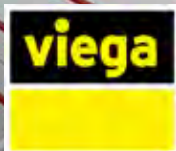


Application technology, 5th edition

Volume III:

Fonterra radiant heating and cooling



Fonterra Side 12 Clip

Planning

System description

The wall heating system Fonterra Side 12 Clip is perfectly suited for use in modern low-energy buildings, not only residential houses but also sports halls, hospitals, swimming pools etc.

The system convinces with various benefits: a reduction of the risk of accidents, no obstruction of utility spaces, and added comfort. Also for reconstruction of old buildings, Fonterra Side 12 Clip offers tried-and tested mounting options, e.g. by means of the flexible variants for installation of the system pipes.

Fonterra Side 12 Clip is a wall heating system for mounting on solid walls made of brick, concrete, sandstone etc.

The polybutene wall heating pipe is mounted on clamping rails and laid in a meandering manner. With gypsum plasters, the required plaster coverage must have a minimum thickness of 10 mm with use of reinforcement fabric to avoid cracking.

The maximum wall heating surface is 6 m² per heating circuit or 80 m including connection lines.

Depending on the selected plaster system, supply temperatures of up to 70 °C are possible. For premium comfort, however, 45 °C should not be exceeded.








Installation situation Fonterra Side 12 Clip

Fig. 178: Installation situation Fonterra Side 12 Clip

System features

- Can be mounted to solid walls made of brick, concrete, sandstone etc.
- Suitable as a wet system for gypsum, lime, loam, or cement plaster
- Total plaster thickness, e.g. with gypsum plasters, 26 mm
- Thanks to flexible laying options, individual room geometries can be covered without problems.
- Operating temperatures ≤ 50 °C with gypsum plasters
- Oxygen-sealed PB heating pipe acc. to DIN 4726
- Wall heating surfaces of up to 6 m² or 80 m can be connected directly to the manifold
- Safe fastening of pipes with clamping rail, in curved areas with nail round clips
- Comfortable mounting thanks to fast and flexible pipe laying
- Fonterra wall heating systems can also provide cooling
- The positions of the wall heating pipes can be identified by means of temperature foil.

System components

Clamping rail/fastening	
 Fonterra Side 12 clamping rail	 Nail round clips
 Impact dowel	
PB pipe and connector	
 12x1.3	 Clamp connection

Technical data

Name	Article number
PB pipe 12x1.3 mm, 120 mm	707712
PB pipe 12x1.3 mm, 240 mm	615680
PB pipe 12x1.3 mm, 650 mm	616502
PB pipe 12x1.3 mm, in protective pipe	609658
Protective pipe for joints 12x18 mm	668945
Clamping rail 12 mm	609429
Impact dowel 35-6	615598
Nail round clips for PB 12	615611
Window screw 22 mm	625191
Pipe guide 90°	609498
connection screw fitting	614508
Connection screw fitting with SC-Contur	614584
Coupling for plastic pipe 12x1.3	614669
Press connector with SC-Contur 12x1.3 mm	614676
Plug-in piece 12x15	637002
Adapter with SC-Contur 12x ½	636166
Temperature foil 160x70 mm	624910
Plaster reinforcement fabric provided on-site	on-site

Technical data system

Tab. 84: Technical data system

Name	Article number
Viega pipe shear	652005
Hand press tool 12	401436
Viega press jaw 12	425302
Viega press tool, e.g. battery Picco	556280

Tools

Tab. 85: Tools

**Technical data
system pipe**

System pipe		PB 12x1.3mm
Dimensions	[mm]	12 x 1.3
Minimum bending radius		5 x d _a
Operating condition acc. to ISO 10508	Class 4 Class 5	[MPa] (bar) 1 (10) 0,8 (8)
Max. operating temperature	[°C]	95
Mounting temperature	[°C]	> 5
Water volume	[l/m]	0,069
Heat conductivity λ	[W/(m·K)]	0,22
Linear coefficient of length expansion	[K ⁻¹]	1.3 x 10 ⁻⁴
Weight	[g/m]	50

Tab. 86: Technical data system pipe

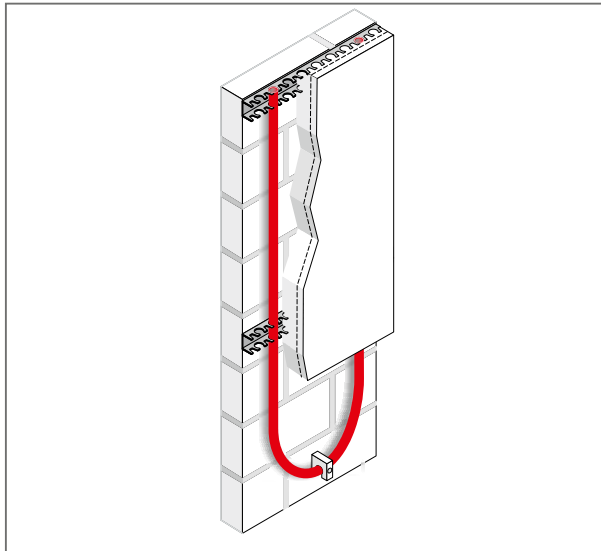
Wall construction
**Wall construction
Fonterra Side 12
Clip**


Fig. 179: Wall construction Fonterra Side 12 Clip

Fonterra Side 12 Clip can be mounted to all suitable underground types with sufficient load carrying capacity, e.g. brick walls, prefabricated and concrete walls.

The system surface facing the room transmits and distributes the heat.

When installing a wall heating in a building, a range of structural aspects must be considered, e.g.:

- Free available wall surface
- Large areas obstructed by furniture
- Quality of the underground
- Existing installations

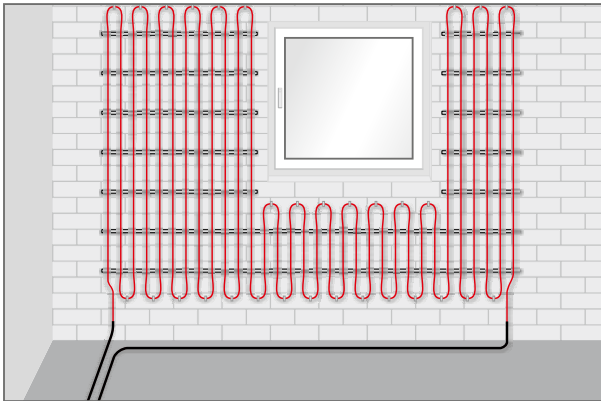


Fig. 180: Flexible mounting options matching the individual structural aspects

Flexible mounting options matching the individual structural aspects

Notes on dimensioning

The new EnEV regulations concern wall heating systems regarding the execution of the external walls or pitched roof areas, or walls bordering on unheated rooms or soil.

If, in heated rooms, walls bordering on unheated rooms are to be replaced or installed for the first time or modified in such a way that insulation layers are provided, the maximum values specified in Appendix 3 line 5 are applicable.

Line 1	Outer walls and pitched roof areas	0.24 W/(m ² K)
Line 5a	Walls bordering on unheated rooms or soil	0.30 W/(m ² K)

Excerpt from EnEV 2014 Appendix 3, Table 1

Tab. 87: Excerpt from the EnEV 2014 Appendix 3, Table 1

Subject to adherence to the above-named values, no additional heat insulation behind the wall heating must be provided. If additional insulation is required nevertheless, e.g. with internal walls against rooms with much lower inside temperatures, soft fibre timber panels can be mounted under the wall heating pipes.

External walls should be insulated only on the "cold side", i.e. the outer side of the external wall, for example by installation of upgraded insulation.

In the special situation of an insulation layer at the interior-room side of the external wall, the requirements of §8 sentence 1 are considered met if the thermal transmission coefficient of the resulting wall construction does not exceed 0.35 W/(m²K). Interior insulation of external walls makes sense for ex-

ample when refurbishing half-timbered houses, but requires particular expert knowledge, since the dew point will shift to the inside of the building, suitable vapour/moisture barriers must be installed to prevent moist inside air from getting behind the insulation layer and condensing there.



If, generally, measures are taken during reconstruction according to EnEV § 9 sentence 1 (thermal transmission coefficient of the external building parts) and if the thickness of the insulation layer provided according to these measures is restricted for technical reasons, the requirement is considered met if the insulation layer is installed with the greatest possible thickness achievable according to the recognized state of practice (with a calculation value of the heat conductivity of $0.035 \text{ W}/(\text{m}\cdot\text{K})$).

Pipe requirement and mounting times

System requirement

Installation data for Fonterra system	Side 12 Clip
Pipe clearance	10.0 cm
Pipes required	10 m/m ²
Max. heating circuit area	6 m ² or 80 m *
Mounting time in group minutes	8 to 9 min/m ²

Tab. 88: Pipe requirement and mounting times

* Connection lengths to the manifold must be considered.

Material requirement for 1 m²

Material required for 1.0 m ²		
System components	Available quantities/packing units	Pro-rata requirement
PB pipe 12x1.3 mm	120/240/650 m	10.00 m/m ²
Clamping rail 12x2000 mm	10 pieces	2.50 m/m ²
Window screws or impact dowels	1000 pieces	15 pc./m ²
	200 pieces	15 pc./m ²
Nail round clips	100 pieces	5 pc./m ²

Tab. 89: Material requirement for 1 m²

Installation example

Viega recommends the following process for a pre-calculation:

- Select the supply temperature. Depending on the system, a supply temperature between 25 and 50 °C can be selected which is valid for the entire building. With higher supply temperatures, make sure to select a suitable plaster type.
- Calculation of the heating fluid overtemperature (see reading example output diagram).
- Dimensioning with Fonterra Side 12 Clip output diagram. Read-off of the heat output into the room. Determination of the required wall heating surface.
- Examination of the maximum heating circuit surface. Determination of the manifold outlets.
- If the total of the heating circuits or walls adds up to an excessively large heating circuit length, the heating circuit surface must be subdivided into several heating circuits.
- Calculation of the actual mass flow. Examination of the pressure losses. Calculation of the valve settings.



To ensure premium comfort, the mean heating surface temperature should not exceed 40 °C.

Assumptions

- Residential building:
New "low-energy house"
- Heat requirement:
approx. 45 W/m²
- Heating system:
Heat generator supply line = 42 °C, return flow = 37 °C
- Room to be dimensioned:
Living room with 45 m² enclosing walls surface and 25 m² floor space (4.65 m x 5.38 m) with one external wall, room height 2.75 m, room temperature 20 °C
- External wall:
OHTC value = 0.20 W/m²K, brickwork
Wall surface for wall heating W x H = 4.65 x 2.75 (2.0) m
(incl. 1 window 1.20 x 1.0 m) and 5.38 x 2.75 (2.0) m (incl. 1 door 1.8 m x 2.02 m)
- Wall heating system:
Fonterra Side 12 Clip

Sample room

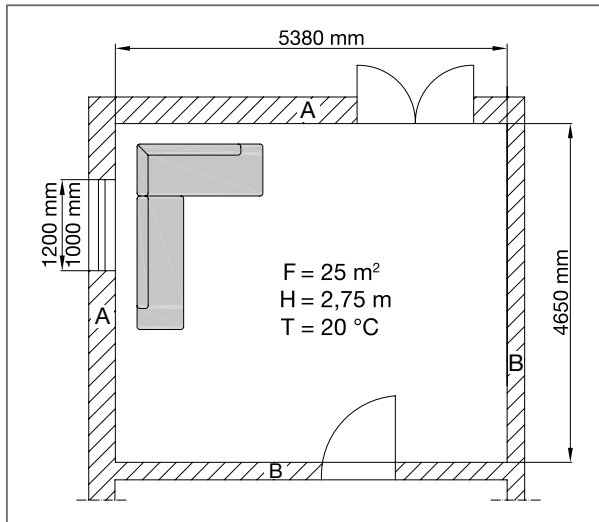


Fig. 181: Sample room

Key

A - External wall

B - Internal wall

F - Area

H - Room height (building shell dimension)

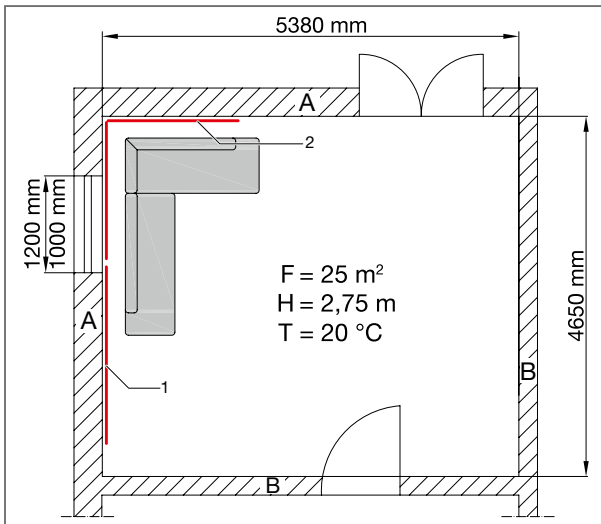
T - Room temperature

Calculation

- Take over the room heat requirement from the heating load calculation:
Heat requirement room = $25 \text{ m}^2 \times 45 \text{ W/m}^2 = 1125 \text{ W}$
- Output Side 12 Clip in W/m^2 :
 $T_m = 39.5 \text{ }^\circ\text{C}$ minus $RT \text{ } 20 \text{ }^\circ\text{C} = 19.5 \text{ K}$ (heating fluid overtemp.) acc. to diagram with $19.5 \text{ K} > 110 \text{ W/m}^2$
- Required wall heating surface:
 $1125 \text{ W} / 110 \text{ W/m}^2 = 10.2 \text{ m}^2$ Fonterra Side 12 Clip
- Number of heating circuits:
max. 6 m^2 per heating circuit (manifold outlet) > 2 heating circuits
- Subdivision of the wall heating surface Side 12 Clip:
coverable surface external wall:
 $B = 4.65 - 2 \times 0.10$ (side edge) = 4.45 m , $H = 2.0$
 $F = 8.9 - 1.54$ (window) = 7.50 m^2 (required 10.2 m^2)
 $>$ difference 2.70 m^2
additional covering of a further external wall
- Subdivision into heating circuits of roughly the same size: 5.0 m^2 and 5.2 m^2 , possible arrangement see Fig. 182.



The arrangement of the wall heating panels shown in the illustration is only an example and must be coordinated with the building owner in respect of the furniture setup etc. In the example, the heating panels were installed at the external wall and behind the sofa to create a comfortable room climate.



Sample room
Surface: 25 m²
Height: 2.75 m
Temperature: 20 °C

Fig. 182: Potential arrangement of the required wall heating registers

Key

A - External wall

B - Internal wall

① - Fonterra Side 12 Clip heating circuit 1 (5 m²)

② - Fonterra Side 12 Clip heating circuit 2 (5.2 m²)



The supply temperature of the heating installation should be set as low as possible.

This results in covering of large heating surfaces, which avoids radiation asymmetries and increases the comfort factor.

Wall view Sample room with potential heating surface covering

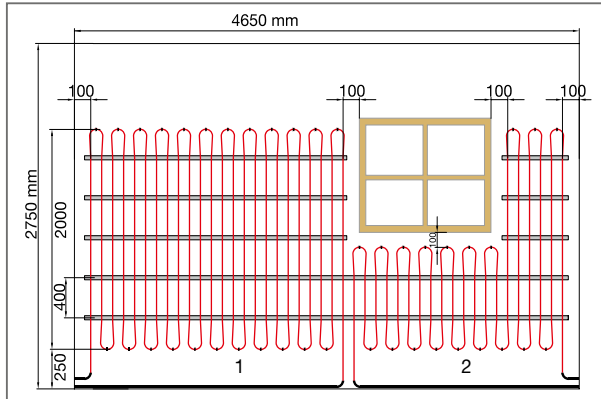


Fig. 183: Wall view Sample room with potential heating surface covering

Key

- ① Heating circuit 1
- ② Heating circuit 2 (continued at adjacent wall)

Output data

**Output data
Fonterra Side 12
Clip**

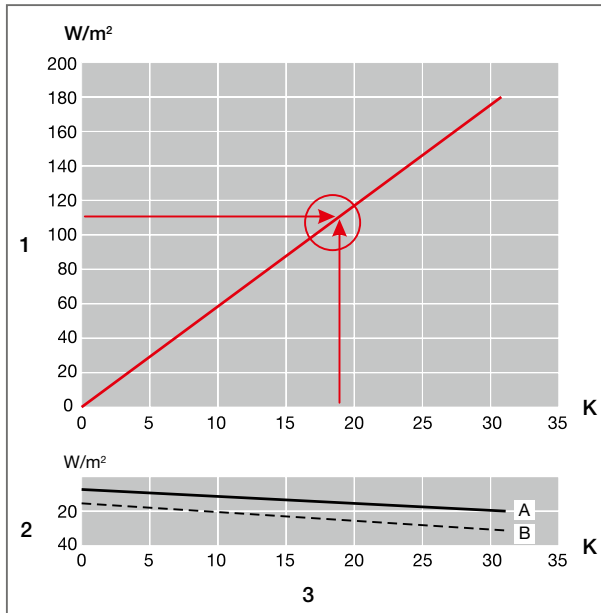


Fig. 184: Output diagram Fonterra Side 12 Clip

Key

- A - Wall, $k = 0.35$ W/m^2
- B - Wall, $k = 0.50$ W/m^2

- ① Heat output into the room q_i in $[W/m^2]$
- ② Dissipation through the external wall q_{a^*} in $[W/m^2]$
- ③ Heating fluid overtemperature $\Delta\theta H$ in [K]

Reading example - output dissipation diagram

■ Calculating the main heating water temperature

$$\frac{\text{Supply temperature} + \text{return temperature}}{2} \quad \text{e.g.} \quad \frac{42^\circ\text{C} + 37^\circ\text{C}}{2} = 39.5^\circ\text{C}$$

■ Deduct the room temperature

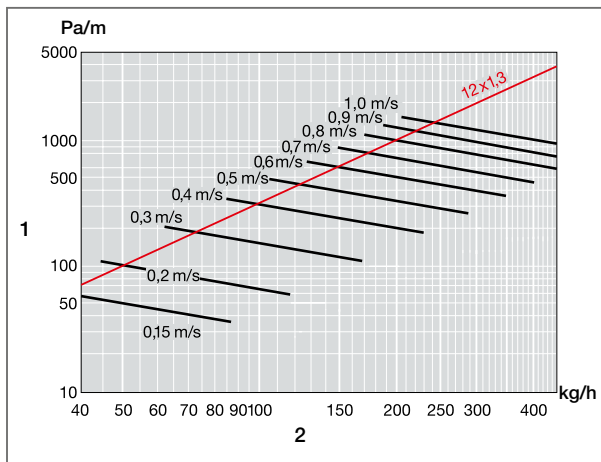
z. B. $39.5^\circ\text{C} - 20^\circ\text{C} = 19.5^\circ\text{C}$

■ The result is the heating fluid overtemperature

e.g. 19.5°K (value for diagram)

■ Read the output q_i from the diagram

e.g. $110\text{W}/\text{m}^2$ with 19.5°K = heat dissipated into the room



Pressure loss diagram for PB pipes 12 x 1.3

Fig. 185: Pressure loss diagram for PB pipes 12 x 1.3

Key

- ① Pressure gradient R in $[\text{Pa}/\text{m}]$
- ② Mass flow m in $[\text{kg}/\text{h}]$ (fluid: water)

For pipes installed on external walls, take the actual losses to the outside into consideration. Next, determine the actual mass flow and R value, add the connection lines to the heating circuits, and consider them for the hydraulics.

Mounting

Structural requirements

For installing Fonterra Side 12 Clip, the following work step sequence of the various trade lots must be observed:

- Windows and doors installed
- Electrical installations (wall breaking, empty pipe installation etc.) completed
- Installation work, beamfilling etc. must be observed

Next, check that the wall installation surface is suitable for installing the system, i.e. dry, level, and firm. If all preconditions are met, installation can start.

Mounting instruction

Fastening the clamping rails

Before mounting the clamping rail, transfer the heating circuits determined in the plan to the wall surface.

The clamping rails are fastened directly on solid walls made of brick, gas concrete blocks, or concrete.

Make sure that the brickwork is free of unevenness, residual mortar etc. to allow for perfect mounting of the clamping rails and to prevent pipe damage.

For fastening,

- use impact dowels or window screws
- or commercially available hot-melt adhesive (start application from the centre of the clamping rail, use a hot-melt gun with at least 200 W power). Not suitable for sand-lime brick
- or a commercially available construction adhesive.

Fastening the clamping rails



Fig. 186: Fastening the clamping rails

Make sure that the clamping rails lie flat on the brickwork so that the pipelines can be fixed securely.

When mounting the clamping rails, observe the clearances between the rails specified in the drawing below. For installation in pitched roof areas, it may be necessary to mount the clamping rails at smaller clearances. The clamping rails can be mounted horizontally or vertically. To allow for subsequent mounting of skirting boards, the clearance between pipes and raw floor should be 15 to 20 cm.



Viega recommends to mount the clamping rails horizontally and to fasten them with window screws or impact dowels.

Important notes on pipe laying

Observe the following when laying the pipes:

- Installation clearance of 10 cm for straight sections
- At least 12 cm in pipe sections with deflections
- Pipe protrusion in curved sections approx. 25 cm
- Fastening in curved sections by means of nail round clips
- Free laying of the wall heating pipe

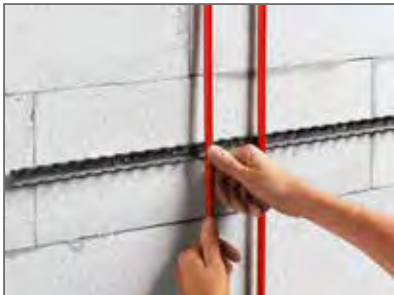


Fig. 187: Installation clearance



Fig. 188: Fastening in curved sections

Important notes on pipe laying

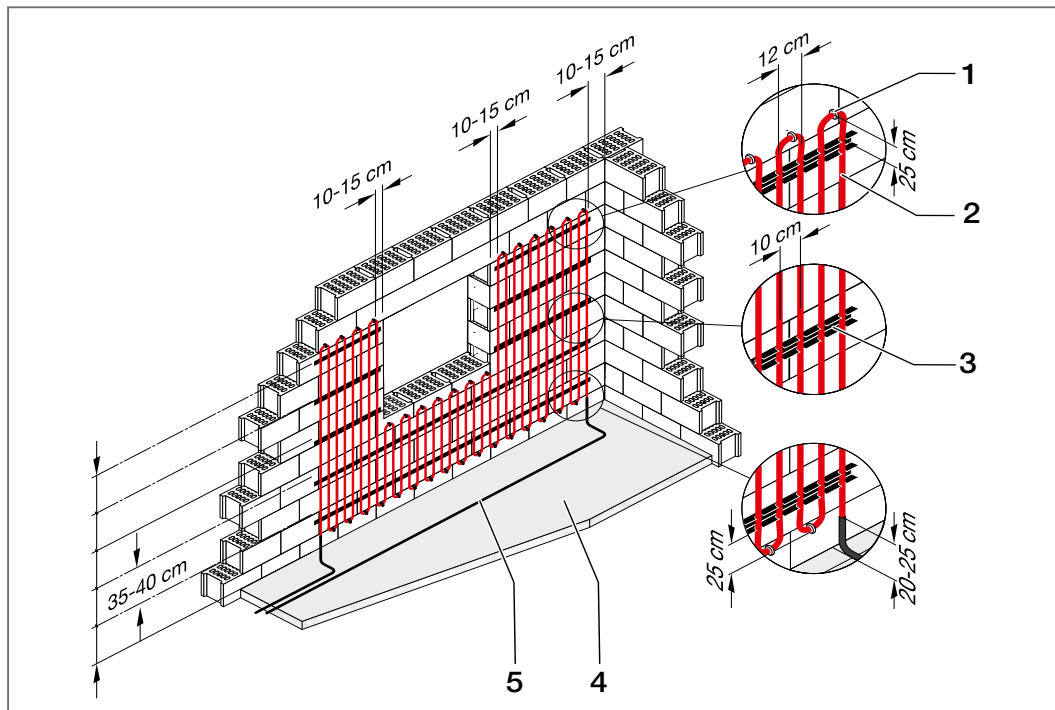


Fig. 189: Installation diagram

Key

- ① Nail round clip (brick)
- ② PB pipe 12x1.3
- ③ Clamping rail
- ④ Raw floor
- ⑤ PB pipe 12x1.3 in protective pipe

Connecting the technical heating elements**Checking the heating circuits**

- Check the maximum wall heating surfaces of 6 m² per heating circuit (with 2 x 10 m connection line) or maximum pipe length 80 m (incl. connection line)
- The heating circuits may supply wall heating surfaces of different sizes.



If Viega press connectors are used, they are covered by the Viega warranty. After installation, mark the position of the press connectors in the plan (measure the position). The plan must be submitted to the building owner with the other documents.

Connection line

The connection lines can be laid either on the raw floor or in the screed on the heat and footfall sound insulation.

- The 12x1.3 mm pipeline is laid as a supply line from the manifold to the wall heating register (without connection to the manifold).
- Generation of the wall heating register according to the specifications
- Laying the return line up to the manifold.
- Mounting of heat insulation according to EnEV via the supply lines (supply and return flow) from the manifold to the wall heating register.
- Fastening of the pipelines on the raw floor with the appropriate pipe clamps.

Excerpt from the EnEV 2014 Appendix 5, Table 1

Line	Type of pipes	Minimum thickness of the insulation layer with a heat conductivity of 0.035 W/mK
1	Inner diameter max. 22 mm	20 mm
2	Heat distribution lines according to lines 1-4 installed after 31 January 2002 in building parts between heated rooms of different users.	50% of the requirements of lines 1-4
7	Pipes in acc. with line 6 in the floor construction	6 mm

Requirement in the heat insulation of pipelines and fittings

Tab. 90: Requirement in the heat insulation of pipelines and fittings

For materials with other thermal conductivities, the minimum thicknesses of the insulation layers must be converted accordingly. Here, for example, a concentric insulation of 6 mm with a heat conductivity of 035 corresponds to a concentric insulation of 9 mm with a heat conductivity of 040 with 40 °C.

Table 1 does not apply if the pipes are located in heated rooms or building parts between heated rooms of one user and when the heat dissipated by such pipes can be controlled by accessible shut-off systems.



Though there are no statutory requirements, the supply lines should still be sheathed at least by a Fonterra protective pipe for joints for the following reasons:

- for avoidance of knocking and flow noises,
- for noise insulation,
- for corrosion protection,
- for reduction of heat loads

Manifold connection

Assembly steps:

- Tension-free connection of the wall heating pipe 12x1.3 mm directly to the supply or return flow or the respective manifold bar by means of Fonterra connectors
- Calibration of the flow volumes at the manifold by means of a flow quantity gauge



The combination of floor heating circuits with wall heating circuits at the manifold is also possible. The respective flow volumes can easily be set at the flow quantity gauge at the supply flow manifold.

Flushing of the pipelines

Precondition for execution of the pressure test:

- Close the supply and return flow at the manifold as well as all supply valves
- Open the valve for heating circuit 1 and flush the heating circuit via the KFE tap at the manifold until there are no longer air bubbles in the water in the return flow line
- Close the valve for heating circuit 1 again and repeat the process for all valves
- Open the supply and return flow locks at the manifold again and do a pressure test

Pressure test

- All surface heating circuits must be checked for leak tightness by means of a water pressure test. The test pressure must be double the operating pressure, minimum 0.4 MPa (4 bar), maximum 0.6 MPa (6 bar) (see pressure test log).
- This pressure must be maintained until the end of the drywall work.
- Record leak tightness and test pressure in a test log.
- After the leakage test, re-tighten all screw fittings.



Caution!

It is mandatory that system components not designed for this pressure, such as expansion vessels, safety valves etc., are shut off or removed.



Please note that a 10K change of the pipe wall temperature occurring during the pressure test will change the test pressure by 0.05 to 0.1 bar.

Commissioning

After flushing the system, do the pre-setting of the heating circuit valves according to the data in the plans submitted. This is the only way for the system hydraulics to ensure proper functioning of the heating installation.

- Setting of the calculated flowthrough volumes via the valves at the manifold
- Mounting the actuators
- Setting the operating temperature

Anti-freeze

If there is a risk of frost, protect the system by temperature control or use of suitable anti-freeze agents (e.g. glycol). If anti-freeze is no longer required for the intended use of a system, the system must be drained and cleaned with a suitable detergent according to manufacturer's information. After that, the system can be filled again.

When using anti-freeze agents, take the increased pressure loss into consideration when doing the calculations.

Notes on plastering

Requirements for plastering

- Before starting on the plastering work, flushing and pressure testing of the wall heating system must have been completed.
- It is not necessary to heat the wall heating pipes up during plastering (exception: with loam rendering, or if specified by plaster manufacturer).
- During plastering, the wall heating system must be at operating pressure (min. 1.5 bar).

Structural requirements

- The plaster base must be level, dry, dimensionally stable, firm, and free of contamination, efflorescence and other adhesion-inhibiting substances.
- The plasterer company must check whether measures for improving the adhesive surface must be taken.
- The room temperatures for plastering must be greater +5 °C.

Movement joints

With heating surface lengths of Side 12 Clip > 10 m, movement joints must be provided on site which are usually implemented with plaster profiles. Type and arrangement must be specified by the planner.

Plaster construction

Generally, plastering of wall heating systems is straight-forward; the only different to regular wall plaster is the thickness of the layer and the additional reinforcement. These reinforcements prevent cracking; plasterers also use them elsewhere, for example at roller shutter boxes or window corners.

Work steps for plastering

- Plaster over the wall heating pipes and the wall clamping rails until the pipe register is covered completely (approx. 18 mm).
- Apply the reinforcement fabric (mesh width 8 to 10 mm) over the entire surface of the wall heating with approx. 20 cm overlapping at plaster opening and at unheated areas.
- Apply the cover layer (e.g. plaster "fresh-in-fresh" with gypsum plasters) so that the pipe coverage is approx. 10 mm (total thickness of plaster layer approx. 26 mm).

Furthermore, observe the relevant DIN standards, manufacturers' processing instructions, VOB (Construction Tendering and Contract Regulations), and for example the BVF datasheet "Richtlinie zur Herstellung beheizter Wandkonstruktionen im Wohnungs-, Gewerbe- und Industriebau" (Regulation on implementation of heated wall constructions in residential, commercial, and industrial buildings).

Suitability of various plaster types

The following plaster types are suitable for plastering wall heating systems:

- Gypsum/lime plasters up to 50 °C
- Lime/cement plasters up to 70 °C
- Loam rendering greater 50 °C

To ensure optimum heat transmission, ensure that the above-named plasters have a good heat conductivity.



Independent of the specifications / directives listed below, the plaster manufacturers' instructions must be observed.

Thermal insulation plasters are not suitable due to their poor heat conductivity. To ascertain the suitability of silicate plasters, mixed plasters, synthetic resin plasters, restoration plasters and acoustic plasters, contact the manufacturer. Observe manufacturer's installation instructions. With these plaster types, a reduction of the heating dissipation output must be expected.

For the plastering work required, comply with the system manufacturer's processing instructions as well as with DIN 18550 and VOB part C DIN 18350. To achieve larger plaster thicknesses, it may be necessary to apply several layers.

For installation of plaster reinforcement, observe the wall heating or plaster system manufacturer's instructions.

Plaster reinforcements are mineral or synthetic fibre inlays in the plaster. They increase the tensile strength of the plaster and prevent widening of any cracks which may form.

Plasters containing gypsum/lime plasters

Due to their low shrinkage, their positive effect on the room climate and good humidity-regulating properties, these plasters are highly suitable for

use with wall heating systems. Usually applied in one layer, this plaster is suitable for operating temperatures up to 50 °C. The system is heated after complete curing of the plaster, at the earliest after 7 to 14 days (note plaster manufacturer's specifications).



With supply temperatures > 50 °C, do not use wall plaster containing gypsum.

For this temperature range, use lime/cement scales or temperature resistant special plasters.

Lime/cement plasters

These plasters are excellent for use as an underground for tile surfaces, e.g. in bathrooms. Usually, the plaster is applied in two layers. It is suitable for operating temperature up to 70 °C. Note the risk of shrinkage cracks. The system is heated after complete curing of the plaster, at the earliest after 21 days (note plaster manufacturer's specifications).

Loam rendering

Due to its diffusion permeability, high capillary conductivity, and length expansion, loam rendering is highly suitable for wall heating systems.

Furthermore, loam rendering is an ideal material for biological housebuilding thanks to its numerous ecological benefits (pollutant-free, moisture absorbing, skin-friendly, heat regulating, permeable to vapour diffusion, smell-absorbing).

Usually applied in two layers, this plaster is suitable for operating temperatures > 50 °C. Optionally, jute fibre fabric can be used as reinforcement. For heat-up, comply with the plaster manufacturer's instructions.



When using loam rendering on rush mats, heat-up of the wall heating after plastering is imperative to cure the rendering, because the rush mats do not absorb any moisture at all, and the rendering would not be able to dry out without heating.

Furthermore, fasten a thin metal fabric over the pipe registers on the underground for better stabilisation of the pipes during the heating process; for installation in pitched roof areas, additionally fix the wall clamping rails at half the installation clearance specified above.


For loam rendering without rush mats, no special measures are required.

Pressure test

After completion of the installation work and execution of the pressure test, this document must be handed over to the planner/building owner.

We recommend to retain the document.

Building project			Date	
Building owner's address				
Address of the qualified installation company				
<p>Before mounting the passive ceiling elements, 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.</p> <p>Notes on the test procedure</p> <ul style="list-style-type: none"> <input type="checkbox"/> Fill the system with filtered water and vent it completely. <input type="checkbox"/> In case of major differences (~10K) between the ambient temperature and the filling water temperature, wait for 30 minutes after filling the system for the temperatures to adjust. <input type="checkbox"/> The leakage test is done with a test pressure of min. 0.4 MPa (4 bar) and max. 0.6 MPa (6 bar). <input type="checkbox"/> Visual inspection of the piping system/check per manometer*. <input type="checkbox"/> This pressure must be maintained until the end of the drywall work. <input type="checkbox"/> Take suitable measures to exclude freezing, for example room heating or addition of anti-freeze to the heating water. <input type="checkbox"/> 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. <input type="checkbox"/> The water temperature must be kept constant during the test. <p>* Use pressure gauges which clearly indicate pressure changes of 0.0 MPa (0.1 bar).</p>				
Materials used	Pipes	<input type="checkbox"/> 12x1.3mm		
	Pipe connectors	<input type="checkbox"/> Pressing	<input type="checkbox"/> 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?		<input type="checkbox"/> yes	<input type="checkbox"/> no	
Position of couplings marked in the installation plan?		<input type="checkbox"/> yes	<input type="checkbox"/> no	
Leak tightness was established, no permanent form changes identified in any component?		<input type="checkbox"/> yes	<input type="checkbox"/> no	
Has the operating pressure been set on system handover?		<input type="checkbox"/> yes	<input type="checkbox"/> no	
Comments				
Building owner	Site management	Qualified installation company		
Date/signature/stamp				

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