valves M 30 x 1.5 mm (supplied with protective cap), suitable for holding thermoelectric servomotors in the return. Heating circuit outflow with ¾" Eurocone connection.

Heating circuits	Manifold width a in mm
2	202
3	252
4	302
5	352
6	402
7	452
8	502
9	552
10	602
11	652
12	702

Kvs value flow/return valve: 0.75 m³/h
Heating circuit distance: 50 mm

Operating conditions:

Max. operating pressure: 6 bar (3 bar)
Max. operating temperature: 60 °C (90 °C)
Min. operating temperature: 6 °C
Max. testing pressure: 10 bar (< 30 °C)

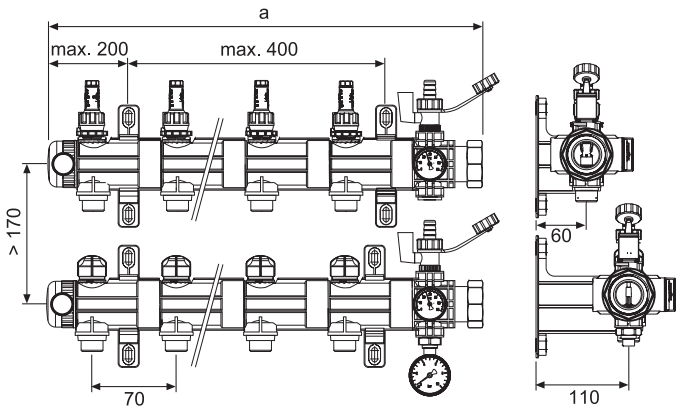
SLQ industrial plastic heating circuit manifold with flow rate display

The SLQ industrial plastic heating circuit manifold 1 ½" has a modular structure: With the basic module, up to 20 flow and return modules can be combined to form a manifold.
On the primary side, the industrial plastic heating circuit manifold can be connected via a flat-sealing union nut screw connection 1 ½". Ball valves 1 ½" OT/1 ½" IT are available for this. On the secondary side, the heating circuits are connected via a ¾" Eurocone thread.
The heating modules have a flow metre, with shut-off (4–20 l/min) (flow) and valve cores (M 30 x 1.5) with shut-off cap (return).

Kvs value flow + return valves (together): 2.09 m³/h
Heating circuit distance: 70 mm

Operating conditions:

Max. operating pressure: 6 bar (3 bar)
Max. operating temperature: 60 °C (90 °C)
Max. testing pressure (24 h): 6 bar (< 30 °C)



Note: A wall mounting set must be included every 400 mm. These have to be ordered separately, if required.

Heating circuits	Manifold width a in mm
2	250
3	320
4	390
5	460
6	530
7	600
8	670
9	740
10	810
11	880
12	950
13	1020
14	1090
15	1160
16	1230
17	1300
18	1370
19	1440
20	1510

Concealed manifold housing UP 110

Concealed manifold housing made of galvanized sheet steel to hold the SLQ heating circuit manifolds.
With lateral pre-punched openings for manifold main connection and removable screed baffle plate.
Door and frame powder-coated similar to RAL 9010.
Housing height adjustable from 705–775 mm, depth-adjustable from 110–150 mm. C rail for mounting the heating circuit manifolds.

Technical data

	Housing type UP 110					
Interior width	**400**	**540**	**690**	**840**	**990**	**1140**
Required niche width	445	585	735	885	1035	1185
No. heating circuits incl. ball valve*	2	3-5	6-8	9-11	12	-
No. heating circuits incl. corner ball valve*	-	2-4	5-7	8-10	11-12	-
No. heating circuits incl. corner calorimeter set*	-	2–3	4–6	7–9	10–12	-

* recommended housing width
= installed elements + and assembly clearance distance (2 x ≥ 50 mm)

Housing depth, interior	110–150 mm
Installation height	705–775 mm
Required niche depth	115–155 mm
Required niche height	710–780 mm

Surface-mounted manifold housing AP 125

Surface-mounted manifold housing made of galvanized sheet steel to hold the SLQ heating circuit manifolds.
Powder-coated similar to RAL 9010. C rail for mounting the heating circuit manifolds.
Housing height: 618 mm
Housing depth: 125 mm

Technical data

	Housing type UP 125			
Interior width	**500**	**730**	**880**	**1030**
No. heating circuits incl. ball valve*	2–4	5–9	10–11	12
No. heating circuits incl. corner ball valve*	2–3	4–8	9–11	12
No. heating circuits incl. corner calorimeter set*	2	3–7	8–10	11–12

* recommended housing width
= installed elements + and assembly clearance distance (2 x ≥ 50 mm)

Housing depth	125 mm
Housing height	618 mm

Single-room rule

Caution: Please note the information in the enclosed installation instructions. Prior to all work, the wiring must be disconnected from the power supply.

230 V room thermostat

The TECEfloor room thermostat is a digital room temperature control for controlling the SLQ servomotors 230 V. Equipped with microprocessor technology, this control has excellent PI control performance offering easier control for the end user. Colour: pure white

- Control performance: PI control
- Design: normally closed (NC)
- Temperature dial with 1/4 degree "soft setting"
- Limitation of settable temperature range
- Automatic temperature reduction (2 K) through external switching signal
- Frost and valve protection function

Switching performance:	max. 5 SLQ servomotor 230 V
Settable temperature range:	10 °C to 28 °C
Operating voltage:	230 V, 50/60 Hz
Switching current (max.):	0.2 A (ohmic load)
Dimensions (mm) H/W/D:	80 / 84 / 27

System base

The TECEfloor room thermostat must always be installed with the TECE system base. The 230 V power line is integrated directly in the system base. The room thermostat should be fitted only after completion of the interior works in order to be protected against dust and paint. Optionally the system base can be fitted to the wall or in a 55 mm concealed socket. After the system base has been mounted, the room thermostat is pushed and locked on to the system base from the side.

Terminal strip 230 V

The TECEfloor terminal strip 230 V is a connection unit for connecting the TECEfloor room thermostats to the servomotors. With a 230 V Euro plug, the terminal strip also provides the operating voltage for the connected devices. The subsequent integration of a pump relay or an automatic timer is made far easier thanks to the terminal strip.

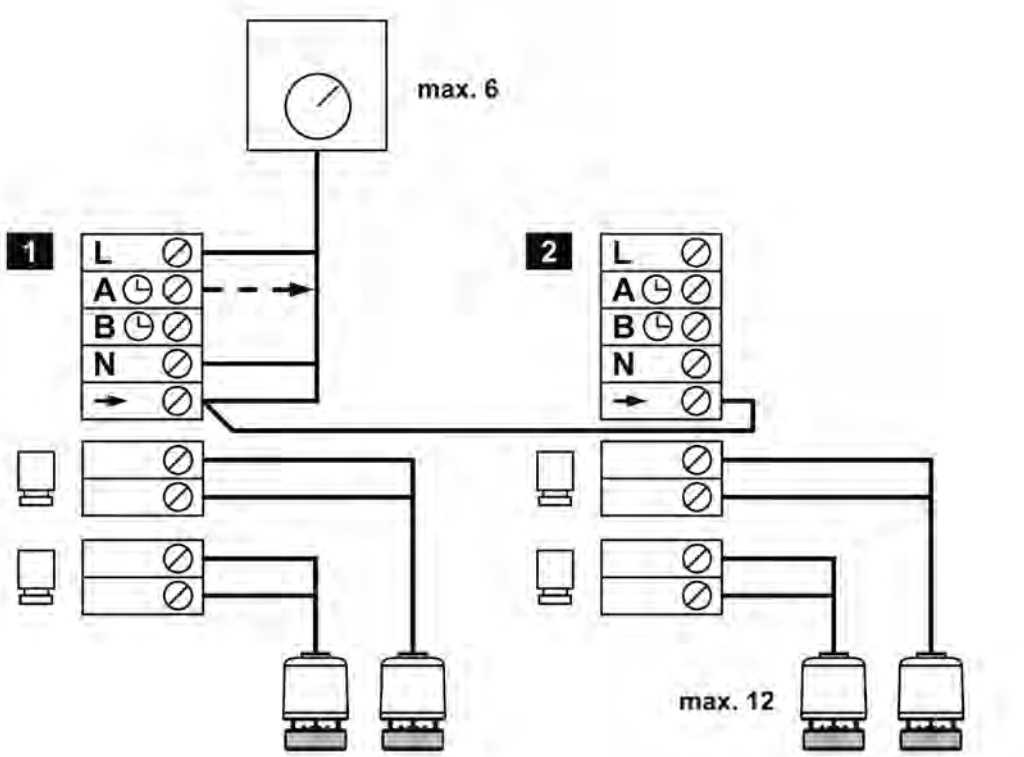
SLQ servomotor 230 V

Thermal servomotor for controlling the return valves of the SLQ heating circuit manifolds in connection with the TECEfloor terminal strip 230 V. As a result of the high protection mode IP 54, the servomotor can be mounted in any position (360°).

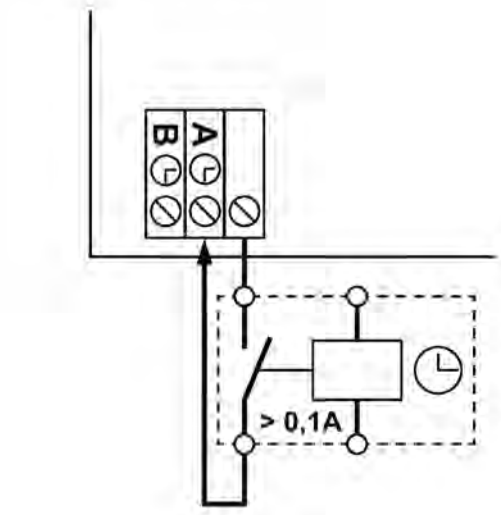
Connection thread:	Union nut screw connection M 30 x 1.5 in nickel-plated brass
Elastic force:	80 N
Max. lift:	3 mm
Connection line:	0.5 mm², 100 cm long
Protection mode:	IP 54
Power input:	2 W
Connection voltage:	230 V

Installation

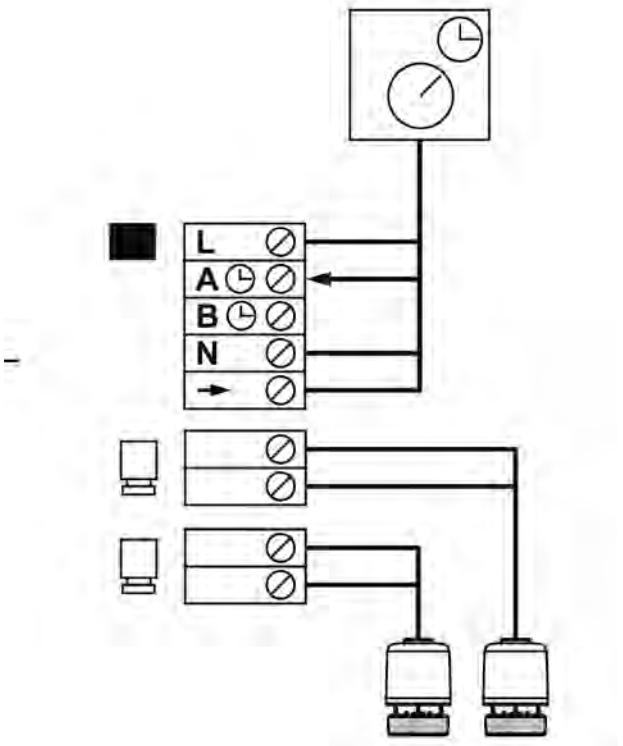
(1) Connection of room thermostat, optionally with reduction function via channel A.
(2) Connection of more than two servomotors by bridging the the switching signal to a free zone.



Connection of an external time switch via a potential-free contact



Connection of a room thermostat with time switch as pilot timer, here via channel A, to control other rooms



Accessories

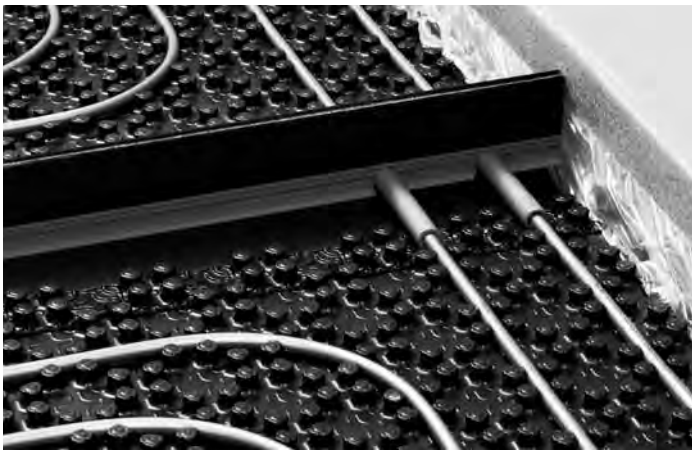
Edge insulation strip

For sound insulation of screed and adjacent components and to compensate for the thermal expansion of the screed layer in accordance with DIN 18560. The edge insulation strip made of closed-cell PE foam with adhesive strips and special film skirting guarantees maximum adhesiveness and fast installation. Suitable for cement and flow screed.
Thickness: 10 mm
Height: 160 mm
Length: 25 m roll

Movement joint profile

To create permanently elastic screed joints and to limit screed sections. Suitable for cement and flow screed.
Thickness: 10 mm
Height: 100 mm

To protect the floor heating pipes, slit approx. 30 cm long tube sleeves from joint protection tube and strip over the connection lines in the area of the movement joints.



TECEfloor screed accessories

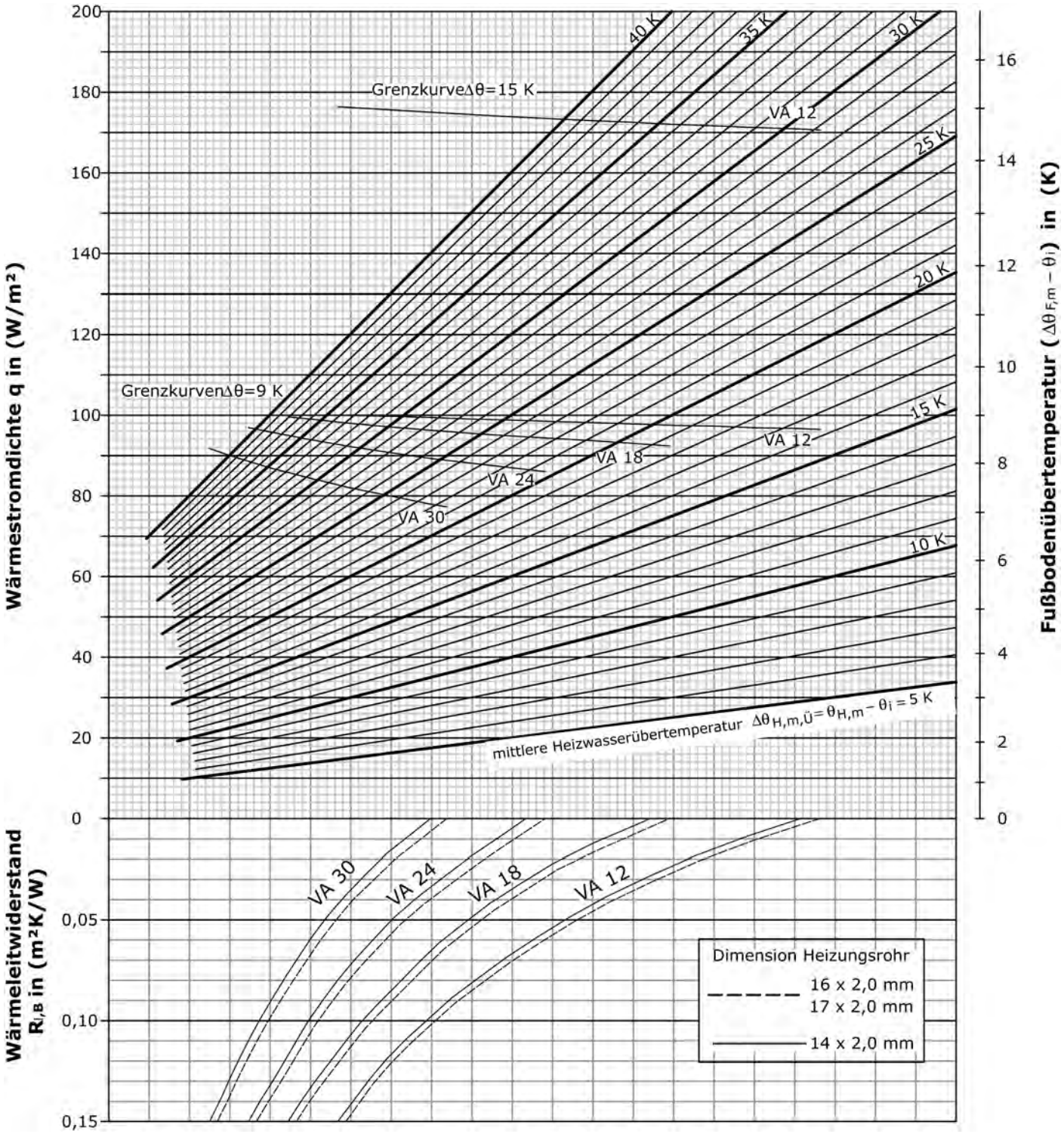
Screed additive

Plasticizing additive specially for the production of cement and calcium sulphate heating screeds (not suitable for flowing screeds). In addition to providing higher bending tensile strength and compression strength, the addition of the screed additive to the mixing water makes the mortar far easier to handle and leads to a reduction in the mixing water while maintaining the same mortar consistency. Requirement: 0.03 kg/m² per cm of screed thickness.

Other screed additives must not be added, and the instructions for use must be followed.

Heating performance chart TECEfloor dimpled panels

(45 mm screed cover)



Limit curves Δθ = 9 K applies for occupied zones

- Indoor temperature θ_i = 20 °C with max. surface temperature $\theta_{F,max}$ = 29 °C
- Indoor temperature θ_i = 24 °C with max. surface temperature $\theta_{F,max}$ = 33 °C

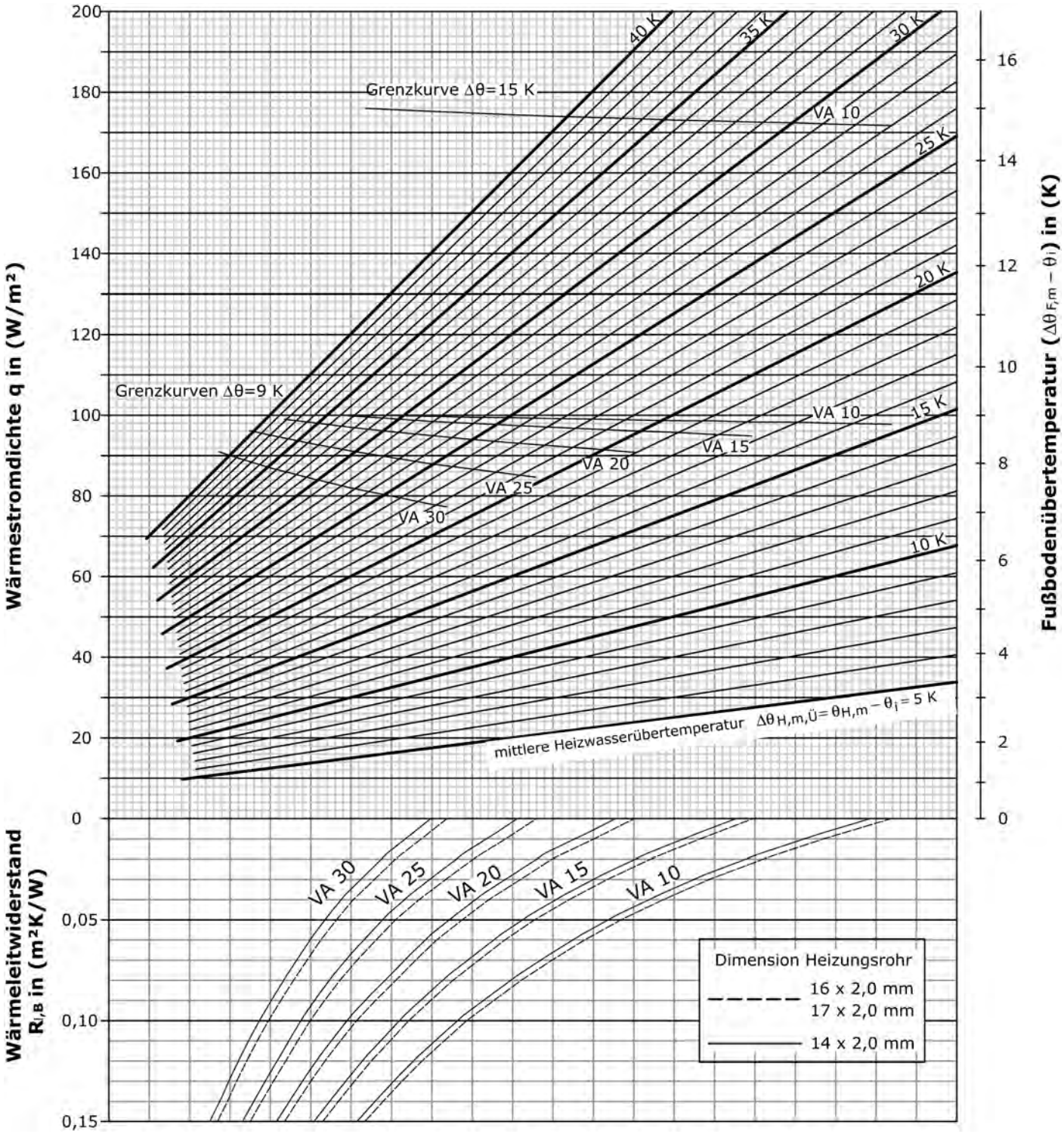
Limit curves Δθ = 15 K applies for peripheral zones

- Indoor temperature θ_i = 20 °C with max. surface temperature $\theta_{F,max}$ = 35 °C

The limit curves must not be exceeded, i.e. the design flow temperature can be max. 2.5 K above the heating limit temperature.

Heating performance chart TECEfloor tacking sheets

(45 mm screed cover)



Limit curves Δθ = 9 K applies for occupied zones

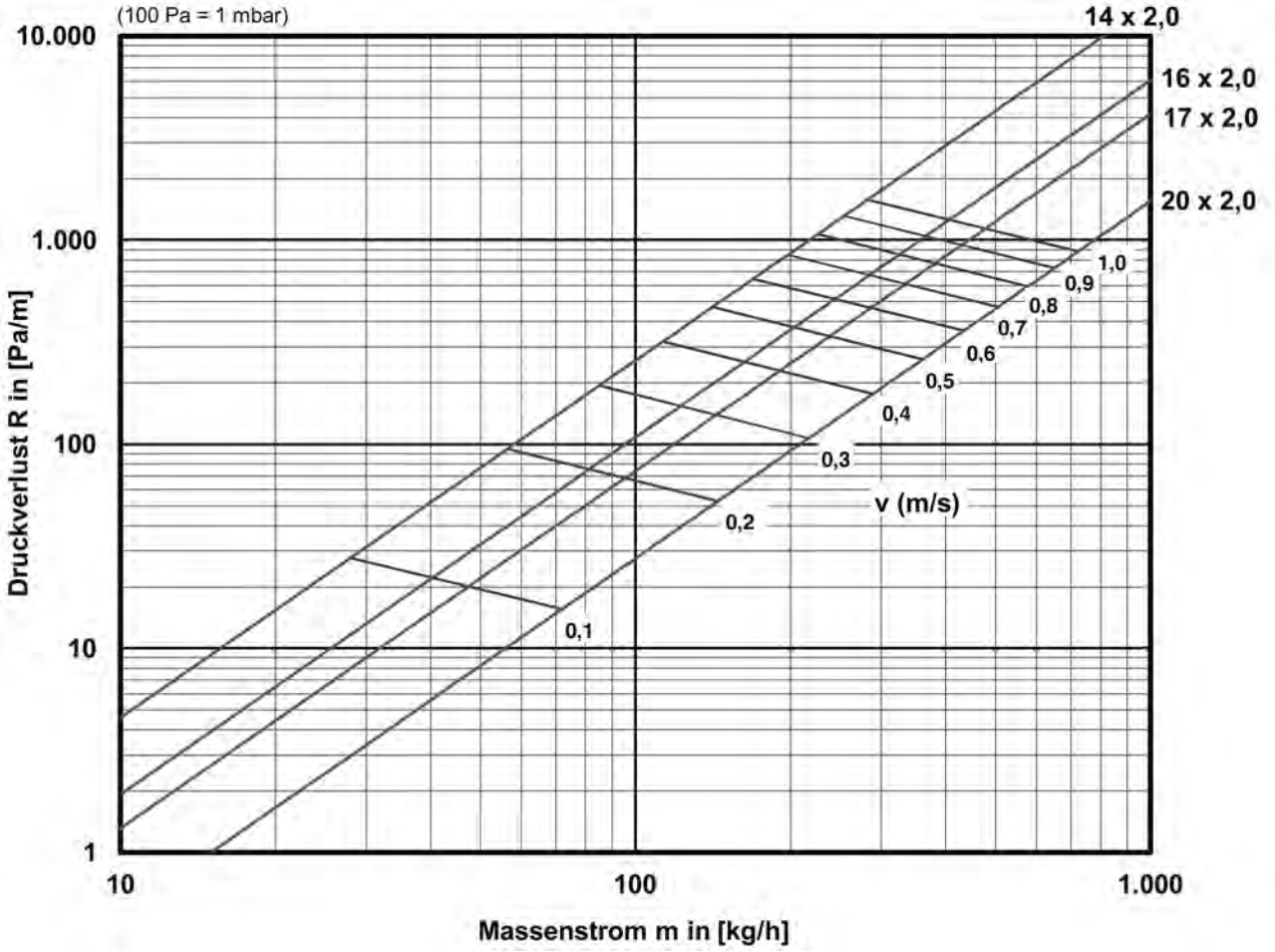
- Indoor temperature θ_i = 20 °C with max. surface temperature $\theta_{F,max}$ = 29 °C
- Indoor temperature θ_i = 24 °C with max. surface temperature $\theta_{F,max}$ = 33 °C

Limit curves Δθ = 15 K applies for peripheral zones

- Indoor temperature θ_i = 20 °C with max. surface temperature $\theta_{F,max}$ = 35 °C

The limit curves must not be exceeded, i.e. the design flow temperature can be max. 2.5 K above the heating limit temperature.

Pressure loss chart SLQ panel heating pipes



Quick layout table TECEfloor dimpled panels (45 mm screed cover)

Flow/return temperature				35/27 °C				40/30 °C			
Thermal resistance	Room temperature	Laying distance	Heating pipe requirement	Max. heat flux density	Mean surface temperature	Max. heating circuit area	Max. heating circuit area	Max. heat flux density	Mean surface temperature	Max. heating circuit area	Max. heating circuit area
RI,B	ti	VA	L	q	to	Dim. 14	Dim. 16	q	to	Dim. 14	Dim. 16
m²K/W	°C	(cm)	(m)	(W/m²)	(°C)	(m²)	(m²)	(W/m²)	(°C)	(m²)	(m²)
0.01	**20°C**	12	8.3	**60**	25.7	10.4	14.9	**82**	27.5	9.7	13.8
		18	5.6	**50**	24.8	13.5	19.3	**69**	26.4	12.4	17.6
		24	4.2	**43**	24.2	16.3	23.3	**59**	25.6	15.1	21.6
		30	3.3	**37**	23.7	19.5	27.9	**50**	24.9	18.3	26.1
	24°C	12	8.3	**38**	27.7	14.6	20.5	**60**	29.7	12.2	17.3
		18	5.6	**32**	27.2	18.9	26.5	**50**	28.8	15.8	22.3
		24	4.2	**28**	26.8	22.6	31.9	**43**	28.2	19.2	27.4
		30	3.3	**23**	26.4	27.9	39.6	**37**	27.7	23.1	32.7
0.05	**20°C**	12	8.3	**48**	24.7	12.4	17.4	**65**	26.1	11.5	16.3
		18	5.6	**41**	24.0	15.7	22.1	**56**	25.3	14.6	20.7
		24	4.2	**36**	23.6	18.7	26.6	**49**	24.7	17.5	24.7
		30	3.3	**31**	23.1	22.2	31.8	**43**	24.2	20.4	29.1
0.10	**20°C**	12	8.3	**38**	23.7	14.6	20.5	**52**	25.0	13.7	19.2
		18	5.6	**34**	23.4	18.0	25.4	**46**	24.4	16.9	23.8
		24	4.2	**30**	23.0	21.6	30.5	**41**	24.0	19.9	28.3
		30	3.3	**27**	22.7	24.9	35.1	**37**	23.7	23.1	32.7
0.15	**20°C**	12	8.3	**32**	23.2	16.6	23.3	**44**	24.2	15.4	21.6
		18	5.6	**29**	22.9	20.2	28.4	**40**	23.9	18.7	26.3
		24	4.2	**26**	22.6	24.0	33.6	**36**	23.6	22.1	31.0
		30	3.3	**23**	22.4	27.9	39.6	**32**	23.2	25.5	36.3

Flow/return temperature				45/35 °C				50/40 °C			
Thermal resistance	Room temperature	Laying distance	Heating pipe requirement	Max. heat flux density	Mean surface temperature	Max. heating circuit area	Max. heating circuit area	Max. heat flux density	Mean surface temperature	Max. heating circuit area	Max. heating circuit area
RI,B	ti	VA	L	q	to	Dim. 14	Dim. 16	q	to	Dim. 14	Dim. 16
m²K/W	°C	(cm)	(m)	(W/m²)	(°C)	(m²)	(m²)	(W/m²)	(°C)	(m²)	(m²)
0.01	**20°C**	12	8.3	**109**	29.7	7.8	11.2	**136**	31.9	6.6	9.5
		18	5.6	**92**	28.3	9.9	14.2	**115**	30.2	8.3	12.1
		24	4.2	**78**	27.1	12.0	17.5	**98**	28.9	10.1	14.6
		30	3.3	**67**	26.2	14.4	21.0	**84**	27.7	12.0	17.4
	24°C	12	8.3	**87**	31.9	9.4	13.2	**114**	34.1	7.6	10.8
		18	5.6	**73**	30.8	11.9	16.9	**96**	32.7	9.5	13.9
		24	4.2	**63**	29.9	14.4	20.6	**83**	31.5	11.5	16.8
		30	3.3	**54**	29.2	17.4	24.9	**70**	30.5	13.8	20.1
0.05	**20°C**	12	8.3	**87**	27.9	9.4	13.2	**108**	29.7	7.9	11.3
		18	5.6	**75**	26.9	11.7	16.6	**94**	28.4	9.7	14.0
		24	4.2	**65**	26.1	13.9	20.2	**82**	27.5	11.5	16.8
		30	3.3	**57**	25.4	16.5	23.7	**71**	26.6	13.8	20.1
0.10	**20°C**	12	8.3	**70**	26.6	10.9	15.5	**87**	27.9	9.4	13.2
		18	5.6	**62**	25.8	13.5	19.1	**77**	27.0	11.3	16.4
		24	4.2	**55**	25.2	15.8	22.8	**68**	26.3	13.4	19.4
		30	3.3	**49**	24.7	18.6	26.4	**61**	25.8	15.6	22.5
0.15	**20°C**	12	8.3	**59**	25.6	12.5	17.5	**74**	26.8	10.6	14.9
		18	5.6	**53**	25.1	15.1	21.4	**66**	26.1	12.8	18.4
		24	4.2	**48**	24.7	17.8	25.2	**60**	25.7	14.9	21.4
		30	3.3	**43**	24.2	20.4	29.1	**53**	25.0	17.4	24.9

The TECEfloor performance table enables you to quickly determine the required laying distance (spacing) and the max. heating circuit size.

Procedure:
1. Define the required flow and return temperature
2. Define the thermal resistance of the surface layer and the interior room temperature
3. Compare the required heating performance (e.g. from heating load calculation) with the max. heat flux density
4. Read off the required laying distance VA and max. heating circuit area (dim. 14 or dim. 16)

The following max. surface temperatures must be taken into account for layout:
- Occupied areas: 29 °C
- Peripheral zones (max. 1 m): 35 °C
- Bathrooms: 33 °C

The following data is taken into consideration in the performance table:
- Screed cover over pipes: 45 mm
- Rooms below heated in the same way (insulation: R = 0.75 m²K/W)
- Max. heating circuit area at 200 mbar pressure loss (incl. 2 x 5 m connection line)

Quick layout table TECEfloor tacking panels

(45 mm screed cover)

Flow/return temperature				35/27 °C				40/30 °C			
Thermal resistance	Room temperature	Laying distance	Heating pipe requirement	Max. heat flux density	Mean surface temperature	Max. heating circuit area	Max. heating circuit area	Max. heat flux density	Mean surface temperature	Max. heating circuit area	Max. heating circuit area
RI,B	ti	VA	L	q	to	Dim. 14	Dim. 16	q	to	Dim. 14	Dim. 16
m²K/W	°C	(cm)	(m)	(W/m²)	(°C)	(m²)	(m²)	(W/m²)	(°C)	(m²)	(m²)
0.01	**20°C**	10	10.0	**64**	26.0	9.5	13.4	**87**	27.9	8.8	12.5
		15	6.6	**56**	25.4	11.7	16.7	**76**	27.0	11.0	15.6
		20	5.0	**48**	24.7	14.4	20.4	**66**	26.2	13.2	18.8
		25	4.0	**42**	24.2	16.8	24.0	**58**	25.5	15.5	22.3
		30	3.3	**37**	23.7	19.5	27.9	**50**	24.9	18.3	26.1
	24°C	10	10.0	**41**	28.0	13.1	18.4	**64**	30.0	11.1	15.5
		15	6.6	**35**	27.5	16.7	23.4	**56**	29.3	13.8	19.5
		20	5.0	**31**	27.1	19.8	28.0	**48**	28.7	16.8	23.8
		25	4.0	**27**	26.7	23.5	33.3	**42**	28.1	19.8	28.0
		30	3.3	**23**	26.4	27.9	39.6	**37**	27.7	23.1	32.7
0.05	**20°C**	10	10.0	**51**	24.9	11.2	15.7	**69**	26.4	10.5	14.8
		15	6.6	**45**	24.4	13.8	19.5	**61**	25.8	12.9	18.3
		20	5.0	**40**	23.9	16.4	23.4	**54**	25.2	15.4	21.8
		25	4.0	**35**	23.5	19.3	27.5	**48**	24.7	18.0	25.5
		30	3.3	**31**	23.1	22.2	31.8	**43**	24.2	20.4	29.1
0.10	**20°C**	10	10.0	**40**	23.9	13.4	18.7	**55**	25.3	12.4	17.4
		15	6.6	**36**	23.6	16.4	23.0	**50**	24.8	15.0	21.2
		20	5.0	**33**	23.3	19.0	26.8	**45**	24.3	17.6	25.0
		25	4.0	**30**	23.0	21.8	30.8	**41**	23.9	20.3	28.8
		30	3.3	**27**	22.7	24.9	35.1	**37**	23.7	23.1	32.7
0.15	**20°C**	10	10.0	**33**	23.3	15.3	21.4	**46**	24.4	14.0	19.6
		15	6.6	**30**	23.0	18.8	26.1	**42**	24.2	17.1	24.0
		20	5.0	**28**	22.8	21.4	30.0	**38**	23.7	20.0	28.2
		25	4.0	**25**	22.6	25.0	35.0	**35**	23.5	22.8	32.0
		30	3.3	**23**	22.4	27.9	39.6	**32**	23.2	25.5	36.3

Flow/return temperature				45/35 °C				50/40 °C			
Thermal resistance	Room temperature	Laying distance	Heating pipe requirement	Max. heat flux density	Mean surface temperature	Max. heating circuit area	Max. heating circuit area	Max. heat flux density	Mean surface temperature	Max. heating circuit area	Max. heating circuit area
RI,B	ti	VA	L	q	to	Dim. 14	Dim. 16	q	to	Dim. 14	Dim. 16
m²K/W	°C	(cm)	(m)	(W/m²)	(°C)	(m²)	(m²)	(W/m²)	(°C)	(m²)	(m²)
0.01	**20°C**	10	10.0	**117**	30.3	7.1	10.1	**145**	32.7	6.0	8.6
		15	6.6	**101**	29.2	8.9	12.6	**127**	31.2	7.4	10.7
		20	5.0	**88**	28.0	10.6	15.2	**110**	29.8	8.8	12.8
		25	4.0	**77**	27.1	12.3	18.0	**96**	28.7	10.3	15.0
		30	3.3	**67**	26.3	14.4	21.0	**84**	27.7	12.0	17.4
	24°C	10	10.0	**93**	32.4	8.4	11.9	**122**	34.8	6.8	9.7
		15	6.6	**81**	31.5	10.5	14.9	**107**	33.6	8.4	12.0
		20	5.0	**70**	30.6	12.6	18.0	**93**	32.4	10.0	14.6
		25	4.0	**62**	29.8	14.8	21.0	**81**	31.4	11.8	17.3
		30	3.3	**53**	29.1	17.4	24.9	**70**	30.5	13.8	20.1
0.05	**20°C**	10	10.0	**92**	28.3	8.5	12.0	**115**	30.2	7.2	10.2
		15	6.6	**81**	27.5	10.5	14.9	**102**	29.1	8.7	12.6
		20	5.0	**72**	26.7	12.4	17.6	**90**	28.1	10.4	15.0
		25	4.0	**64**	26.0	14.3	20.5	**80**	27.3	12.0	17.3
		30	3.3	**57**	25.4	16.5	23.7	**71**	26.6	13.8	20.1
0.10	**20°C**	10	10.0	**73**	26.8	10.1	14.2	**92**	28.3	8.5	12.0
		15	6.6	**66**	26.2	12.2	17.3	**83**	27.6	10.2	14.7
		20	5.0	**60**	25.7	14.2	20.2	**75**	26.9	12.0	17.2
		25	4.0	**54**	25.2	16.3	23.5	**67**	26.3	13.8	20.0
		30	3.3	**49**	24.7	18.6	26.4	**61**	25.8	15.6	22.5
0.15	**20°C**	10	10.0	**61**	25.8	11.5	16.1	**76**	27.0	9.8	13.7
		15	6.6	**56**	25.3	13.8	19.5	**69**	26.5	11.9	16.8
		20	5.0	**51**	24.9	16.0	22.8	**63**	26.0	13.6	19.6
		25	4.0	**47**	24.5	18.3	26.0	**58**	25.5	15.5	22.3
		30	3.3	**43**	24.2	20.4	29.1	**53**	25.1	17.4	24.9

Examples: TECEfloor quick layout

Building project: Sample house
TECEfloor laying system: Tacking sheet 30-2
Flow/return temperature 40/30 °C
TECEfloor pipe: PE-Xc 14 x 2.0 mm

1	Room designation		Office	Bedroom	Kitchen	Living room	Bath-room	WC	Hall	Σ
2	Room number		1	3	4	5	6	7	8	
4	Standard indoor temperature	°C	20	20	20	20	24	20	20	
5	Room area	m²	14.5	20.0	12.5	34.0	8.0	3.0	10.5	102.5
6	Floor area to be heated	m²	14.5	20.0	12.5	34.0	6.2	3.0	10.5	100.7
7	Heating load (in accordance with DIN 12831)	W	754	960	700	1496	608	195	546	5259
8	Required heat flux density	W/m²	50.0	48.0	56.0	44.0	98.0	65.0	52.0	
9	Floor covering resistance	m²K/W	0.1	0.1	0.01	0.1	0.01	0.01	0.05	
10	Laying distance	cm	15	15	20	20	10	20	20	
11	Max. heat flux density	W/m²	50	50	66	45	64	66	54	
12	Mean surface temperature	°C	24.8	24.8	26.2	24.3	30.0	26.2	25.2	
13	Max. heating circuit area	m²	15.0	15.0	13.2	17.6	11.1	13.2	15.4	
14	No. floor heating circuits	m	1	2	1	2	1	1	1	9+1
15	Pipe length per heating circuit	m	97	67	63	85	62	15	53	592
16	Connection line per heating circuit	m	10	16	6	12	12	8	2	94
17	Heat flux per HC (↑u.↓)	W	880	655	844	939	521	329	623	6385
18	Mass flow per heating circuit	l/min	1.3	0.9	1.2	1.3	0.7	0.5	0.9	9.1

Notes:

1. Areas below the bath tub and shower tray are cut out.
2. In the bathroom, there is a residual heating load of approx. 211 W (64 W/m² x 6.2 m² = 397 W - 608 W = 211 W).
3. The residual heating load in the bathroom is covered by additional bathroom radiators. Additional manifold outlet planned.
4. Insulate connection lines against excessive heat dissipation, if necessary.

List of materials:

	Quantity		Order quantity		Delivery units	
TECEfloor tacking sheet 30-2	102.5	m²	110	m²	10	m²
TECEfloor tacking pins	2058	pc	2200	pc	200	pc
TECEfloor adhesive tape	3	pc	3	pc	1	pc
TECEfloor pipe 14 x 2	686	m	900	m	300/600	m
TECEfloor stainless steel manifold HKV10	1	pc	1	pc	1	pc
TECEfloor manifold housing UP 110-5	1	pc	1	pc	1	pc
TECEfloor clamped joints 14 x 2	20	pc	20	pc	10	pc
TECEfloor corner ball valve 1"	1	Set	1	Set	1	Set
TECEfloor edge insulation strip	120	m	200	m	100	m
TECEfloor movement joint profile	15	m	18	m	18	m
TECEfloor joint pipe protection	10	m	12	m	12	m
TECEfloor pipe bender	20	pc	25	pc	25	pc
TECEfloor terminal strip	2	pc	2	pc	1	pc
TECEfloor servomotor	9	pc	9	pc	1	pc
TECEfloor room thermostat	7	pc	7	pc	1	pc
TECEfloor screed additive	18.5	kg	20	kg	10	kg
Other						

Function heating log for TECE panel heating

According to DIN EN 1264 part 4, anhydrite and cement screeds must be heated up before the floor coverings are laid. In the case of cement screed, heating should take place no earlier than 21 days after the screed work has been completed, and in the case of anhydrite screed, no earlier than 7 days, according to the manufacturer.

Note: A reduction in the aforementioned drying times and/or changes to the heating sequence described below (temperature, number and duration of heating steps) require written approval from the screed manufacturer and/or screed layer before the heating phase begins.

Building project: _____

Heating construction company: _____

Screed laying company: _____

TECE laying system: _____

TECE pipe (type/nominal dimension/laying distance): _____

Screed type: ❒ Cement screed_____ cm thick ❒ Anhydrite screed_____ cm thick

Date of screed laying: _____

Outside temperature before start of function heating: _____

Room temperature before start of function heating: _____

1. Initial flow temperature of 20–25 °C set and kept constant for 3 days:

Started on: _____ Ended on: _____

2. Set max. permitted design temperature and maintain for at least 4 days (without reduction at night):

Started on: _____ Ended on: _____

Function heating carried out without defects: ❒ Yes ❒ No

Heating stopped: _____

Defects found: _____

_____ _____

City, date City, date

_____ _____

Client/representative (signature)

Contractor/installer (stamp/signature)

Note: After function heating has been completed, it is not certain that the screed has reached the degree of moisture required for readiness for laying the floor covering. The screed readiness for covering must therefore be checked by the floor layer.

Pressure test log for TECE panel heating

Building project: _____

Heating construction company: _____

1. System data

Type and performance of heat generator: _____

Manufacturer: _____

Installation location: _____

Max. operating pressure: _____ max. operating temperature: _____

2. Pressure test

	completed
a. Close ball valve on manifold	❒
b. Fill and rinse heating circuits one after the other	❒
c. Bleed system	❒
d. Apply test pressure: 2x operating pressure, or at least 6 bar (according to DIN EN 1264 part 4)	❒
e. After 2 hours, apply pressure again, as a drop in pressure is possible as a result of pipe expansion	❒
f. Testing time 12 hours	❒
g. The pressure test has been passed if water does not leak at any point in the pipeline and the testing pressure did not fall more than 0.1 bar per hour.	❒

Note: When the screed is laid, the max. operating pressure must exist so that any leaking points can be identified immediately.

3. Certification

The tightness test was carried out correctly. There were no leaking points, and no component permanently changed shape.

_____	_____
City, date	City, date
_____	_____
Client/representative (signature)	Contractor/installer (stamp/signature)

Notes

For more information on our products,
please visit us at **www.tece.com**.

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