UFH PLANNING

SCREED FLOOR HEATING SYSTEMS

www.variotherm.com

VARIOTHERM

VPLAN3 | e30720

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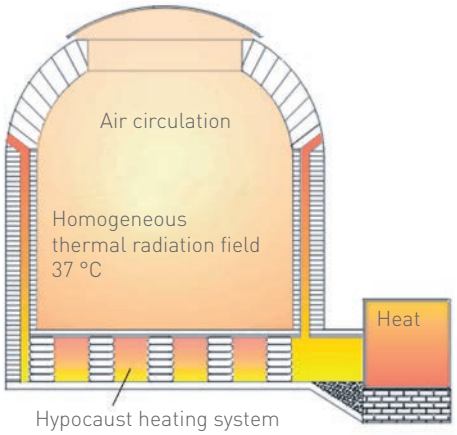
1 PRINCIPLES

That the ancient Romans already appreciated the qualities of floor and wall heating systems is proven by extensive finds and reconstructions of Roman thermal baths from the 1st century BC.
In the last 20 years, the popularity of floor heating systems has seen a substantial revival. The Variotherm floor heating system gives off radiant, long-wavelength infrared heat. Consistent with the body's own heat, similar to the heat of the sun, this type of heat is experienced as particularly pleasant.
The Variotherm floor heating system is ideal for all 'cold' floor coverings. It is an optimum temperature regulator, creating a pleasant atmosphere. Naturally, it can be used with all other floor coverings suitable for floor heating systems.



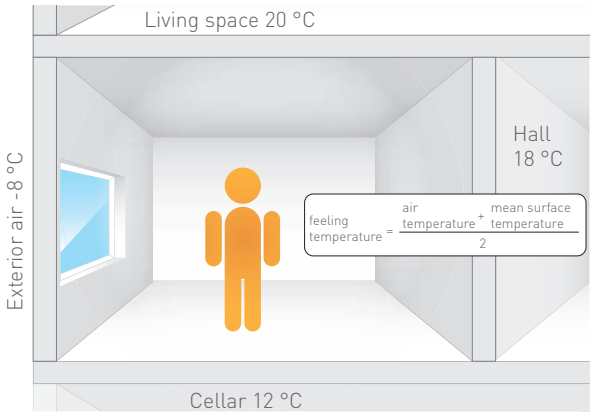
1.1 Comfort

Comfort is not only created through a certain air temperature in the room. The temperature of the surfaces enclosing the room is of equal importance. The felt temperature is roughly consistent with the arithmetic mean of both temperatures.

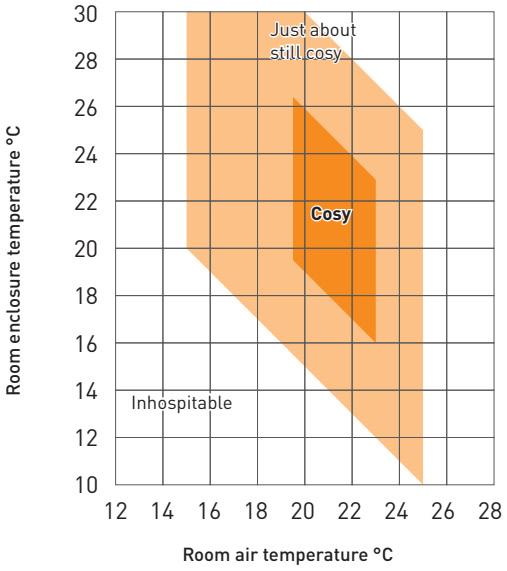
What makes people feel comfortable?

People feel comfortable when the following basic 'thermal comfort' equation holds:

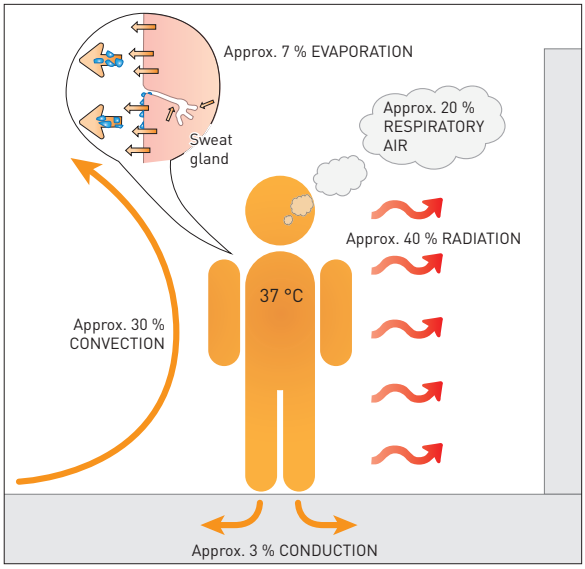
Heat production = heat loss



▲ Impact of the room on felt temperature

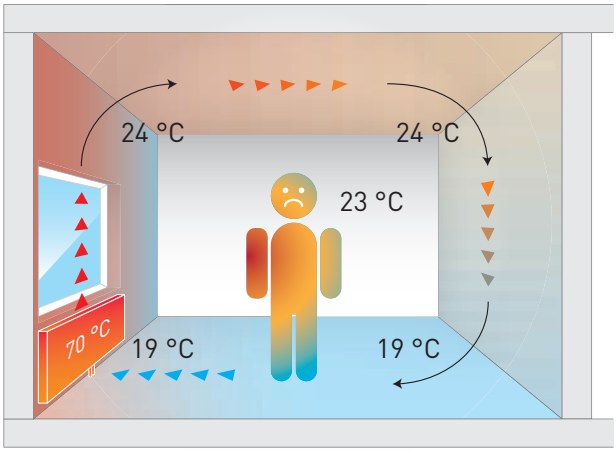


▲ Zone of cosiness



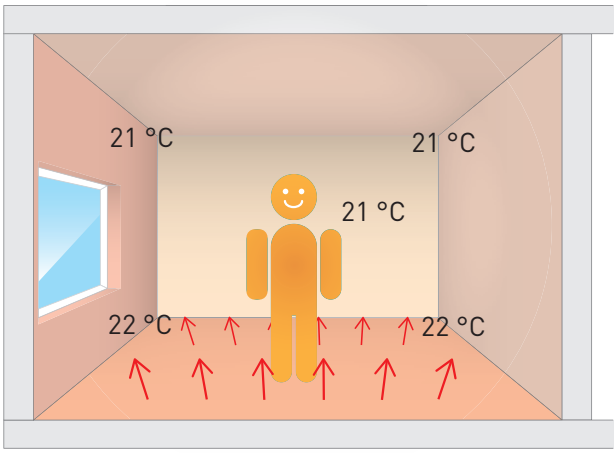
▲ Human heat balance

In this context, it is important that the heat loss from the human body is as evenly distributed in all directions as possible. We feel uncomfortable if too much heat is lost in one particular direction (cold surfaces, droughts) or heat loss is prevented in one direction (hot surfaces or steam-tight, thick clothing). In many cases it is therefore recommendable to install a combination involving the Variotherm wall heating system. Consistent heat transfer ensures that temperature layering in the room is kept at a minimum, promoting the general spreading of a pleasant temperature. In the case of floor heating, the floor is indeed warmer than the air at head-level. Indeed, according to popular wisdom, people ‚stay healthy with a cool head and warm feet'. The room temperature can be set lower than with conventional heating systems. Radiant heat raises the felt air temperature without affecting your comfort.



▲ Discomfort with radiators

Since the heat is transferred invisibly via the floor, no visible components have to be planned for, such as recesses for heating devices, radiators and pipes. These almost unavoidable 'subtenants' in expensive living space require a lot of room and are not pleasing to the eye. They restrict both the wall and window design and the space where furniture can be positioned.



▲ Comfort with floor heating system

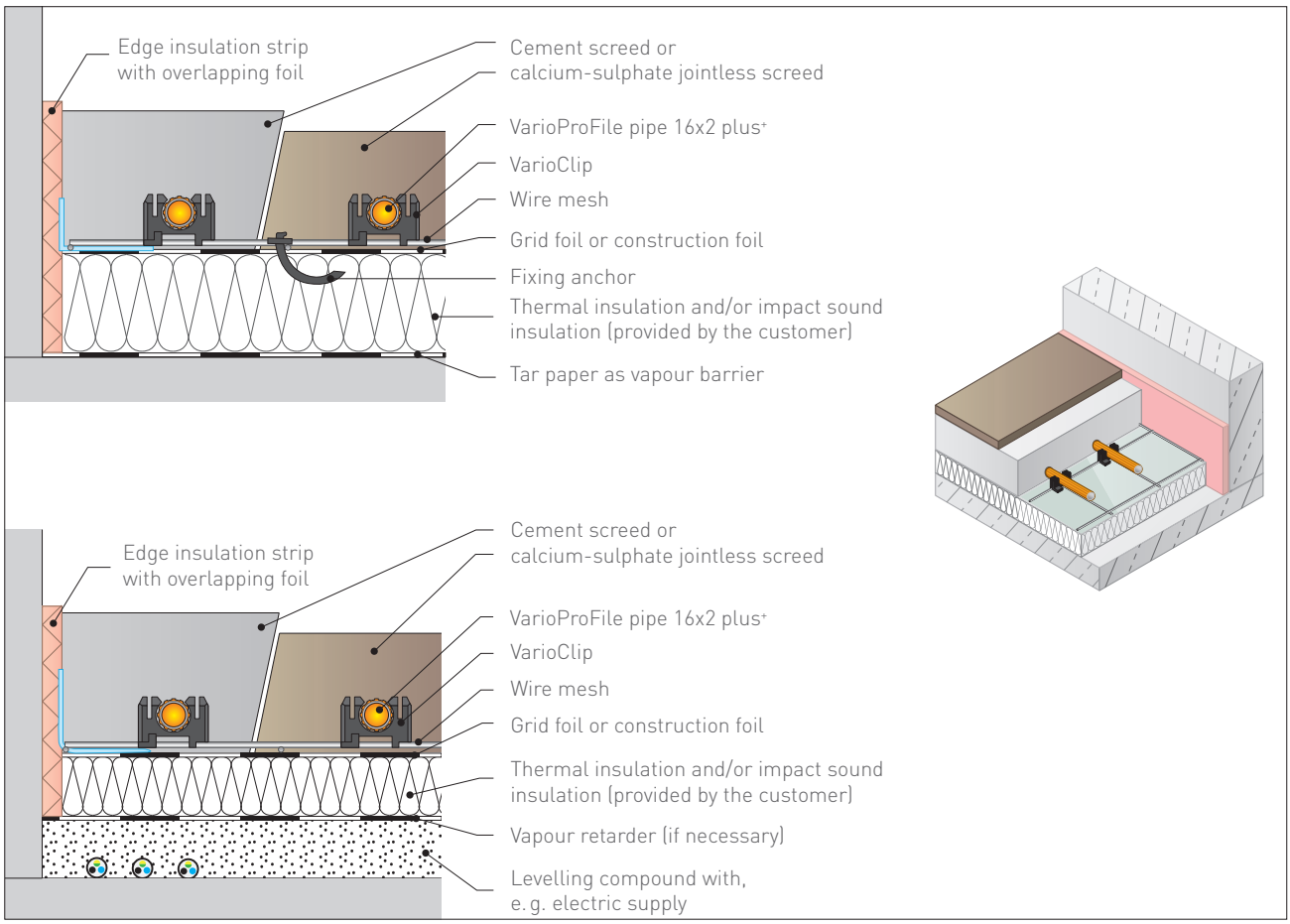
Combined floor heating and wall heating/cooling systems complement each other perfectly in living spaces. They allow for a customised heat supply in every room and represent an optimal solution for pleasant surface cooling.

1.2 Energy savings

The right floor heating system not only gives you optimum comfort, it also saves energy and money. The cost of operating a floor heating system can be reduced due to low surface temperatures and hence low heating water temperatures. Floor heating is therefore ideal where low-temperature energy sources are used, such as condensing boilers, heat pumps and solar collectors.
The approximate cost savings per 1 K (°C) lower room air temperature are 6 %. Low room air temperature also has the great physiological advantage of significantly increasing the absorption of oxygen.

2 COMPONENTS

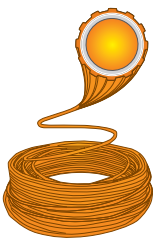
2.1 Overview – VarioClip



▲ Examples of floor structures

VarioProFile pipe 16x2 plus+ PG 050

Profiled surface structure guarantees optimum heat transfer.
For details see chapter 2.5.



Part No.	PKU	Weight/PKU	Pallet
VP16+100	100 m roll	10.3 kg	21 rolls
VP16+300	300 m roll	29.5 kg	10 rolls
VP16+500	500 m roll	49.0 kg	7 rolls

Wire mesh connector PG 030

for joining the wire meshes

Part No.	PKU	Weight/PKU	Carton
V2856	Bag with 30 pcs.	100 g	3000 pcs.

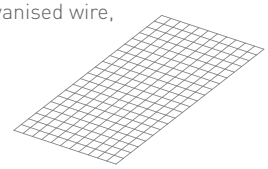
VarioClip PG 030

for fastening the VarioProFile pipe 16x2 plus+ to the wire mesh,
with tilt protection – clips do not fall over

Part No.	PKU	Weight/PKU	Carton
V2852	8 pcs. magazine	50 g	50 magazines

Wire mesh PG 030

Spot-welded mesh made of galvanised wire, with edge wire
Wire size: ø 2.9 mm
Mesh width: 100 × 100 mm
Dimensions:
2103 × 1203 mm = 2.53 m²

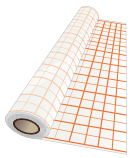


Part No.	PKU	Weight/PKU
V2875	2.53 m²	3.0 kg

Grid foil

PG 030

for the necessary covering of the thermal insulation (separating layer) according to EN 1264-4, made of 100 % polyethylene recycled granulate with 50 mm grid imprint, 0.2 mm thick
Dimensions: 1030 mm × 50 m = 51.5 m²
Usable area: 1000 mm × 50 m = 50.0 m²
(with a 30 mm overlap)

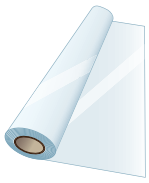


Part No.	PKU	Weight/PKU
V282	50 m² roll	10.4 kg

PE construction foil

PG 030

for the necessary covering of the thermal insulation (separating layer), transparent recycled material, 0.1 mm thick
Dimensions: 1030 mm × 50 m = 51.5 m²
Usable area: 1000 mm × 50 m = 50.0 m²
(with a 30 mm overlap)

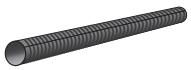


Part No.	PKU	Weight/PKU
V2895	50 m² roll	5.1 kg

Sleeve tube 400 mm

PG 030

for protecting the VarioProFile pipe 16x2 in the area of movement joints, length: 400 mm



Part No.	PKU	Weight/PKU
V2894	10 pcs.	200 g

Sleeve tube 50 m

PG 030

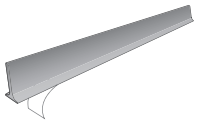
for protecting the VarioProFile pipe 16x2 in the area of movement joints, length: 50 m

Part No.	PKU	Weight/PKU
V2894R	1 roll	2.5 kg

T-joint profile 10/70

PG 030

for movement joints, with adhesive strips, height: 70 mm, length 1 m



Part No.	PKU	Weight/PKU
V2893	1 m	50 g

Screed admixture

PG 031

Cement screed admixture for the liquification and plastification of the screed, increases flexural strength and initial strength
Consumption:
0.1–0.2 kg/m² with 70 mm cement screed
(concentration 0.5–1 % of the cement weight)

Part No.	PKU	Weight/PKU
V279	5 kg canister	5 kg
V284	10 kg canister	10 kg

Setter for VarioClip

PG 140

for putting the VarioClips quickly

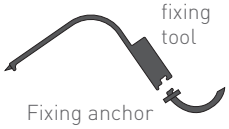
Loan: 5 working days free of charge

Part No.	PKU	Weight/PKU
W036	1 pcs.	2.0 kg
W035 (loan)	1 pcs.	2.0 kg

Fixing anchor

PG 030

for fastening the wire mesh to the thermal insulation
Incl. fixing tool per PKU



Part No.	PKU	Weight/PKU
V2775	100 pcs.	1.25 kg

Adhesive tape

PG 031

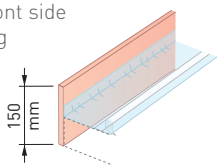
for gluing the grid foil/PE construction foil, 50 mm × 66 m roll

Part No.	PKU	Weight/PKU	Carton
V288	1 pce.	210 g	36 pcs.

Edge insulation strip 150 mm

PG 030

as per EN 1264-4, 150 mm high, 10 mm thick, made of PE foam, with 40 mm fold, front side with self-adhesive, welded overlapping foil for the sealed connection of edge insulation strips and separating layer, rear side with butyl rubber adhesive strips



Part No.	PKU	Weight/PKU	Bag
V278	50 m roll	2.2 kg	8 rolls

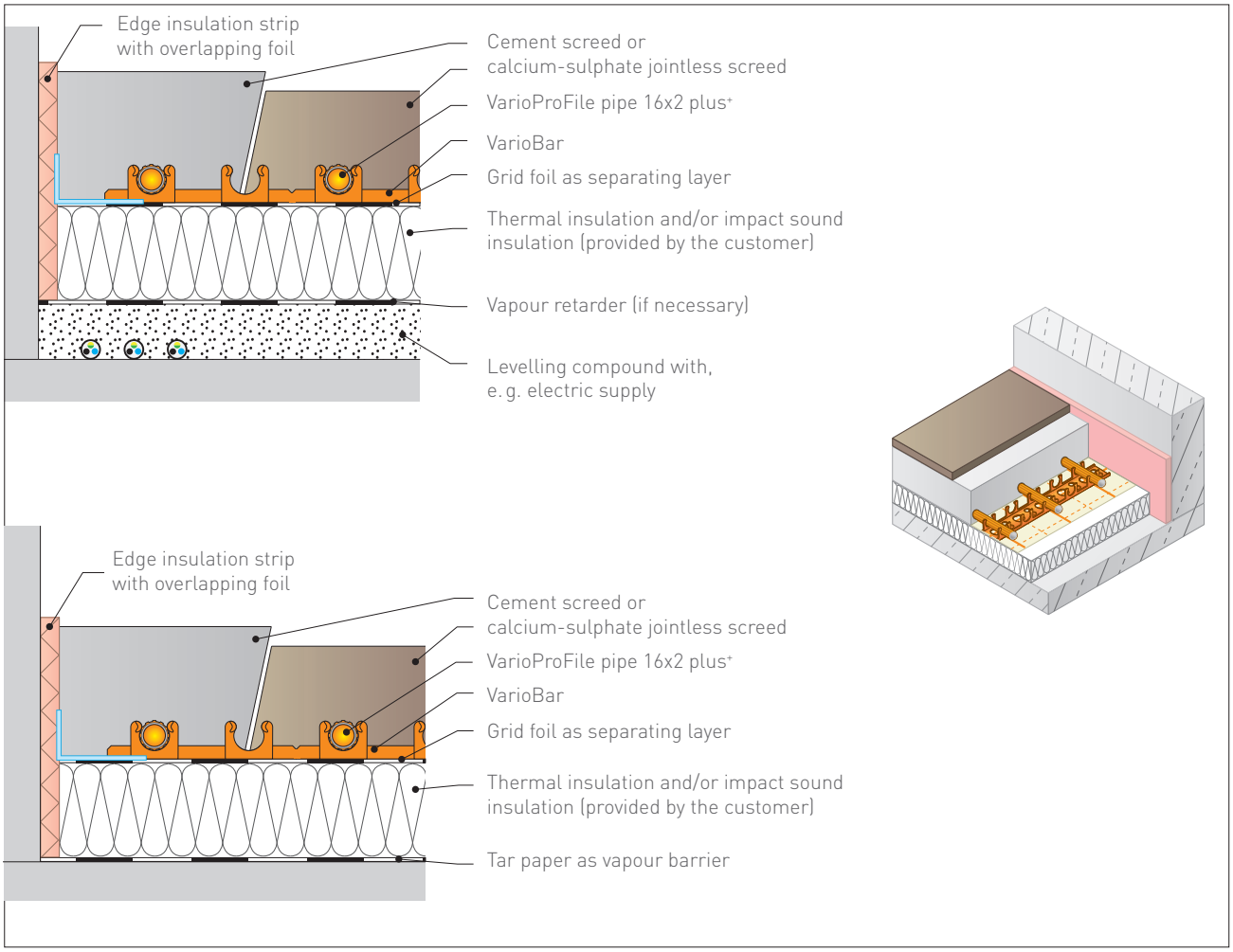
Cold shrink tape

PG 100

For optimum corrosion resistance of press-fit coupling connections as per ÖN H 5155
Roll: 50 mm × 15 m, 1 roll is sufficient for approx. 35 press-fit coupling connections (with a 50 % overlap)

Part No.	PKU	Weight/PKU	Carton
Z1699	1 pce.	990 g	20 pcs.

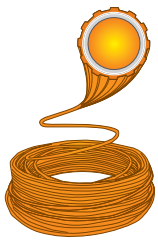
2.2 Overview – VarioRast



▲ Examples of floor structures

VarioProFile pipe 16x2 plus+ PG 050

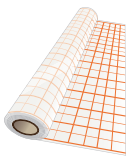
Profiled surface structure guarantees optimum heat transfer.
For details see chapter 2.5.



Part No.	PKU	Weight/PKU	Pallet
VP16+100	100 m roll	10.3 kg	21 rolls
VP16+300	300 m roll	29.5 kg	10 rolls
VP16+500	500 m roll	49.0 kg	7 rolls

Grid foil PG 030

for the necessary covering of the thermal insulation (separating layer) according to EN 1264-4, made of 100 % polyethylene recycled granulate with 50 mm grid imprint, 0.2 mm thick
Dimensions: 1030 mm × 50 m = 51.5 m²
Usable area: 1000 mm × 50 m = 50.0 m²
(with a 30 mm overlap)

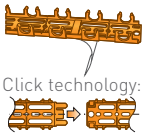


Part No.	PKU	Weight/PKU
V282	50 m² roll	10.4 kg

VarioBar K16/100

PG 030

VarioBar made of PE, for latching the VarioProFile pipe 16x2 plus⁺, can be extended to any length required using special click technology, grid spacing 50 mm, with adhesive strips



Part No.	PKU	Weight/PKU	Carton
VK1610	1 m	140 g	50 × 1 m

Fixing needles

PG 030

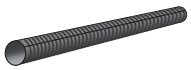
for fastening the VarioBar to the thermal insulation
Length: 45 or 60 mm

Part No.	Length	PKU	Weight/PKU
V277	45 mm	Bag with 500 pcs.	700 g
V2771	60 mm	Bag with 500 pcs.	950 g

Sleeve tube 400 mm

PG 030

for protecting the VarioProFile pipe 16x2 in the area of movement joints, length: 400 mm



Part No.	PKU	Weight/PKU
V2894	10 pcs.	200 g

Adhesive tape

PG 031

for gluing the grid foil, 50 mm × 66 m roll

Part No.	PKU	Weight/PKU	Carton
V288	1 pce.	210 g	36 pcs.

Sleeve tube 50 m

PG 030

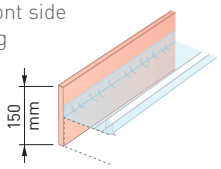
for protecting the VarioProFile pipe 16x2 in the area of movement joints, length: 50 m

Part No.	PKU	Weight/PKU
V2894R	1 roll	2.5 kg

Edge insulation strip 150 mm

PG 030

as per EN 1264-4, 150 mm high, 10 mm thick, made of PE foam, with 40 mm fold, front side with self-adhesive, welded overlapping foil for the sealed connection of edge insulation strips and separating layer, rear side with butyl rubber adhesive strips

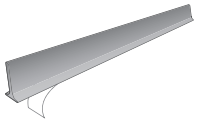


Part No.	PKU	Weight/PKU	Bag
V278	50 m roll	2.2 kg	8 rolls

T-joint profile 10/70

PG 030

for movement joints, with adhesive strips, height: 70 mm, length 1 m



Part No.	PKU	Weight/PKU
V2893	1 m	50 g

Cold shrink tape

PG 100

For optimum corrosion resistance of press-fit coupling connections as per ÖN H 5155
Roll: 50 mm × 15 m, 1 roll is sufficient for approx. 35 press-fit coupling connections (with a 50 % overlap)

Part No.	PKU	Weight/PKU	Carton
Z1699	1 pce.	990 g	20 pcs.

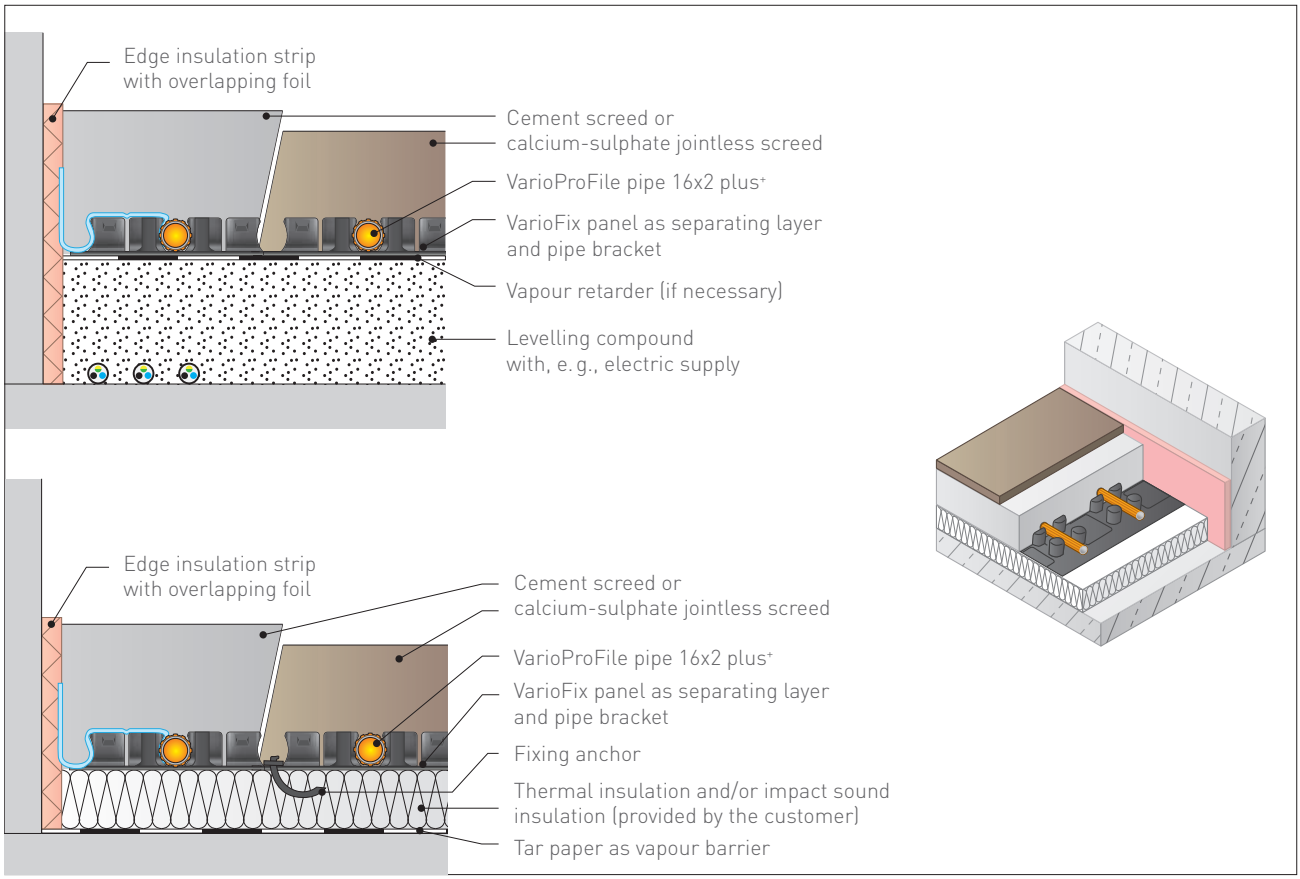
Screed admixture

PG 031

Cement screed admixture for the liquification and plastification of the screed, increases flexural strength and initial strength
Consumption:
0.1–0.2 kg/m² with 70 mm cement screed (concentration 0.5–1 % of the cement weight)

Part No.	PKU	Weight/PKU
V279	5 kg canister	5 kg
V284	10 kg canister	10 kg

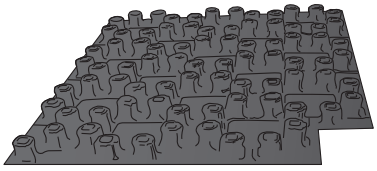
2.3 Overview – VarioFix



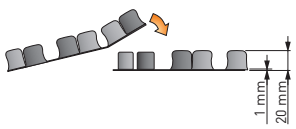
▲ Examples of floor structures

VarioFix panel PG 030

- Pipe bracket and separating layer
- Dimensions: 1450 × 850 mm
  Usable area: 1400 × 800 mm = 1.12 m² (with a 50 mm overlap)
  Panel thickness including naps = 20 mm
- Min. pipe spacing 50 mm
- Bridges raise the VarioProFile pipe from the panel
- Form-fitting connection as first rows of naps overlaps
- Surface sufficiently stable to walk on



Snap fastening system

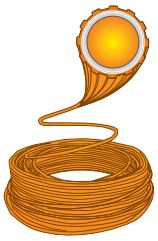


Part No.	PKU	Weight/PKU	Carton
V2860	1.12 m²	1.3 kg	13.44 m²

VarioProFile pipe 16x2 plus+

PG 050

Profiled surface structure guarantees optimum heat transfer.
For details see chapter 2.5.

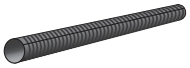


Part No.	PKU	Weight/PKU	Pallet
VP16+100	100 m roll	10.3 kg	21 rolls
VP16+300	300 m roll	29.5 kg	10 rolls
VP16+500	500 m roll	49.0 kg	7 rolls

Sleeve tube 400 mm

PG 030

for protecting the VarioProFile pipe 16x2 in the area of movement joints,
length: 400 mm



Part No.	PKU	Weight/PKU
V2894	10 pcs.	200 g

Sleeve tube 50 m

PG 030

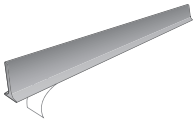
for protecting the VarioProFile pipe 16x2 in the area of movement joints,
length: 50 m

Part No.	PKU	Weight/PKU
V2894R	1 roll	2.5 kg

T-joint profile 10/70

PG 030

for movement joints, with adhesive strips,
height: 70 mm, length 1 m



Part No.	PKU	Weight/PKU
V2893	1 m	50 g

Screed admixture

PG 031

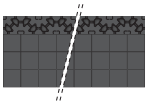
Cement screed admixture for the liquification and plastification of the screed, increases flexural strength and initial strength
Consumption:
0.1–0.2 kg/m² with 70 mm cement screed
(concentration 0.5–1 % of the cement weight)

Part No.	PKU	Weight/PKU
V279	5 kg canister	5 kg
V284	10 kg canister	10 kg

Adjustment element

PG 030

for VarioFix in the door, distribution manifold and edge areas
Dimensions: 1400 × 200 mm

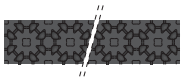


Part No.	PKU	Weight/PKU	Carton
V2890	1 pce.	270 g	14 pcs.

Connecting element

PG 030

for VarioFix for joining residual pieces
Dimensions: 1400 × 100 mm

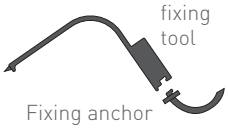


Part No.	PKU	Weight/PKU	Carton
V2896	1 pce.	120 g	20 pcs.

Fixing anchor

PG 030

for fastening the VarioFix panels to the thermal insulation
Incl. fixing tool per PKU

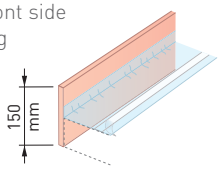


Part No.	PKU	Weight/PKU
V2775	100 pcs.	1.25 kg

Edge insulation strip 150 mm

PG 030

as per EN 1264-4, 150 mm high, 10 mm thick, made of PE foam, with 40 mm fold, front side with self-adhesive, welded overlapping foil for the sealed connection of edge insulation strips and separating layer, rear side with butyl rubber adhesive strips



Part No.	PKU	Weight/PKU	Bag
V278	50 m roll	2.2 kg	8 rolls

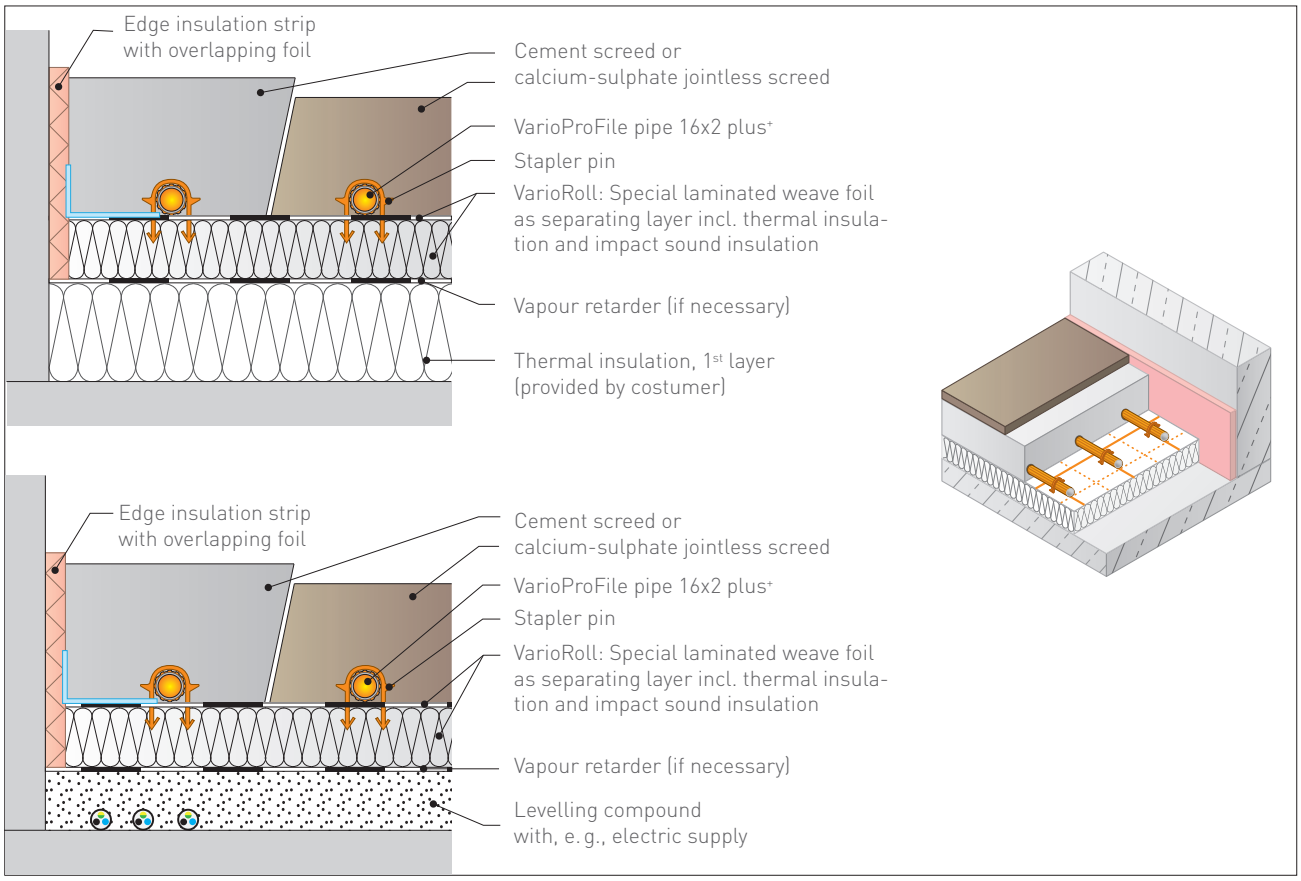
Cold shrink tape

PG 100

For optimum corrosion resistance of press-fit coupling connections as per ÖN H 5155
Roll: 50 mm × 15 m, 1 roll is sufficient for approx. 35 press-fit coupling connections (with a 50 % overlap)

Part No.	PKU	Weight/PKU	Carton
Z1699	1 pce.	990 g	20 pcs.

2.4 Overview – VarioRoll

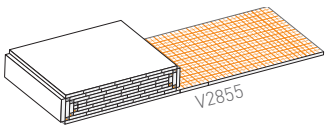


▲ Examples of floor structures

VarioRoll thermal insulation & impact sound insulation PG 030

- Made from monitored impact sound polystyrene
- Swift and easy installation
- Reaction to fire: Euroclass E
- Optimal retaining power for stapler pins via the incorporated weave
- Service load on screed (according to EN 13163) 5 kN/m²
- One-sided 30 mm overlap with self-adhesive strips
- Special laminated weave foil with 50 mm grid as separating layer

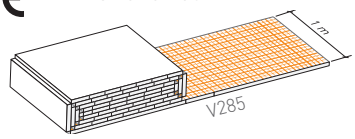
VarioRoll 20-2



Insulation nominal thickness 20 mm
Sound impact improvement 26 dB

CE

VarioRoll 30-2

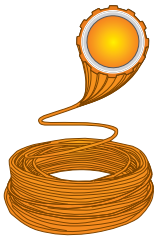


Insulation nominal thickness 30 mm
Sound impact improvement 28 dB

Part No.	Insulation nominal thickness	Declared thermal conductivity	Compressibility	Dynamical stiffness	PKU	Weight/PKU
V2855	20 mm	0.040 W/mK	≤ 2 mm	≤ 30 MN/m³	10 m² roll	4.1 kg
V285	30 mm	0.040 W/mK	≤ 2 mm	≤ 30 MN/m³	10 m² roll	6.6 kg

VarioProFile pipe 16x2 plus+ PG 050

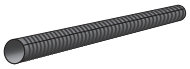
Profiled surface structure guarantees optimum heat transfer.
For details see chapter 2.5.



Part No.	PKU	Weight/PKU	Pallet
VP16+100	100 m roll	10.3 kg	21 rolls
VP16+300	300 m roll	29.5 kg	10 rolls
VP16+500	500 m roll	49.0 kg	7 rolls

Sleeve tube 400 mm PG 030

for protecting the VarioProFile pipe 16x2 in the area of movement joints,
length: 400 mm



Part No.	PKU	Weight/PKU
V2894	10 pcs.	200 g

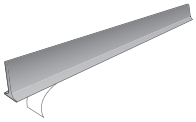
Sleeve tube 50 m PG 030

for protecting the VarioProFile pipe 16x2 in the area of movement joints,
length: 50 m

Part No.	PKU	Weight/PKU
V2894R	1 roll	2.5 kg

T-joint profile 10/70 PG 030

for movement joints, with adhesive strips,
height: 70 mm, length 1 m



Part No.	PKU	Weight/PKU
V2893	1 m	50 g

Screed admixture PG 031

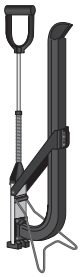
Cement screed admixture for the liquification and plastification of the screed, increases flexural strength and initial strength
Consumption:
0.1–0.2 kg/m² with 70 mm cement screed
(concentration 0.5–1 % of the cement weight)

Part No.	PKU	Weight/PKU
V279	5 kg canister	5 kg
V284	10 kg canister	10 kg

Stapler PG 140

for inserting the stapler pins, carries up to 5 magazines

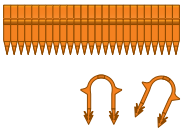
Loan: 5 working days free of charge



Part No.	PKU	Weight/PKU
W013	1 pce.	2.8 kg
W014 (loan)	1 pce.	2.8 kg

Stapler pins PG 030

for fastening the VarioProFile pipe to the VarioRoll thermal and impact sound insulation. A new system holds the stapler magazine together without adhesive strips, which prevents gluing of the stapler.



Part No.	PKU	Weight/PKU
V2853	Carton at12 magazines at 25 pcs.	500 g

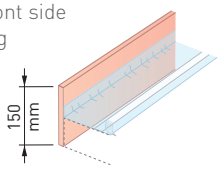
Adhesive tape PG 031

For gluing the wide side of the VarioRoll and VarioRoll remnants,
50 mm × 66 m roll

Part No.	PKU	Weight/PKU	Carton
V288	1 pce.	210 g	36 pcs.

Edge insulation strip 150 mm PG 030

as per EN 1264-4, 150 mm high, 10 mm thick, made of PE foam, with 40 mm fold, front side with self-adhesive, welded overlapping foil for the sealed connection of edge insulation strips and separating layer, rear side with butyl rubber adhesive strips



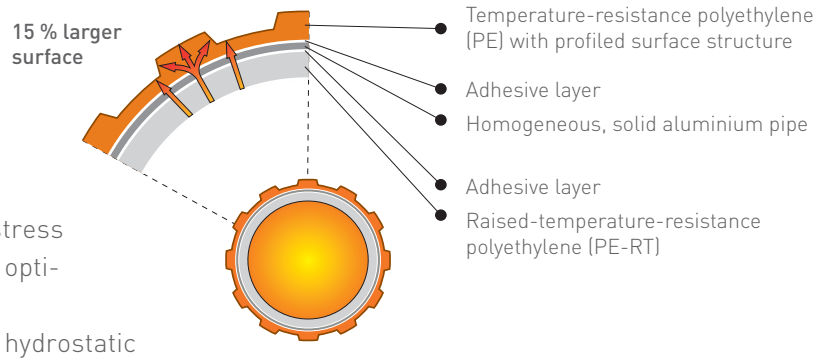
Part No.	PKU	Weight/PKU	Bag
V278	50 m roll	2.2 kg	8 rolls

Cold shrink tape PG 100

For optimum corrosion resistance of press-fit coupling connections as per ÖN H 5155
Roll: 50 mm × 15 m, 1 roll is sufficient for approx. 35 press-fit coupling connections (with a 50 % overlap)

Part No.	PKU	Weight/PKU	Carton
Z1699	1 pce.	990 g	20 pcs.

2.5 VarioProFile pipe 16x2 plus+



Advantages

- Fully corrosion-free
- As light as a plastic pipe
- 10-year guarantee with certificate
- Optimum behaviour under long-term stress
- Profiled surface structure guarantees optimum heat transfer
- Flexible, easy to bend, extremely good hydrostatic stability
- Resistant to hot water additives (inhibitors, antifreeze)
- Mirror-smooth inner surface – less pressure loss – no encrustation
- High pressure and temperature resistance
- 100 % oxygen diffusion-tight
- Lower linear coefficient of expansion, lower heat expansion forces
- Tested as per EN ISO 21003

Elongation

with 10 m and temperature difference Δt 25 °C (e. g. 20 °C to 45 °C):

Tubing	Elongation
PEX/VPE	50.00 mm
PP	42.50 mm
PB	32.50 mm
PVC	20.00 mm
VarioProFile pipe	5.75 mm
Cu	4.20 mm
Stainless steel	3.50 mm
Steel	2.88 mm

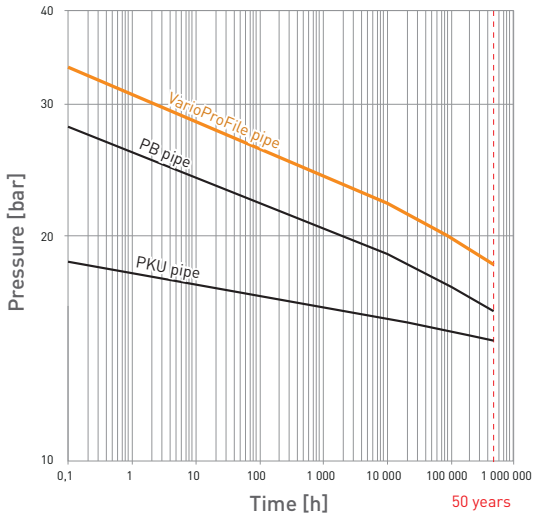
Homogeneous plastic pipes produce high stress levels in the device because of their expansion coefficient.

The VarioProFile pipe combines the minor elongation and thermal expansion. So it is perfect for surface heating- and -cooling pipes.

Technical data

Pipe diameter:	16 mm
Pipe wall thickness:	2 mm
Aluminium pipe thickness:	0.15 mm
Roll length:	100/300/500 m
Water content:	0.113 l/m
Special narrow bending radius (use a suitable bending device):	48 mm
Max. operating temperature:	t_{max} = 70 °C
Short-term resistant:	t_{mal} = 95 °C
Max. operating pressure:	p_{max} = 10 bar
Linear expansion coefficient:	2.6×10^{-5} [K^{-1}]
Mean heat conduction coefficient:	λ = 0.43 W/mK
Heat transmission resistance:	R_λ = 0.0043 m²K/W

Creep behaviour



3 FLOOR STRUCTURE | SCREED

3.1 Coordination of floor construction

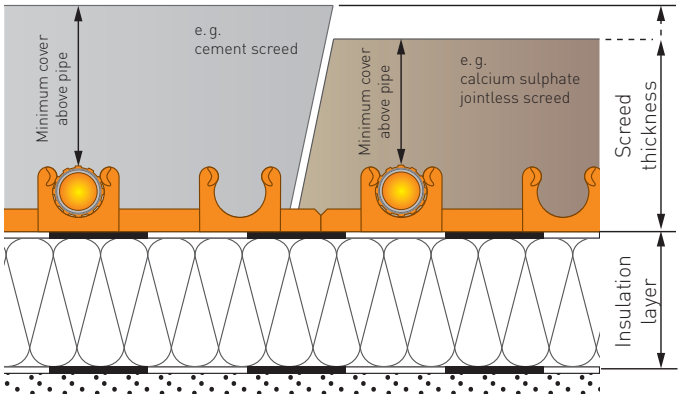
The following items must be coordinated between the architect, construction manager, installation technician, screed layer and floor layer:

- Horizontal marking
- Necessary vapour retarders/barriers and building sealants
- Floor heating system
- Type and thickness of screed
- Expansion joints in screed
- Measurement points for moisture measurement
- Floor covering, if necessary with heat sensors

3.2 Screed material and thickness

The screed material must be suitable for the floor heating system and compatible with the VarioProFile pipe (no bitumen or asphalt screeds!). The VarioProFile pipes must be surrounded by the screed mortar to the maximum extent possible in order to achieve optimum thermal conductivity.

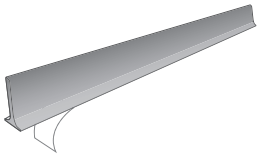
The minimum cover above pipes in the case of floating screeds, e.g., according to ÖNORM B 3732 and DIN 18560-2 (approximation), is presented in the table below:



Type of screed and national designation	Flexural strength classification as per ÖNORM EN 13813	Minimum cover above pipe			
		Insulation layers 0 to 25 mm		Insulation layers > 25 mm	
		Surface load ≤ 2 kN/m²	Surface load ≤ 3 kN/m²	Surface load ≤ 2 kN/m²	Surface load ≤ 3 kN/m²
Cement screed E 225	F4	45 mm	60 mm	50 mm	65 mm
Cement screed E 300	F5	40 mm	50 mm	45 mm	55 mm
Calcium sulphate screed E 225	F4	45 mm	60 mm	50 mm	65 mm
Magnesia screed E 225	F4	45 mm	60 mm	50 mm	65 mm
Jointless cement screed/ calcium sulphate jointless screed E 225 F	F4	40 mm	50 mm	45 mm	55 mm
Jointless cement screed/ calcium sulphate jointless screed E 300 F	F5	35 mm	45 mm	40 mm	50 mm
Cement screed E 400	F7	35 mm	45 mm	35 mm	50 mm
Calcium sulphate screed E 400	F7	35 mm	45 mm	35 mm	50 mm

3.3 Movement joints in screed

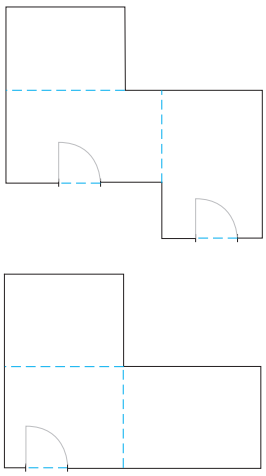
Screed expands upon a temperature increase. To ensure the tension-free accommodation of this expansion, it is necessary to provide movement joints in the floor structure as defined by the architect or planner. The appropriate standards and guidelines are to be observed (DIN 18560-2, ÖN EN 1264-4, planning and implementation guidelines for jointless screed, VÖEH ...)
The heating installer must be provided with a plan specifying the positions of the joints as part of the specification.

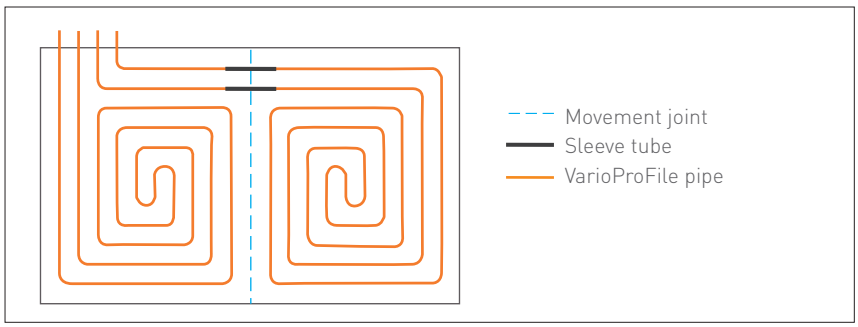


▲ T-joint profile 10/70

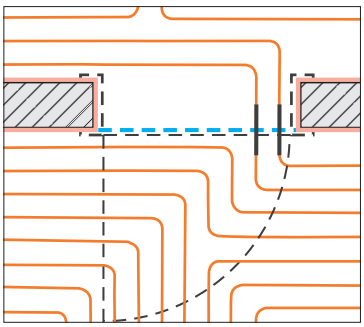
Requirements for movement joints:

- The number of joints and size of the screed area depend on the screed material and floor covering, surface geometry and abrasion resulting from service loads and temperature changes.
- The movement joints must provide for at least 5 mm of free space between the screed edges.
- Movement joints must always be provided in the case of building joints.
- Heating pipe feed-throughs are to be fitted with flexible sleeve tubes (approx. 400 mm), with the number of these feed-throughs being kept to the minimum possible.
- Unheated screed areas should be separated from the heated screed areas by a movement joint.

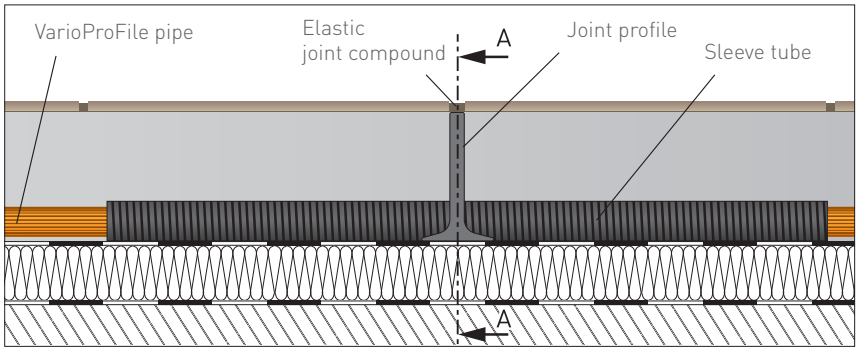




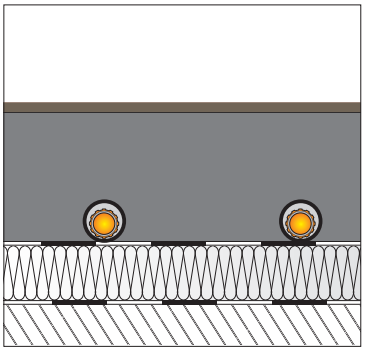
▲ Keep pipe feed-throughs to a minimum



▲ Movement joint in door area

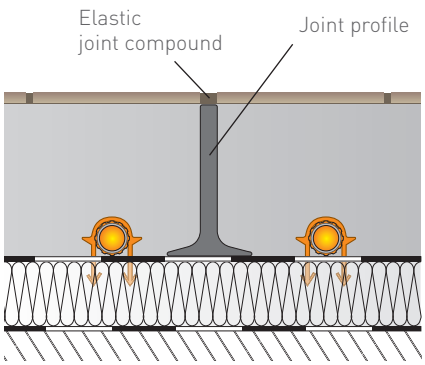


▲ Pipe installation through movement joint

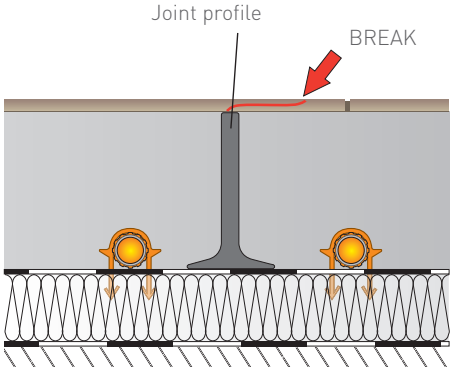


▲ Cross-section through mov. joint

The movement joints are particularly important in the case of ceramic coverings. It is crucial that the movement joints run congruently in all layers above the insulation.



▲ Correct movement joint

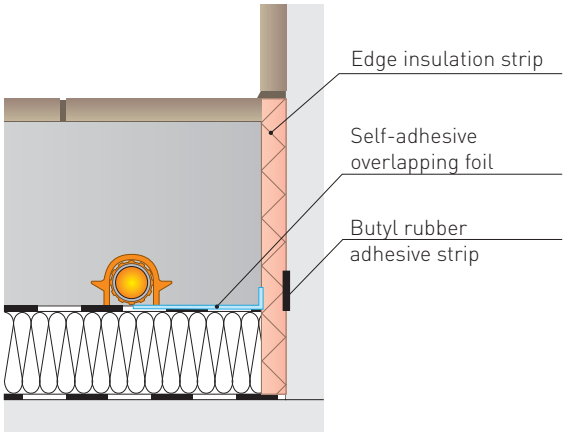


▲ Incorrect movement joint

3.4 Impact sound insulation

Particular attention should be paid to impact sound insulation. The impact sound improvement values should be determined by the planner or architect. The sound impact improvement factor of the VarioRoll systems is up to 28 dB.

Edge insulation strips are to be applied along the exterior walls, including columns, steps, door frames, pillars and shafts. They prevent sound and thermal bridges and allow the screed to expand.



3.5 Screed admixture for cement screed

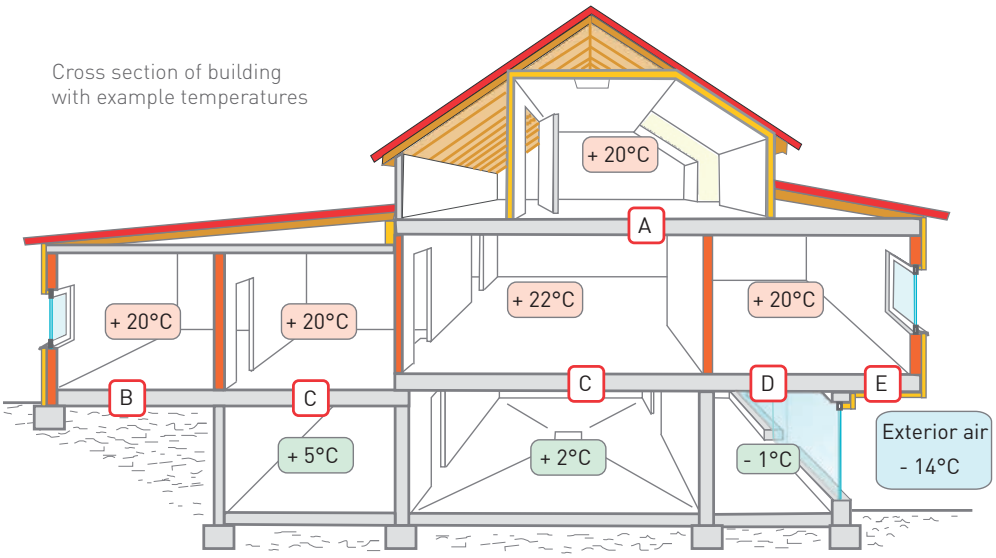
The Variotherm screed admixture should be used with the specified mixture ratio (approximately 0.5–1 vol. % of cement fraction ≙ 0.1–0.2 kg/m² for 70 mm screed thickness) and exhibits the following properties:

- Improvement of water retention capacity
  (tempering water can be reduced by approx. 12 %)
- Increased plastification of the screed mortar
- Increased flexural strength
- Increased pressure resistance – the screed becomes more compact and therefore abrasion-resistant

▲ Screed admixture, 5 or 10 kg

3.6 Thermal insulation

The thermal insulation thickness should comply with the respective regulations. ÖNORM/DIN EN 1264-4 provides an example:



	Floor heating system adjacent to ...	R [m²K/W]	λ [W/mK]	Example of insulation	Total insulation thickness
A	Heated rooms	0.75	0.040	• 30 mm impact sound insulation EPS, with VarioRast or VarioFix on top	30 mm
				• VarioRoll 30-3	30 mm
B	Unheated rooms, temporarily heated rooms, ground (if the ground water table is less than or equal to 5 m, increase this value)	1.25	0.040	• 50 mm impact sound insulation EPS, with VarioRast or VarioFix	50 mm
				• 20 mm impact sound insulation EPS + VarioRoll 30-3	50 mm
C	Rooms with an air temperature of 0 °C or above, cellar rooms without external door, built-in garages, vestibules	1.25	0.040	• 50 mm impact sound insulation EPS, with VarioRast or VarioFix on top	50 mm
				• 20 mm impact sound insulation EPS + VarioRoll 30-3	50 mm
D	Rooms with an air temperature above -5 °C and below 0 °C, glazed access balconies	1.5	0.040	• 60 mm impact sound insulation EPS, with VarioRast or VarioFix on top	60 mm
				• 30 mm impact sound insulation EPS + VarioRoll 30-3	60 mm
E	(Exterior) air temperature above -15 °C and below -5 °C	2.0	0.040	• 80 mm impact sound insulation EPS, with VarioRast or VarioFix on top	80 mm
				• 50 mm impact sound insulation EPS + VarioRoll 30-3	80 mm

R ... required thermal resistance [m²K/W], λ ... thermal insulation's thermal conductivity coefficient [W/mK]

4 THERMAL OUTPUT

4.1 Calculating the heating load

Along with the respective national annex, the EN 12831 standard will be used to calculate the heating load for the heated rooms.
Every room is considered individually. For the outside temperature, the locally acquired and standardised outdoor temperature T_{ne} is used.

Übersicht der Bauteile

Code	Bezeichnung	U-Wert W/m²K	Rges m²K/W	Rsi m²K/W	Rse m²K/W	R-Baut m²K/W
AF01	Außenfenster	1.100	0.909	0.130	0.040	0.739
AT01	Außentür	1.700	0.588	0.130	0.040	0.418
AW01	Außenwand	0.220	4.545	0.130	0.040	4.375

Raum		Θ_{int}	A_R	Φ_{Te}	Φ_T	Φ_V	$\Phi_{Nettoluft}$	$\Phi_{Nettoluft}$	Φ_{Netto}	Φ_{RH}	Φ_{RL}
Nr.	Bezeichnung	°C	m²	W	W	W	W	W	W	W	W
Haus, EG			180.88	5427		3396			9160	0	9160
00.001.001	Eltern	20.0	29.10	833	833	501	46	15	1335	0	1335
00.001.002	Kinder	20.0	20.49	762	762	343	54	19	1106	0	1106
00.001.003	Vorraum	20.0	24.40	571	571	409	40	14	980	0	980

▲ Extract from a heating load calculation

4.2 Variotherm dimensioning software

Key values for individual heating circuits (the amount of water, pressure loss, number of circuits, allocation of the manifolds etc.) can be quickly and easily calculated by inputting the heating load into the Variotherm dimensioning software. It can be found in our Professional Area at *www.variotherm.com/profi.*

Dimensioning of Variotherm Heating Systems

Building project: John Doe ZIP: 2544 City: Leobersdorf Date: Processed by: AS

No.	Room name	Floor space A [m²]	Maximum length of DCH or SH L [m]	Heating load Q [W]	Supplement heating load Suppl. [%]	Heating load incl. Supplement Q+Suppl. [W]	Room temp. ti [°C]	Heat transfer system	Floor covering FH [dB]	Dimensioning temperature tf/tr [°C]	Mathematical Dim.	Unit	Type	Practical No. of circuits	Dim.	Unit	Type	Residual performance	FH to (Ti=20) [°C]	Supply pipe	Supply line length per circuit [m]	Pressure loss per circuit [mWC]	Flow quantity per circuit [kg/h]	Distribution manifold number
101	Room	12,50		566	10%	623	20	Screed floor heating	0,075	40/30	12,30	m²	RA20	1	12,50	m²	RA20	15	24	16 x 2	17	0,25	55	-1
102	Room	14,50		655	10%	721	20	Screed floor heating	0,075	40/30	14,20	m²	RA20	1	14,50	m²	RA20	19	24	16 x 2	12	0,33	64	-1
103	Kitchen	12,00		610	10%	671	20	Screed floor heating	0,010	40/30	11,00	m²	RA20	2	6,00	m²	RA15	157	26	16 x 2	14	0,10	36	-1
104	Living room	25,00		1250	10%	1.375	22	Screed floor heating	0,075	40/30	24,60	m²	RA10	2	12,50	m²	RA10	25	26	16 x 2	13	0,54	61	-1
105	WC	2,50		187	10%	206	20	Screed floor heating	0,010	40/30	2,50	m²	RA10	1	2,50	m²	RA10	-3	27	16 x 2	8	0,02	18	-1
106	Anteroom	10,50		650	10%	715	20	Screed floor heating	0,010	40/30	10,40	m²	RA15	1	10,50	m²	RA15	10	26	16 x 2	10	0,31	63	-1
107	Bathroom	8,50		590	10%	649	24	Screed floor heating	0,010	40/30	8,50	m²	RA10	1	6,00	m²	RA10	-295	27	16 x 2	20	0,10	31	-1
						295	24	SystemWall SWHK2		40/30	3,60	m²	SWHK2	1	4,00	m²	SWHK2	33	-	16 x 2	22	0,07	29	(-1)

Summary of the heating systems

Amount	Unit	Heating system	Type	Pipe / Heating element	
4,0	m²	System wall heating	SWHK2	40,0	lfm
	m²	System wall heating	SWHK3		
	m²	Modular wall heating	MSW		
	m²	EasyFlex wall heating	EWH77F		
	m²	EasyFlex wall heating	EWHK77		
	m²	EasyFlex wall heating	EWHK115		
	m²	Modular ceiling heating	MSD/MRD		
33,5	m²	Screed floor heating	RA10	335,0	lfm
22,5	m²	Screed floor heating	RA15	150,8	lfm
27,0	m²	Screed floor heating	RA20	135,0	lfm
	m²	Screed floor heating	RA25		
	m²	Screed floor heating	RA30		
	m²	Compact floor heating	RA10		
	m²	Compact floor heating	RA20		
	m	Skirting heating	HL mini		
	m	Skirting heating	HL Ia		
	m	Skirting heating	HL IIa		
	m	Skirting heating	HL IIIa		
	m	Ducted channel heating	BKH1 mini		
	m	Ducted channel heating	BKH1		
	m	Ducted channel heating	BKH2 mini		
	m	Ducted channel heating	BKH2		
143,0	m	Supply pipe	16x2	143,0	lfm
	m	Supply pipe	11,6x1,5		
		Total filling water		**90,8**	**litres**

Summary of pipe length by line

Line	Room	m⌀ 16	m⌀ 11,6
1	Room	79,5	
2	Room	84,5	
3	Kitchen	108,4	
4	Living room	276,0	
5	WC	33,0	
6	Anteroom	80,4	
7	Bathroom	80,0	
8		62,0	
9			
10			
11			
12			
13			

Line	Room	m⌀ 16	m⌀ 11,6
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
TOTAL			803,8

Summary of the floor heating surface area

Screed floor heating	83,0 m²
Compact floor heating	m²

Summary of loads

Total heating load	4,508 W
Total installed load	5,214 W

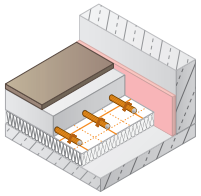
	tf/tr	Number of heating circuits	Flow quantity manifold [kg/h]	Max. pressure loss + 0,1 mWC for manifold [mWC]	Manifold notation according to drawing
Distribution manifold -1	40/30	9	454	0,64	
Distribution manifold -2					
Distribution manifold -3					
Distribution manifold -4					
Distribution manifold -5					

When all distribution manifolds are fed via one pump, the following applies:

Total flow quantity:	454	kg/h
Maximum pressure loss from distribution manifold incl. 0,1mWC for max. opened valve	0,64	mWC

▲ Variotherm dimensioning software example for heating

- **Floor covering: tiles, ceramic and natural stone coverings, thermal resistance d/λ = 0.01–0.02 m²K/W**
- Max. length of VarioProFile pipe 16x2 plus⁺ per heating circuit incl. supply pipe: 120 m (e.g. 10 m² heating circuit and 20 m supply pipe with 100 mm pipe spacing), pressure loss according to Variotherm dimensioning software
- Pipe requirement [m/m²] = 1/pipe spacing [m]



t_f/t_r [°C]	t_{mH} [°C]	Pipe spacing	Heat output [W/m²] at room temperature ...					T_0 [°C] (at T_r = 20 °C)
			... 15 °C	... 18 °C	... 20 °C	... 22 °C	... 24 °C	
30/20	25.0	100 mm	54	38	27	16	–	23
		150 mm	47	33	23	14	–	22
		200 mm	41	28	20	12	–	22
		250 mm	36	25	18	11	–	22
		300 mm	31	22	15	9	–	22
30/25	27.5	100 mm	67	51	40	29	18	24
		150 mm	58	44	34	26	16	23
		200 mm	51	38	30	22	14	23
		250 mm	45	34	26	19	12	23
		300 mm	38	29	23	17	11	22
35/25	30.0	100 mm	81	64	53	43	32	25
		150 mm	70	56	46	38	28	24
		200 mm	61	49	41	33	24	24
		250 mm	54	43	35	28	21	23
		300 mm	46	37	31	25	18	23
35/28	31.5	100 mm	88	72	61	50	40	25
		150 mm	77	62	53	44	32	24
		200 mm	67	55	47	39	30	24
		250 mm	59	48	41	33	27	23
		300 mm	51	41	35	29	22	23
35/30	32.5	100 mm	93	78	67	56	46	26
		150 mm	82	67	58	48	39	25
		200 mm	71	59	51	43	34	25
		250 mm	63	52	45	37	31	24
		300 mm	55	45	39	32	26	24
37.5/32.5	35.0	100 mm	107	91	81	69	59	27
		150 mm	93	79	69	61	51	26
		200 mm	82	69	61	53	45	26
		250 mm	71	61	53	46	39	25
		300 mm	62	53	46	41	34	24
40/30	35.0	100 mm	107	91	81	69	59	27
		150 mm	93	79	69	61	51	26
		200 mm	82	69	61	53	45	26
		250 mm	71	61	53	46	39	25
		300 mm	62	53	46	41	34	24
40/35	37.5	100 mm	121	105	95	83	72	29
		150 mm	105	91	82	72	62	27
		200 mm	92	80	71	63	55	27
		250 mm	81	70	63	56	48	26
		300 mm	70	61	54	48	42	25
45/35	40.0	100 mm	134	118	107	96	86	30
		150 mm	117	103	93	84	74	28
		200 mm	102	90	82	73	65	27
		250 mm	89	78	72	64	57	27
		300 mm	77	68	62	56	50	26
45/40	42.5	100 mm	148	132	122	110	99	31
		150 mm	129	115	106	96	87	29
		200 mm	113	101	92	84	76	28
		250 mm	99	88	81	73	66	27
		300 mm	86	77	70	64	57	26
50/40	45.0	100 mm	161	146	135	124	113	32
		150 mm	141	127	118	108	98	30
		200 mm	123	111	102	94	86	29
		250 mm	107	97	89	83	75	28
		300 mm	93	84	78	71	65	27
50/45	47.5	100 mm	175	158	148	137	127	33
		150 mm	153	138	129	119	110	31
		200 mm	133	121	113	105	96	30
		250 mm	117	106	98	91	84	29
		300 mm	101	92	86	79	73	28

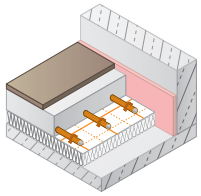
t_{mH} = mean heating circuit water temperature = $\frac{t_f + t_r}{2}$ [°C]

T_0 = mean surface temperature [°C]

T_r = room temperature [°C]

t_f/t_r = flow/return temperature [°C]

- **Floor covering: thin parquet floor, laminate and carpets, thermal resistance d/λ = 0.075 m²K/W**
- Max. length of VarioProFile pipe 16x2 plus⁺ per heating circuit incl. supply pipe: 120 m (e.g. 10 m² heating circuit and 20 m supply pipe with 100 mm pipe spacing), pressure loss according to Variotherm dimensioning software
- Pipe requirement [m/m²] = 1/pipe spacing [m]



t_f/t_r [°C]	t_{mH} [°C]	Pipe spacing	Heat output [W/m²] at room temperature ...					T_0 [°C] (at T_r = 20 °C)
			... 15 °C	... 18 °C	... 20 °C	... 22 °C	... 24 °C	
30/20	25.0	100 mm	43	30	21	13	–	22
		150 mm	38	26	19	12	–	22
		200 mm	33	23	17	10	–	22
		250 mm	29	21	15	9	–	22
		300 mm	26	18	13	8	–	21
30/25	27.5	100 mm	53	40	32	24	15	23
		150 mm	48	36	29	21	14	22
		200 mm	42	32	26	19	13	22
		250 mm	38	29	23	16	10	22
		300 mm	33	25	20	14	9	21
35/25	30.0	100 mm	65	52	43	35	26	24
		150 mm	58	46	38	30	23	23
		200 mm	51	40	34	28	20	23
		250 mm	45	36	30	24	18	22
		300 mm	39	32	26	22	16	22
35/28	31.5	100 mm	71	58	49	41	32	24
		150 mm	64	51	44	36	29	23
		200 mm	55	45	38	32	25	23
		250 mm	49	40	34	28	22	22
		300 mm	43	35	30	25	20	22
35/30	32.5	100 mm	76	62	53	45	37	24
		150 mm	68	55	48	40	33	24
		200 mm	59	49	42	35	29	23
		250 mm	53	44	38	32	26	23
		300 mm	46	38	33	28	23	23
37.5/32.5	35.0	100 mm	86	73	65	56	48	26
		150 mm	76	65	58	49	43	25
		200 mm	68	58	51	44	38	24
		250 mm	60	52	45	39	33	23
		300 mm	52	45	39	34	29	23
40/30	35.0	100 mm	86	73	65	56	48	26
		150 mm	76	65	58	49	43	25
		200 mm	68	58	51	44	38	24
		250 mm	60	52	45	39	33	23
		300 mm	52	45	39	34	29	23
40/35	37.5	100 mm	96	84	76	66	58	26
		150 mm	86	74	68	59	52	26
		200 mm	76	66	59	52	46	25
		250 mm	68	58	53	46	40	24
		300 mm	59	51	46	40	35	24
45/35	40.0	100 mm	108	95	86	78	69	27
		150 mm	96	84	76	69	62	27
		200 mm	85	75	68	62	55	26
		250 mm	75	66	60	54	48	25
		300 mm	65	58	52	47	42	24
45/40	42.5	100 mm	118	105	96	88	79	28
		150 mm	105	93	86	78	71	27
		200 mm	93	83	76	69	63	27
		250 mm	83	73	68	62	55	26
		300 mm	72	64	59	54	49	25
50/40	45.0	100 mm	129	118	108	99	90	29
		150 mm	115	105	96	89	80	28
		200 mm	102	93	85	79	71	27
		250 mm	90	83	75	69	63	27
		300 mm	78	72	65	60	55	26
50/45	47.5	100 mm	139	126	118	109	100	30
		150 mm	128	113	105	98	90	29
		200 mm	110	100	93	86	80	28
		250 mm	98	88	83	76	70	27
		300 mm	84	78	72	67	62	26

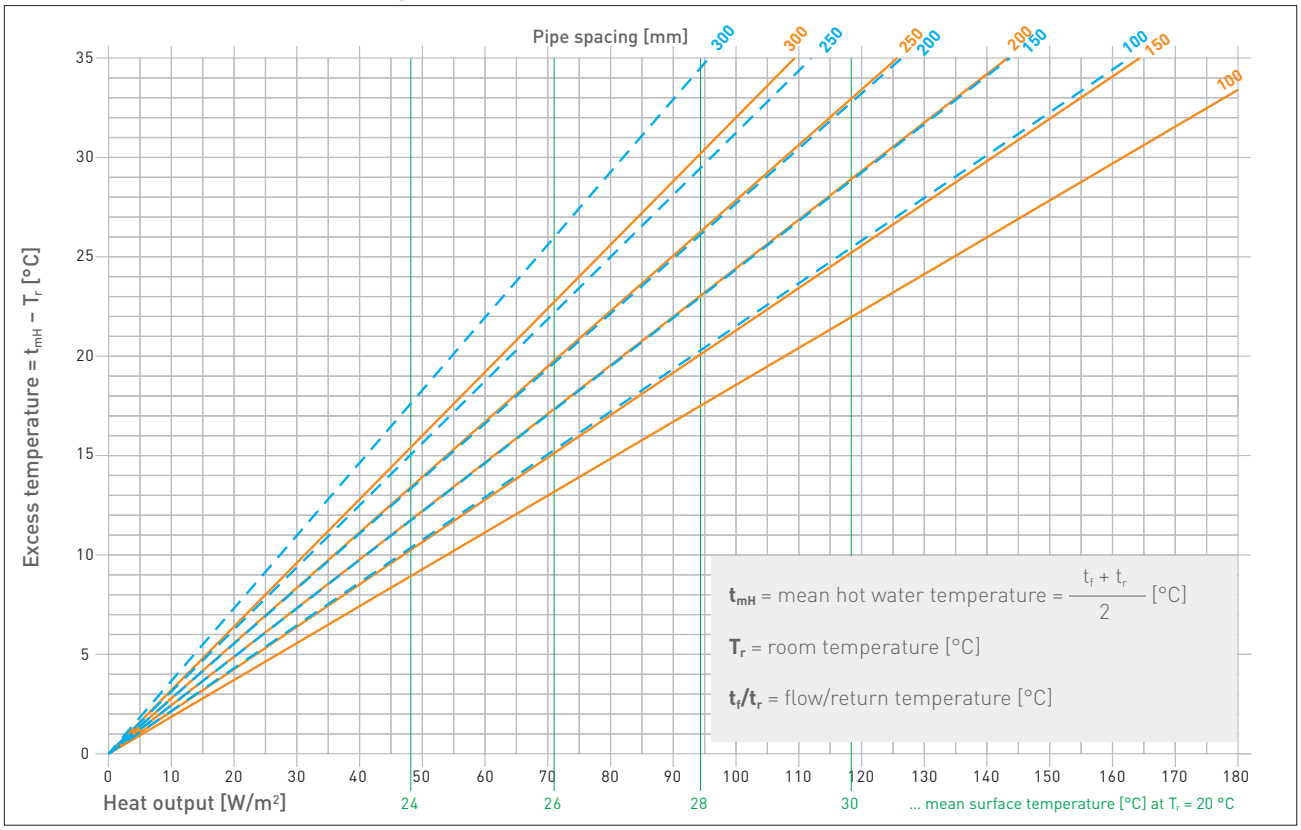
t_{mH} = mean heating circuit water temperature = $\frac{t_f + t_r}{2}$ [°C]

T_0 = mean surface temperature [°C]

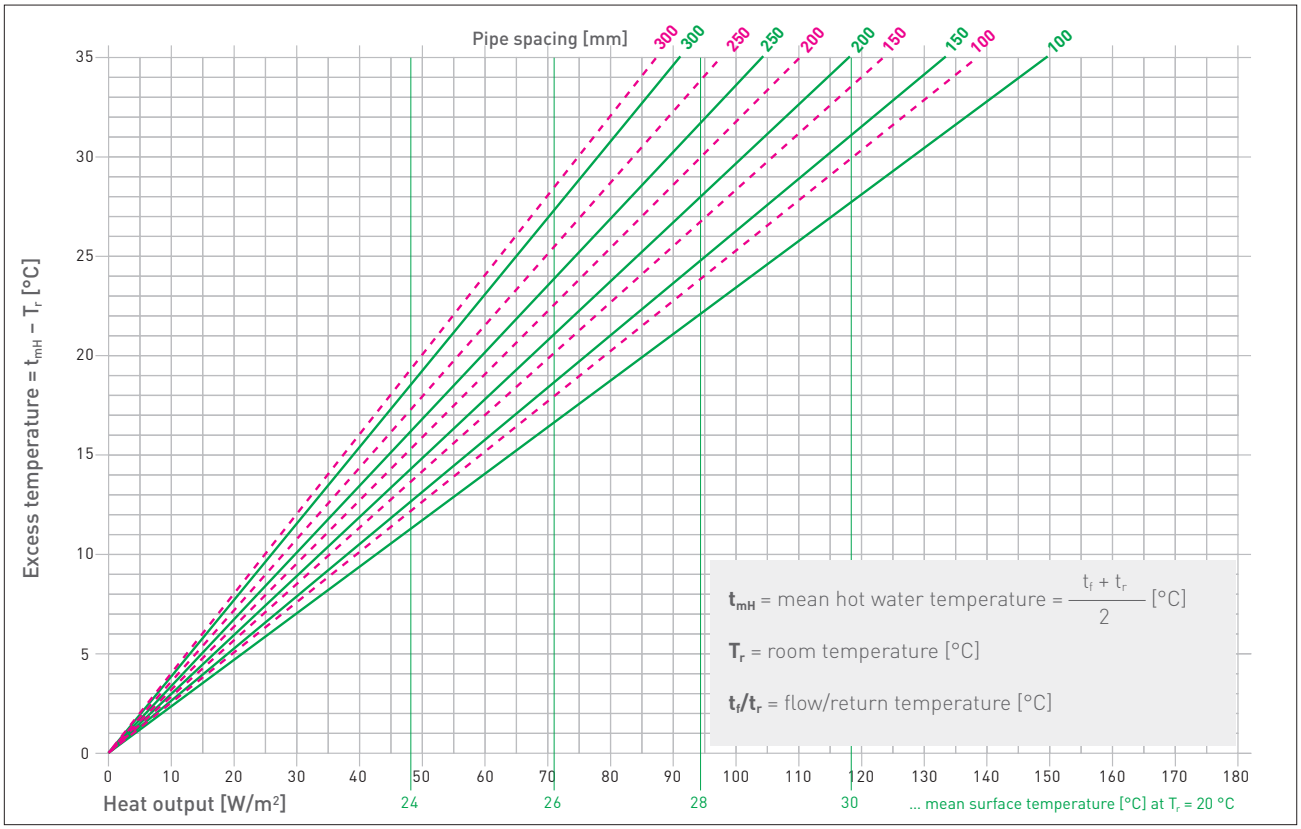
T_r = room temperature [°C]

t_f/t_r = flow/return temperature [°C]

HEAT OUTPUT for a floor covering with a thermal resistance[1] of **d/λ = 0.01 / 0.05 m²K/W**

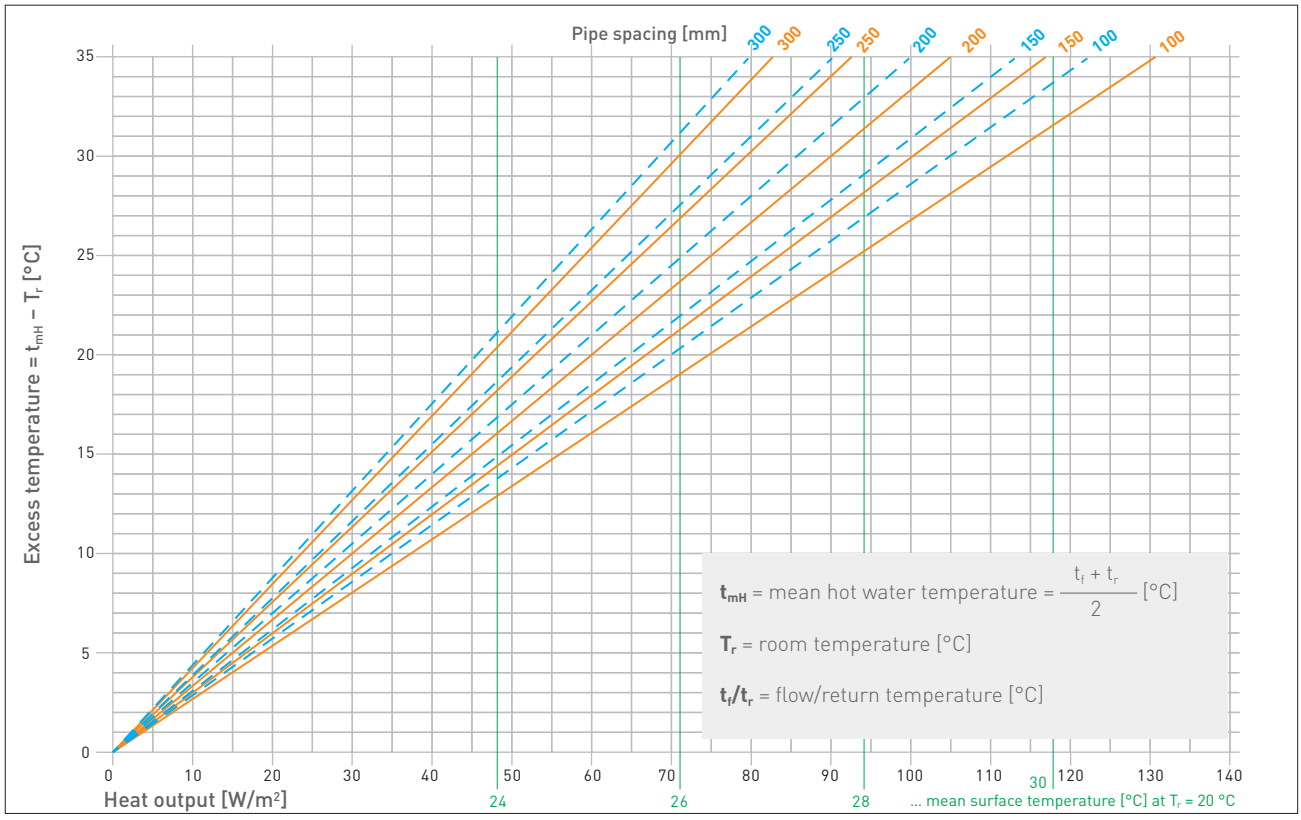


HEAT OUTPUT for a floor covering with a thermal resistance[1] of **d/λ = 0.075 / 0.10 m²K/W**

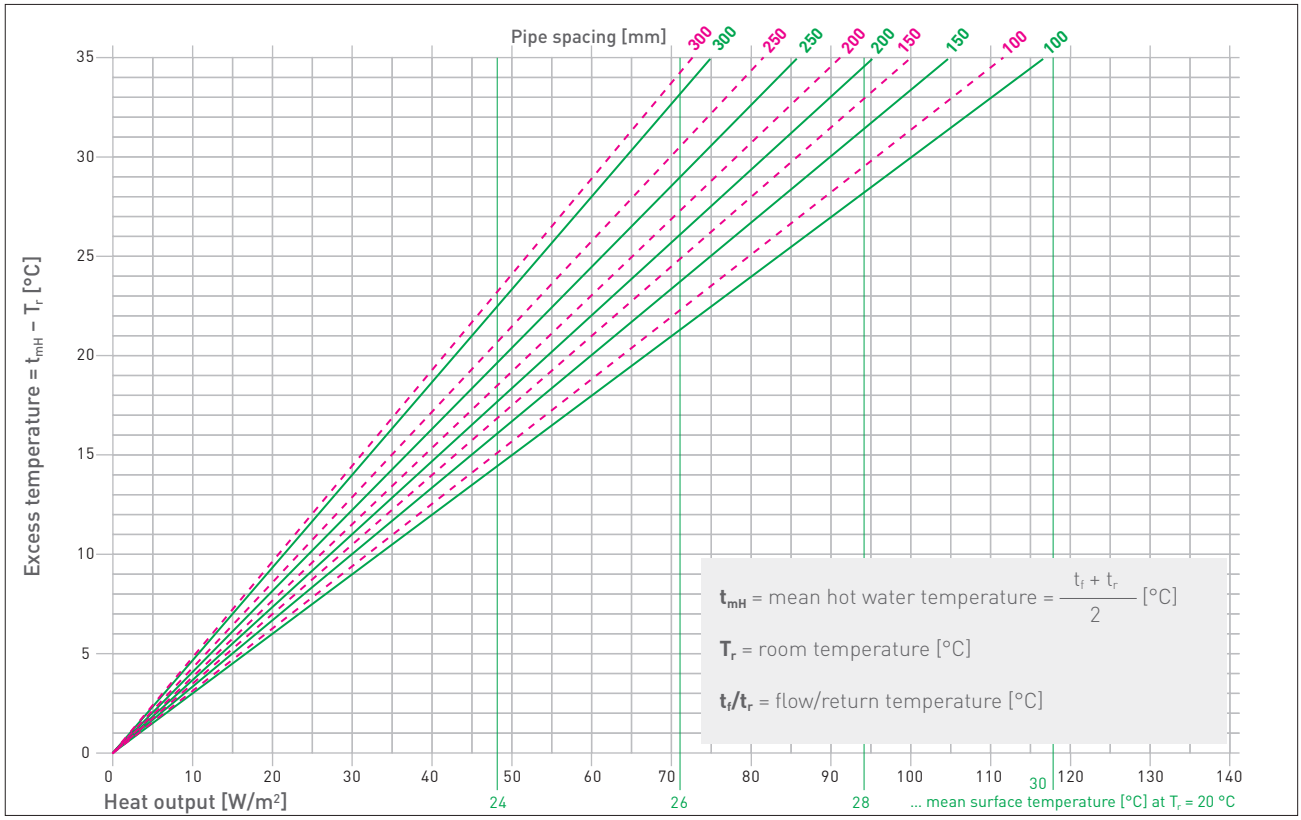


[1] Guidelines for the thermal resistance of various floor coverings see chapter 6.1

HEAT OUTPUT for a floor covering with a thermal resistance[1] of **d/λ = 0.12 / 0.14 m²K/W**



HEAT OUTPUT for a floor covering with a thermal resistance[1] of **d/λ = 0.16 / 0.18 m²K/W**



[1] Guidelines for the thermal resistance of various floor coverings see chapter 6.1

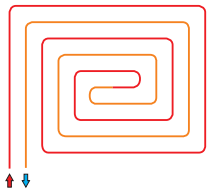
5 PIPING

The required thermal output of the individual room determines the spacing between the pipes. In living spaces, the pipes are spaced at 100, 150 and 200 mm distance to create a pleasant room atmosphere. In other rooms (halls, laboratories, etc.) pipes are laid in distances of up to 300 mm.

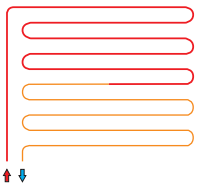
Pipe spacing	Pipe requirement
100 mm	10.0 m/m²
150 mm	6.7 m/m²
200 mm	5.0 m/m²
250 mm	4.0 m/m²
300 mm	3.3 m/m²

Maximum pipe length per heating circuit including supply pipe: 120 m

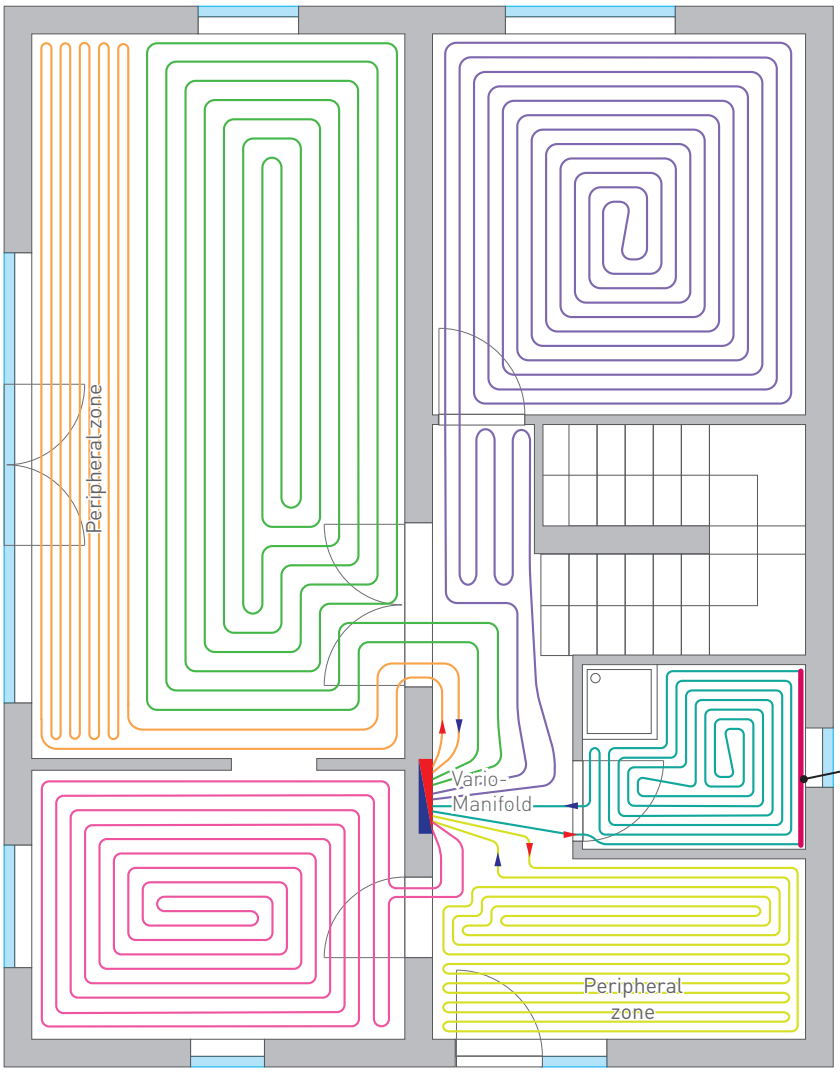
Distance to walls: 50 mm
Distance to chimneys, fireplaces, open or walled shafts: 200 mm



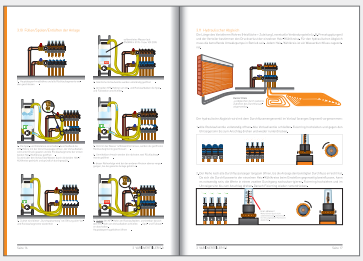
Bifilar
Uniform distribution of surface temperature as the supply is located next to the return.



Meandering
Less uniform distribution of surface temperature, for small, ancillary rooms and peripheral zones.



▲ Laying example of a single-family house



Details regarding the system and heating circuit pipes and the room temperature control are provided in the DISTRIBUTION and CONTROL planning and installation manual.

Wall heating for residual load in bath

Peripheral zone: Starting in front of a large glass surface or glass doors, a meander pattern layout goes along the glass surface, reaching into the room by about 1 metre. This will lead to a higher surface temperature in front of the glass surfaces (Variotherm comfort tip).

6 FLOOR COVERING

6.1 Suitable floor covering

All floor coverings suitable for floor heating systems may be used on screed floor heating systems.
We recommend covering with a maximum thermal resistance of 0.15 m²K/W.

The required screed evenness must be as per ÖNORM DIN 18202.

Guideline for thermal resistance of various floor coverings:

Floor covering	Thickness	Thermal resistance R = d/λ [m²K/W]
Tiles	8 mm	0.01
Clinker slabs	11 mm	0.01–0.02
Marble	10 mm	0.01
Natural stone slab	12 mm	0.01
Linoleum	2.5 mm	0.015
PVC coverings	2.5 mm	0.01–0.02
Adhesive cork	5 mm	0.01
Prefinished parquet floor (2 layer)	10 mm	0.05–0.07
Prefinished parquet floor (3 layer)	14 mm	0.07–0.10
Laminate	9 mm	0.05
Thin carpet	6 mm	0.07–0.11
Medium-thick carpet	9 mm	0.11–0.15
Thick carpet	13 mm	0.15–0.24

6.2 Residual moisture

The residual moisture of the screed is determined using CM measurement before the floor covering is laid. Regardless of the floor covering, the following values must not be exceeded:

- Calcium-sulphate jointless screed: 0.3 %
- Cement screed: 1.8 %
- Jointless cement screed: 1.8 %

Where measurements are below these values, dry heating should be applied, e.g., in accordance with BVF (German Federal Association of Surface Heating and Surface Cooling).

The control points for subsequent analysis of the screed moisture (CM measurement) are determined by the planner. Heating pipes must be 100 mm (ø 200 mm) away from the control point. A minimum of one control point shall be provided in each room. Rooms in excess of 50 m² require respectively more control points. Spaces measuring 200 m² or more require at least 3 control points.

▲ Gauge rod

NOTES

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