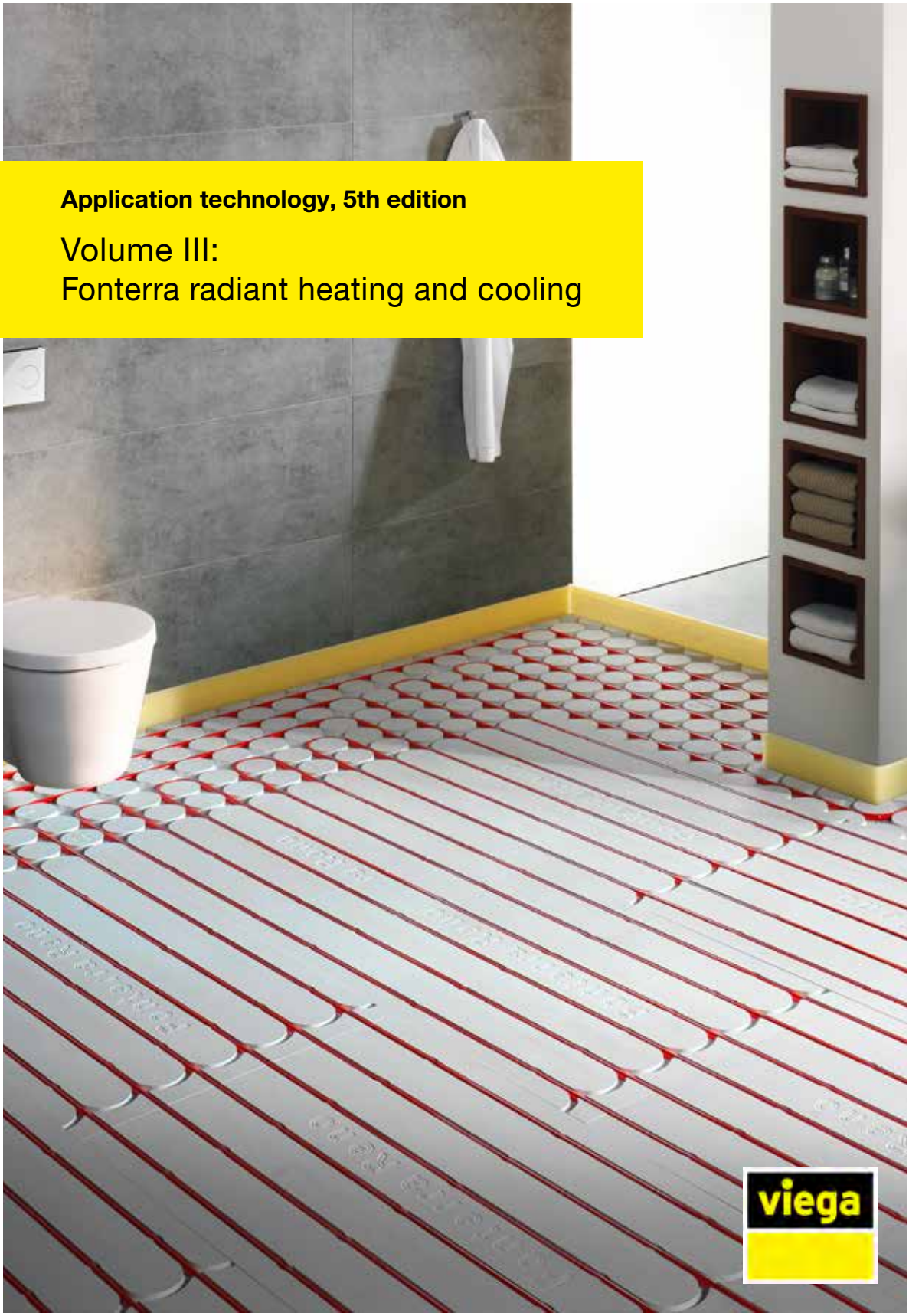
Application technology, 5th edition

Volume III:
Fonterra radiant heating and cooling



Fonterra Industry

Planning

System description
Fonterra Industry, developed for thermal activation of floor surfaces (usually concrete floors without covering), uses the limitless application possibilities with steel, clamping, or fibre cement boards.
It presents the largest possible design freedom in the utilisation of various commercial buildings, e.g. warehouses with forklift truck operation, production floors with light or heavy machinery, or different types of workshops.

The suitability of the system is not affected by requirements in the traffic or payload of the buildings. The only variable feature is the thickness of the floor panel which must be determined by the structural engineer.

System features
- Oxygen sealed Fonterra pipes 20 x 2.0 or 25 x 2.3 mm acc. to DIN 4726
- System also suitable for cooling
- Unlimited traffic load
- Variable installation clearances
- Even temperature distribution because the full-area heating of the hall floor
- Low investment costs and fast pay-off thanks to an economical and energy-efficient heat distribution system
- No additional maintenance costs
- Use of tested system components
- Compliance with the requirements of the Workplaces Ordinances regarding the floor surface temperature of min. 18 °C
- Object-focused project planning adapted to the individual building for absolute freedom of design of the usable surfaces
- Can be combined with other heating systems
- No static requirements in the ceiling construction

Fonterra Industry Installation example

Fig. 227: Fonterra Industry, installation example

Fonterra Industry

Fig. 228: Fonterra Industry

System components

Fixing/protection		
 Pipe guide	 Protective pipe for joints	 Clamping rail
System pipes		
 PB pipe 20 x 2.0 mm 25 x 2.3 mm	 PE-Xc pipe 20 x 2.0 mm 25 x 2.3 mm	 PE-RT pipe 20 x 2.0 mm 25x2.3mm
manifold		
 Industry manifold 1½ inch		
Connector and accessories		
 Adapter with SC-Contur	 Coupling with SC-Contur	 Ball valve set

Tools for Fonterra Industry

Name	Article number
Viega press jaw 20, 25 for Pressgun Picco	485573, 485580
Viega press tool Pressgun Picco	622404
Pipe reel	562359, 754761
Pipe shear up to 25 mm	652005

Tab. 109: Tools for Fonterra Industry

System components

Name	Article number
PB pipe 20 x 2.0 240 m	703561
PB pipe 25 x 2.3 240 m	703585
PE-Xc pipe 20 x 2.0 240 m	613631
PE-Xc pipe 25 x 2.3 240 m	636579
PE-RT pipes 20 x 2.0 240 m	657345
PE-RT pipes 20 x 2.0 480 m	657352
PE-RT pipes 25 x 2.3 240 m	657369
PE-RT pipes 25 x 2.3 480 m	657376
Clamping ring screw fitting 20 x ¾ inch	614645
Clamping ring screw fitting 25 x ¾ inch	640972
Coupling 20 x 2.0	619824
Coupling 25 x 2.3	640996
Adapter with SC-Contur 20 x ¾ inch	614652
Adapter with SC-Contur 25 x ¾ inch	636814
Coupling with SC-Contur 20 x 2.0	614720
Coupling with SC-Contur 25 x 2.3	636586
Pipe guide 20	609504
Pipe guide 25	637019
Protective pipe for joints 20 x 28	562731
Protective pipe for joints 25 x 34	636500
Cable tie 200 mm	638344
Clamping rail 20	613624
Clamping rail 25	636524
Industry manifold 1½ inch 4 to 16 outlets	various
Fonterra ball valve set 1½ inch	696085
Mounting console for industry manifold	613082

Tab. 110: System components

Technical data

Technical data system pipes

System pipes		PE-Xc 20 x 2.0	PE-Xc 25 x 2.3	PB 20 x 2.0
Dimensions	[mm]	20 x 2.0	25 x 2.3	20 x 2.0
Minimum bending radius		6 x d_a		5 x d_a
Operating condition acc. to ISO 10508	Class/[MPa]			4/0.6
Operating condition acc. to ISO 15875-1	Class/[MPa]	4/0.8	4/0.6	
	Class/[MPa]	5/0.6		
Operating condition acc. to ISO 22391-1	Class/[MPa]			
Max. operating temperature	[°C]	90	70	
Mounting temperature	[°C]	≥ +5		≥ -5
Water volume	[l/m]	0,2	0,32	0,2
Heat conductivity λ	[W/(m·K)]	0,35		0,22
Linear coefficient of length expansion	[K^{-1}]	2.0 x 10^{-4}		1.3 x 10^{-4}
Weight	[g/m]	118	170	120

Tab. 111: Technical data system pipes (Part 1)

System pipes		PB 25 x 2.3	PE-RT 20 x 2.0	PE-RT 25 x 2.3
Dimensions	[mm]	25 x 2.3	20 x 2.0	25 x 2.3
Minimum bending radius			6 x d_a	
Operating condition acc. to ISO 10508	Class/[MPa]	4/0.6		
Operating condition acc. to ISO 15875-1	Class/[MPa]			
	Class/[MPa]			
Operating condition acc. to ISO 22391-1	Class/[MPa]		4/0.6	4/0.6
Max. operating temperature	[°C]		70	
Mounting temperature	[°C]		≥ +5	
Water volume	[l/m]	0,32	0,2	0,32
Heat conductivity λ	[W/(m·K)]		0,40	
Linear coefficient of length expansion	[K^{-1}]		1.8 x 10^{-4}	
Weight	[g/m]	160	122	170

Tab. 112: Technical data system pipes (Part 2)

Technical data

Fonterra Industry	
Pipe dimensions	20 x 2.0 mm 25 x 2.3 mm
Installation clearances	variable
Mounting time RA 300	~ 0.5 min*
Max. heating circuit length	150 m with 20 x 2.0 mm 200 m with 25 x 2.3 mm
Average clearance of the clamping rails	200 cm
Average clearance of the pipe fasteners	75 cm

Tab. 113: Technical data
*running meter, depending on fixing type

Construction types

Construction variants

Fonterra Industry is suitable for use in different construction variants, primarily reinforced concrete and steel fibre concrete floor panels as well as vacuum concrete.

Reinforced concrete

Usually, industry surface heating systems are inserted in reinforced concrete panels. Reinforced concrete panels are floor panels reinforced with steel mats.
Fonterra Industry is mounted to the bottom layer of the reinforcement by means of cable ties or drilling tools.
If the structural analysis establishes the need for a layer in the neutral zone, this installation layer must be created by using suitable spacers and applying another layer of structural steel (e.g. Q131).

Construction variant with reinforced concrete

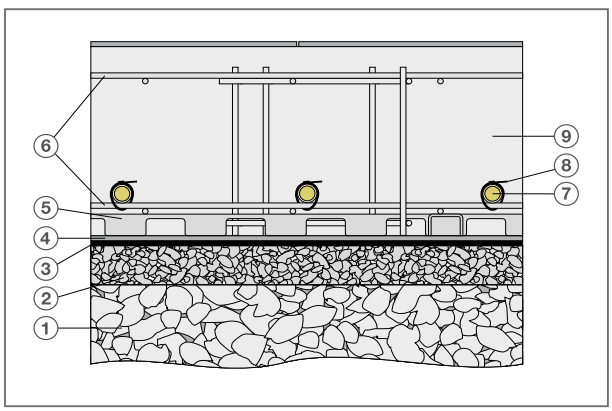


Fig. 229: Construction variant with reinforced concrete

Key
① Base layer
② Blinding concrete
③ Building waterproofing acc. to DIN 18195
④ Sliding layer
⑤ Spacers
⑥ Reinforcement
⑦ Pipe (20 x 2.0 or 25 x 2.3 mm)
⑧ Mounting strap
⑨ Concrete

Steel fibre concrete

Steel fibre concrete is concrete reinforced with steel fibres. It goes without steel mat reinforcement.
For this variant, Fonterra system pipes are laid in clamping rails and fastened on-site on the blinding concrete.

Construction variant with steel fibre concrete

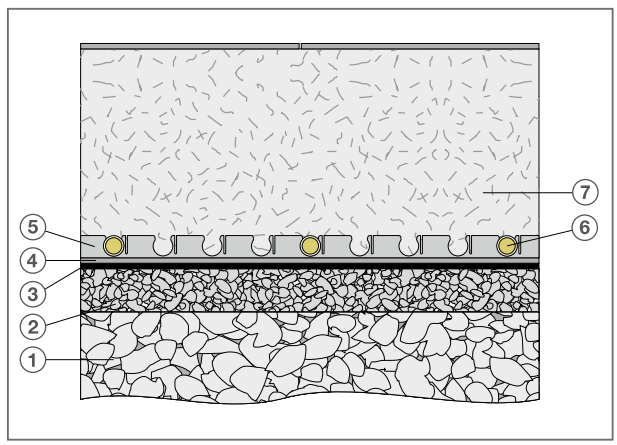


Fig. 230: Construction variant with steel fibre concrete

Key
① Base layer
② Blinding concrete
③ Building waterproofing acc. to DIN 18195
④ Sliding layer
⑤ Clamping rail
⑥ Pipe (20 x 2.0 or 25 x 2.3 mm)
⑦ Steel fibre concrete

Vacuum concrete

For floor panels provided in vacuum concrete variant, the mixing water is removed from the reinforced or prestressed concrete by means of a vacuum pump and filter mats or vacuum formwork. This process improves the early and final consolidation of the concrete layer close to the surface.

Heat insulation

Generally, check whether the EnEV (non-residential buildings with low internal temperatures), DIN 4108-2 or DIN EN 1264 specify the need for heat insulation.
No heat insulation is required if the temperature in the room is below 12 °C, the building is heated for less than 4 months per year, the doors to the building stand open for prolonged periods without interruption, or in cases of hardship acc. to § 25.
With an internal room temperature between 12 and 19 °C, DIN 4108-2 Tab. 3 specifies a minimum thermal resistance of the floor of 0.9 m^2K/W up to a room depth of 5 m. This corresponds to insulation WLG 040 with a thickness of approx. 40 mm.

Note that a thermal insulation layer, if provided, will be the weakest link in the floor construction in terms of load.
If required nevertheless, a so-called perimeter insulation (usually on extruder foam panels) is suited best. Applied directly on the soil, it is non-sensitive to moisture and extremely pressure-proof.
According to EnEV § 25, a waiver can be applied for with the authority responsible according to the law of the respective Federal State if the heat insulation requirements would cause unreasonable costs and efforts, or other undue hardships. Evidence must be submitted by way of a respective payoff calculation.
According to DIN 4108, any heat insulation provided must only be included in the calculation of the OHTC value if situated above the building waterproofing, or if the manufacturer can prove suitability acc. to DIN 4108 by means of general building approval.

Notes on interpretation
The traffic loads described in DIN 1055 part 3 are changing or variable loads of the building part (e.g. from machines, materials, vehicles, etc.). The permissible traffic load is determined by the structural engineer; it affects the dimensioning of the concrete panel. Heating pipes embedded in the concrete do not affect its pressure resistance.
Depending on the use/stress, different requirements in the quality of the concrete apply.

When selecting the heating level, take the drilling depth for rack or machine anchoring devices into consideration, if applicable; possibly, the pipelines must be positioned at a different height or certain areas must be bypassed (so-called taboo zones).

Drilling depth
In commercially used buildings, racks or foundations often need to be anchored in the floor panels. The technical planner must be informed of the required drilling depths, and consider them in the design. Usually, the Fonterra Industry system pipes lie deep enough on the bottom reinforcement or in the clamping rail. However, if the height of the floor panel is not sufficient, the pipelines must bypass this area, creating so-called taboo zones. No pipelines must cross these zones.

Performance data

The heat requirement must be determined according to DIN EN 12831.
In case of industrial buildings, various correction factors, e.g. building heights, must be considered.
According to Appendix B Table 2.1 of DIN EN 12831, a room height correction factor is required for determination of the standard heat loss in special cases. Since Fonterra Industry dissipates most of the heating output as radiant heat, factor 1 can be applied with hall heights of max. 15 m.

Heat flow density diagrams

The heating fluid overtemperature, depending on the selected floor covering, can be read from the diagrams below following determination of the heat flow density, which follows from the calculated standard heating load of a room.

Reading example for Fonterra Industry 20

- Calculate the required heat output per m², or take it over from the heating load calculation, e.g. q = 60 W / m²
- Read the heating fluid overtemperature from the diagram
- e.g. 15 K with VA 200 mm
- Room temperature + overtemperature of the fluid = heating fluid temperature
- e.g. 18 °C + 15 K = 33 °C (mean heating water temperature) = 38 °C supply temperature+ 28 °C return temperature

Output diagram Fonterra Industry 20

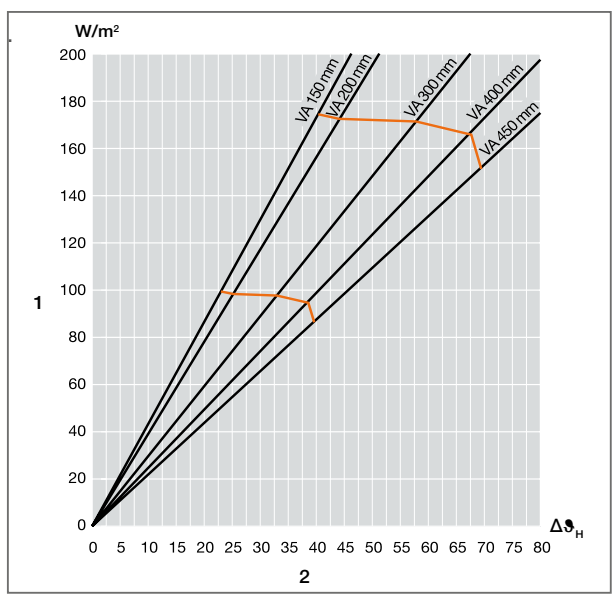


Fig. 231: Output diagram Fonterra Industry 20

Key
① Heat flow density q in [W/m2]
② Heating fluid overtemperature $\Delta\vartheta_H$
IC - installation clearance (VA)

Reading examples for Fonterra Industry 25

- Calculate the required heat output per m², or take it over from the heating load calculation, e.g. q = 60 W / m²
- Read the heating fluid overtemperature from the diagram
  e.g. 18 K with IC 300 mm
- Room temperature + overtemperature of the fluid = heating fluid temperature
  e.g. 18 °C + 18 K = 36 °C (mean heating water temperature) =
  41 °C supply temperature+ 31 °C return temperature

Output diagram Fonterra Industry 25

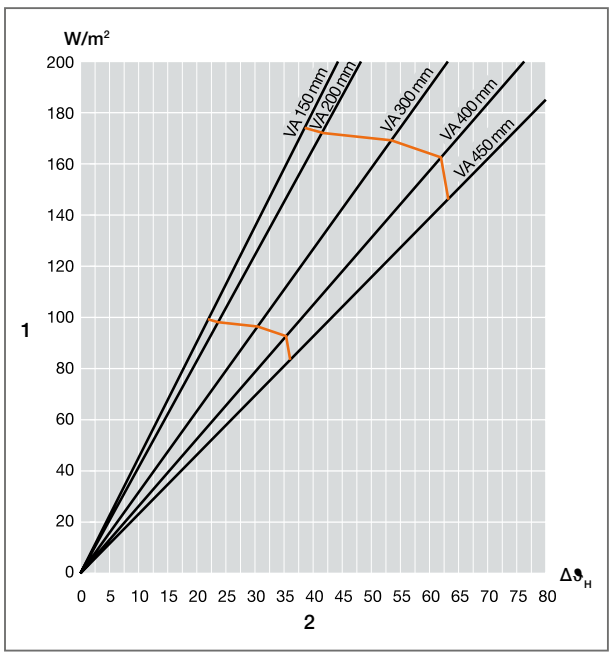


Fig. 232: Output diagram Fonterra Industry 25

Key
① Heat flow density q in [W/m2]
② Heating fluid overtemperature $\Delta\vartheta_H$
IC - installation clearance (VA)

Any losses to adjacent areas not considered in the heating load calculation must be adjusted in the form usually applied with underfloor heating, i.e. "adjusted heat requirement plus actual losses".

Pressure loss diagram for pipe 20x2.0 and 25x2.3

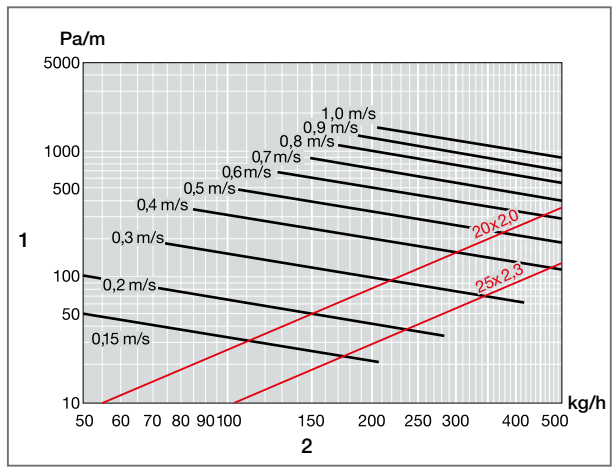


Fig. 233: Pressure loss diagram for pipe 20x2.0 and 25x2.3

Key
① Pressure gradient R in [Pa/m]
② Mass flow m in [kg/h] (fluid: water)

Material requirement

Material requirement

Article designation	Installation clearance	Pro-rata requirement	Article number	Quantities/ packing units
Pipe 20x2.0	VA 150	m/m²	613631	240 m
	VA 300	3.1 m/m²		
	VA 450	2.0 m/m²		
Pipe 25x2.3	VA 150	6.5 m/m²	636579	240 m
	VA 300	3.1 m/m²		
	VA 450	2.0 m/m²		
Clamping rail 20	all CI	0.5 m/m²	613624	20 m
Clamping rail 25	all CI	0.5 m/m²	636524	20 m
Cable tie	VA 150	9 pc./m²	638344	100 pc.
	VA 300	4 pc./m²		
	VA 450	2.5pc./m²		
Fixing set	VA 150	9 pc./m²	636128	100 pc.
	VA 300	4 pc./m²		
	VA 450	2.5pc./m²		

Tab. 114: Material requirement

Mounting

Structural requirements

Contrary to conventional installation of underfloor heating systems, industrial surface heating systems are installed parallel to the reinforcement and concrete pouring work. Accordingly, careful planning and coordination among the individual trade lots is the precondition for successful completion.
Before the concrete is poured, a pressure test must be done and documented to check the heating surfaces for leak tightness.

Underground, base layer, blinding concrete

The underground must have an even composition and a sufficient carrying capacity. In case of insufficient carrying capacity of the compacted underground, a base layer must be applied. It absorbs the stresses from the floor panel, deflecting them to the underground. Usually, the underground consists of pebbles or crushed rock with hydraulic binding agents (e.g. cement).
A level surface must be provided for reception of the floor panel. This is achieved by means of a so-called blinding layer, which can be produced by means of a thin concrete or cement screed layer. As an alternative, a thin layer of fine sand can be applied (sand alignment).

Building waterproofing

Before the floor panel is installed, the sub-construction must be approved by the site management.
Building waterproofing features are determined by the building planner and must be carried out acc. to DIN 18195 or DIN 18336.

Building waterproofing

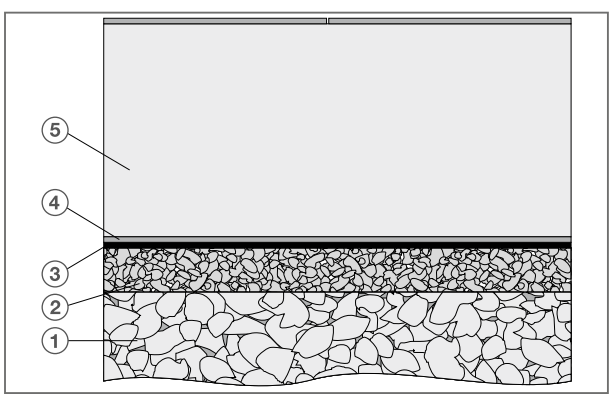


Fig. 234: Building waterproofing

Key

① Base layer
② Blinding concrete
③ Building waterproofing acc. to DIN 18195
④ Sliding layer
⑤ Concrete

Usually, building waterproofing is made using sheet material such as bitumen or PVC. In case of low requirements in the humidity of the room air, a capillary-breaking layer of approx. 15 cm thickness can be sufficient.

Pipe installation

The heating circuits in the selected pipe dimension are mounted in a meandering manner in the applicable installation clearance according to the planning specifications. The pipelines are laid and fixed as shown in the illustrations below. For pipe deflections, low-stress fixing must be provided, and the minimum bending radius must be observed (depending on pipe dimension and material).

Mounting on construction steel mat

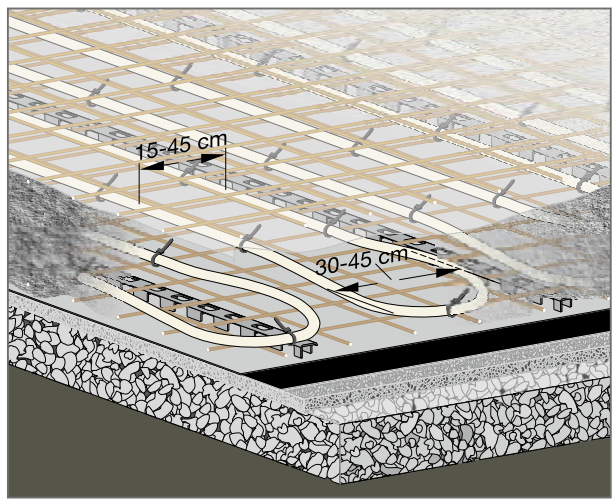


Fig. 235: Mounting on construction steel mat

Mounting on clamping rail, e.g. Fonterra pipe 25 x 2.3 mm

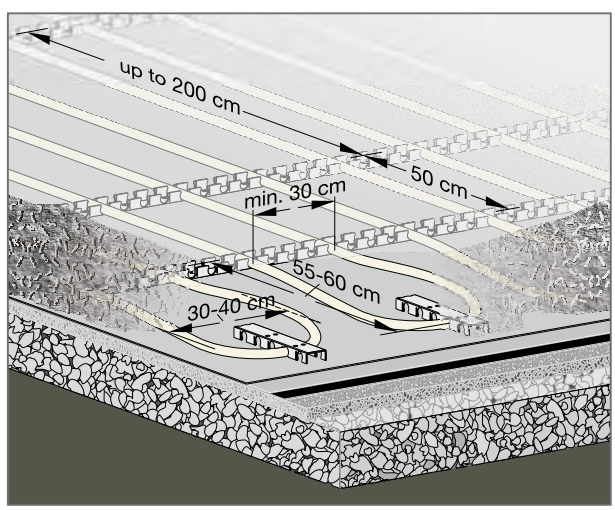


Fig. 236: Mounting on clamping rail, e.g. Fonterra pipe 25 x 2.3mm

If the processing temperature during mounting of the Fonterra Industry system pipes is < 10 °C, adjustment of the bending radii may be required.

Joints

The structural engineer is responsible for planning and arrangement of the joints, as well as for the determination of the field size. This depends on various factors such as payloads, floor panel type, panel thickness, structural subdivisions (columns, walls, etc.).

When installing the industrial underfloor heating, the structural engineer's joint plan must be complied with. The heating circuits and connection lines must be coordinated with the joint plan.
Generally, three types of joints are differentiated:
Movement joints, also called running joints, separate the concrete panel over its entire length from other building parts such as walls, supports, channels etc.; they are created with expansion joint strips or with a suitable insert in a width of approx. 20 mm.
Supply lines crossing the movement joints must always be sheathed with a suitable protective sleeve.

Movement joints

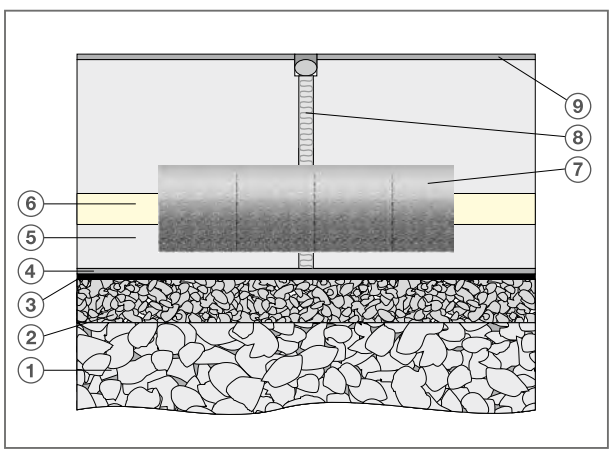


Fig. 237: Movement joints

Key
① Base layer
② Blinding concrete
③ Building waterproofing acc. to DIN 18195
④ Sliding layer
⑤ Concrete
⑥ Pipe (20 x 2.0 or 25 x 2.3 mm)
⑦ Protective sleeve (l=1 m)
⑧ Press joint
⑨ Wear layer

Press joints, also called daywork joints, are no movement joints. They are generated when the concrete fields are poured at different times. They can be connected to each other by means of a tongue and groove connection, or by dowels. To protect the heating pipe from mechanical stresses during mounting (e.g. erection of formwork on the heating pipe), it must be sheathed by a suitable protective sleeve of approx. 1 m length.

Press joints

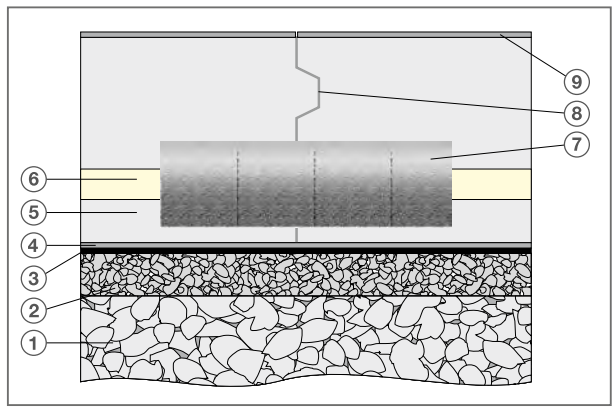


Fig. 238: Press joints

Key

① Base layer
② Blinding concrete
③ Building waterproofing acc. to DIN 18195
④ Sliding layer
⑤ Concrete
⑥ Pipe (20 x 2.0 or 25 x 2.3 mm)
⑦ Protective sleeve (l=1 m)
⑧ Press joint
⑨ Wear layer

Concealed joints with a width of approx. 3 to 4 mm are rated break points cut subsequently into the concrete layer to a depth of approx. 25 to 30% of the panel thickness.

Concealed joints

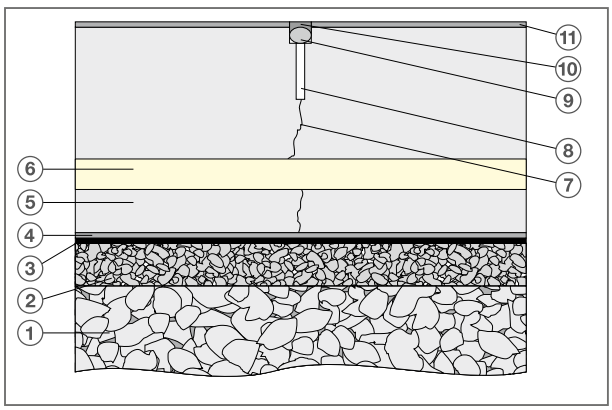


Fig. 239: Concealed joints

Key
① Base layer
② Blinding concrete
③ Building waterproofing acc. to DIN 18195
④ Sliding layer
⑤ Concrete
⑥ Pipe (20 x 2.0 or 25 x 2.3 mm)
⑦ Rated break point
⑧ Concealed joint
⑨ Joint filler material (e.g. foam rubber)
⑩ Elastic joint filling
⑪ Wear layer

The crack intended to form below the cut has no effect on the heating pipe; accordingly, no sheathing is required here. Joints in the floor panel must also be provided for in the floor covering or the wear layer, and sealed with elastic fillers.

Wear layer

The building planner decides on the manner and type of executing the wear layers. In accordance with the stress (e.g. from fork-lift truck traffic), different coats (mastic asphalt, magnesia screed, cement-bonded hart substances etc.) acc. to DIN 18560 can be applied.
Joints in the concrete panel must be provided along the same lines in the coat.

Connection to the manifold

Viega industry manifolds are suitable for use in heating systems according to DIN EN 12828 for connection of heating circuits under the specified operating conditions.
The manifold can be mounted in vertical position, with outlet facing up or down, or in horizontal position at a storey floor.
If the manifold is positioned below the heating level, an air separator must be provided to avoid air cushions.
It must only be installed with original Viega system accessories and suitable mounting tools.

Manifold installation dimensions

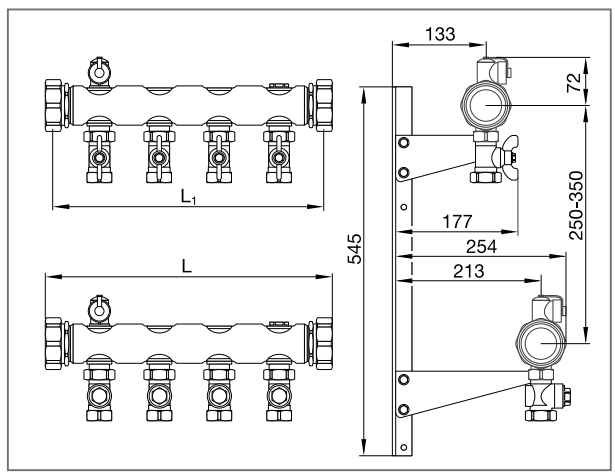


Fig. 240: Installation dimensions of industry manifold

Industry manifold, technical data

Art. no.	Outlets	L (mm)	L1 (mm)	Kvs value (m³/h)
620806	4	395	380	6,52
620813	5	475	460	7,74
620820	6	555	540	8,95
620837	7	635	620	10,14
620844	8	715	700	11,33
621957	9	795	780	12,52
921964	10	875	860	13,7
621971	11	955	940	14,87
621988	12	1035	1020	15,93
621995	13	1115	1100	16,98
622008	14	1195	1180	17,95
622015	15	1275	1260	18,83
622022	16	1355	1340	19,66

Tab. 115: Industry manifold, technical data

Target values of the valves

K_v value (m³/h)								K_{vs} value (m³/h)
Number of revolutions (U)								
0,25	0,5	1	1,5	2	2,5	3	3,5	
0,22	0,37	0,62	0,92	1,27	1,55	1,72	1,85	1,93

Tab. 116: Target values of the valves

Flowthrough diagram

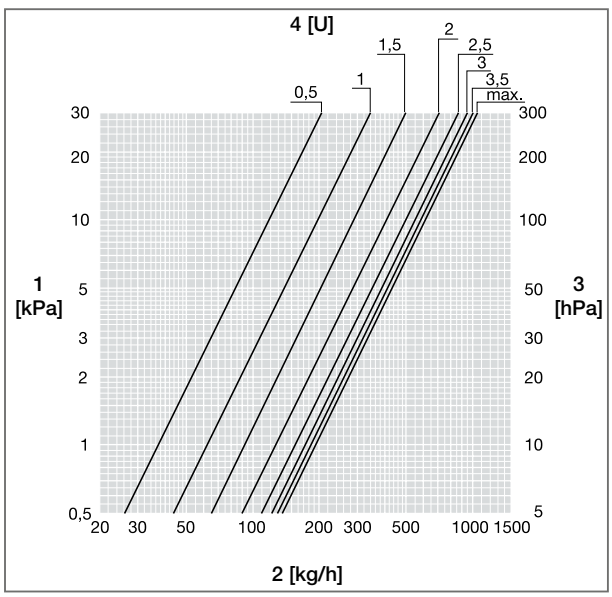


Fig. 241: Flowthrough diagram

Key
① Pressure loss Δp [kPa]
② Mass flow m [kg/h]
③ Pressure loss Δp [hPa]
④ Number of revolutions [U]

To ensure an even flow through the individual heating circuits, hydraulic calibration of the heating circuits is required.
The presettings at the individual regulation valves are made by means of the flow diagram and the calculated mass flows.

Example:
- Pressure loss most unfavourable circuit = 220 mbar (value from project planning)
- Pressure loss circuit to be calibrated = 130 mbar (value from project planning)
- Differential pressure to be calibrated = 220 mbar - 130 mbar = 90 mbar
- Mass flow of the circuit to be calibrated = 180 kg/h (value from project planning)
- Transfer the values into the diagram and get the reading for the setting revolutions.

Control

Heating systems must provide the output needed to fulfil the current heat requirement.
For this reason, the EnEV requires the installation of an automatic device for controlling the room temperature separately for each room or for reduction and switch-off of the heat supply in centrally heated buildings.
In industrial and non-residential buildings used for one purpose only, group or zone control is permissible.
To exclude hydraulic problems, we recommend to use suitable control components (electronically controlled pumps, differential pressure regulators etc.).

Commissioning

Functional heating

After completion of the concrete pouring and covering work and after expiry of a defined period of time, concrete panels with integrated Fonterra surface heating systems must undergo a function test.
This functional heating is not only intended to dry out the concrete but also as a function test according to VOB DIN 18380. With concrete thicknesses of up to 30 cm, the test is usually done as follows:

- Start of heating the floor surface approx. 28 days after installation and after approval by the site management/structural engineer
- Determine the floor temperature; set the supply temperature 5K higher, and maintain for one week
- Increase the supply temperature by 5K every day until the max. design supply temperature is reached
- Maintain the design supply temperature for one day
- Reduce the supply temperature by 10K per day until the operating temperature is reached
- Setting the operating temperature

If there is the likelihood of frost, do not decommission the system, or take appropriate protective measures (addition of anti-freeze).
If the anti-freeze is not required for normal operation, the system must be cleaned by flushing with at least three water exchanges.

Functional heating

We recommend to retain the document.

Building project		**Construction stage Distribution list**	
Building owner's address			
Address of the qualified installation company		Date	

The functional heating of concrete surfaces is intended to check the heating system/the floor surface, and it may speed up the screed curing process.
Start of heating at the earliest
☐ 28 days after concrete pouring and approval by the site management

General notes
☐ The heating process must be slow and continuous.
☐ During functional heating, the heating surface must not be exposed to draughts.
☐ Set the supply temperature 5 K above floor temperature, but at least 20 °C, and maintain for 7 days.
☐ Increase the supply temperature by 5 K per day until the maximum design supply temperature is reached.
☐ Maintain the design supply temperature for one day. After that, reduce the supply temperature by 10 K per day until operating temperature is reached.

Materials used Pipes: ☐ 20 x 2.0 mm ☐ 25 x 2.3 mm

Functional heating log

with supply temperature 20 - 25 °C Start: End:

with maximum design supply temperature in the supply line reached on:

Interruptions: ☐ yes from: to: ☐ no

The system was approved for further building work at an outside temperature of °C.

☐ At this point, the system was out of operation.
☐ At this point, the floor was heated at a supply temperature of °C.
☐ All windows and external doors were closed.

Notes on commissioning
The supply temperatures and the individual room temperature regulation must be set in such a way that the maximum heating surface temperature in the proximity of the heating pipes is not exceeded.

Comments

Building owner	**Site management**	**Qualified installation company**
Date/signature/stamp		

Handover certificate

This document is handed over to the planner/building owner after completion of the installation work.

Building project		**Construction stage Distribution list**	
Building owner's address			
Address of the qualified installation company		Date	

Pressure test carried out acc. to pressure test log on:	☐ yes	☐ no
Visual inspection of pipe connectors carried out?	☐ yes	☐ no
Position of couplings marked in the installation plan?	☐ yes	☐ no
Leak tightness established and documented?	☐ yes	☐ no
Any leaks were remedied and reported in a separate log.	☐ yes	☐ no

Laying of the registers acc. to the installation plan	Plan designation:	As at:

Status of the system on handover	☐ System is full (Caution: if not running, system is not frost proof)	
	☐ System has been emptied and is frost proof	
	☐ System is running	☐ System is not running

Comments

Building owner Date/signature/stamp	**Site management**	**Qualified installation company**

Pressure test

This document must be handed over to the planner/building owner after completed pressure test. We recommend to retain the document.

Building project		**Construc-tion stage manifold**	
Building owner's address			
Address of the qualified instal-lation company		Date	

Before pouring the concrete, the leak tightness of the heating circuits is tested with water. The leakage test is carried out at the finished but not yet covered pipelines.

Notes on the test procedure

- ☐ Fill the system with filtered water and vent it completely.
- ☐ The filling/top-up water must not exceed the limit values specified in VDI2035.
- ☐ In case of major differences (~10 K) between the ambient temperature and the filling water temperature, wait for 30 minutes after filling the system for the temperatures to adjust.
- ☐ Carry out the leakage test at a pressure of 0.4 MPa (4 bar), max. 0.6 MPa (6 bar). This test pressure must be maintained during the entire concrete pouring process.
- ☐ System units not designed for these pressure levels (e.g. safety valves, expansion vessels etc.) must be exempted from the test.
- ☐ Visual inspection of the piping system/check per manometer*.
- ☐ Take suitable measures to exclude freezing, for example room heating or addition of anti-freeze to the heating water.
- ☐ If the anti-freeze is not required for normal operation, the system must be cleaned by emptying and flushing with at least three water exchanges.

* Pressure gauges must be used which clearly indicate pressure changes of 0.01 MPa.

Materials used	Pipes:	☐ 20 x 2.0 mm	☐ 25 x 2.0 mm
	Pipe connectors:	☐ Pressing	☐ Clamping

Log of the pressure test

Start of the pressure test:	Start pressure:	Water temperature [°C]:
End of the pressure test:	Final pressure:	Water temperature [°C]:

Visual inspection of pipe connectors carried out?	☐ yes	☐ no
Position of couplings marked in the installation plan?	☐ yes	☐ no
Leak tightness was established, no permanent form changes identified in any component?	☐ yes	☐ no
Has the operating pressure been set on system handover?	☐ yes	☐ no

Comments

Building owner	**Site management**	**Qualified installation company**
Date/signature/stamp		

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