

# DESIGN & INSTALLATION

# Wall

MODULAR WALL  
HEATING AND  
COOLING

Modular Wall



PDF



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**VARIOTHERM**

*This is how*



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*it's done ...*



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# 1 PRINCIPLES

Variotherm recommends a combination of floor, wall and ceiling. In general, walls offer the largest exchange area, which is why wall heating/cooling systems ensure that people can easily feel the radiant heat.

For hot summer days, we recommend wall and/or ceiling cooling. Instead of hot water, cool water flows through the pipes at a temperature of 16–20 °C. Rooms are cooled to a comfortable temperature, in complete silence and without forced air.

## 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?

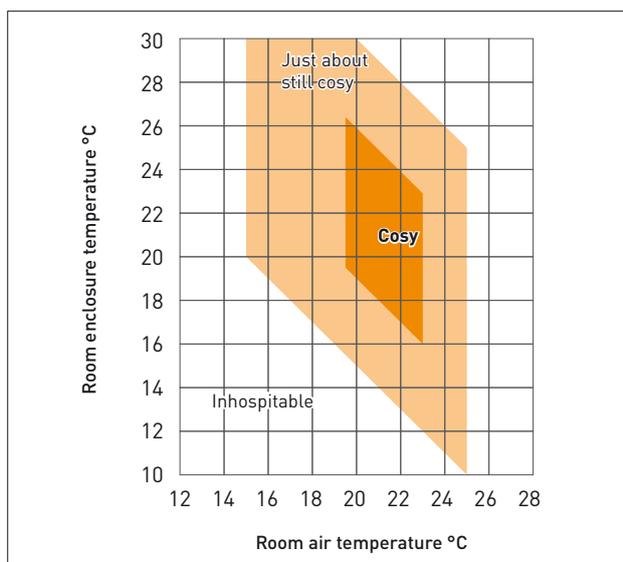
People feel comfortable when the following basic 'thermal comfort' equation holds:

$$\text{Heat production} = \text{heat loss}$$

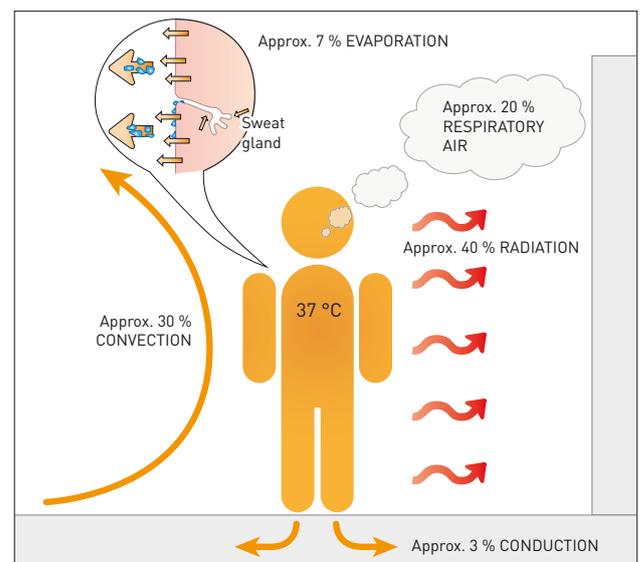
	Heating	Cooling
Ceiling	++	+++
Wall	+++	+++
Floor	++	+

▲ Which system areas are suitable for which needs?

Heat production = heat loss



▲ Zone of cosiness



▲ Human heat balance

In this context, it is important that 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 (e.g. cold surfaces, draughts) or the heat loss is prevented in one direction (hot surfaces or vapour-tight, thick clothing).

The lower the inside air temperature is, the warmer the surrounding surfaces (wall surfaces, floor and ceiling, as well as doors and windows) must be to ensure cosiness.

Compared to other heating systems, the Modular Wall significantly increase cosiness. The installation of surface heating on an exterior wall, especially under windows, can largely cancel out the unpleasant effects from the radiation exchange between your body and cold exterior walls and windows. You can set the room temperature lower than you would with convection heating, since radiant heat raises the perceived air temperature.

### 1.2 Energy savings

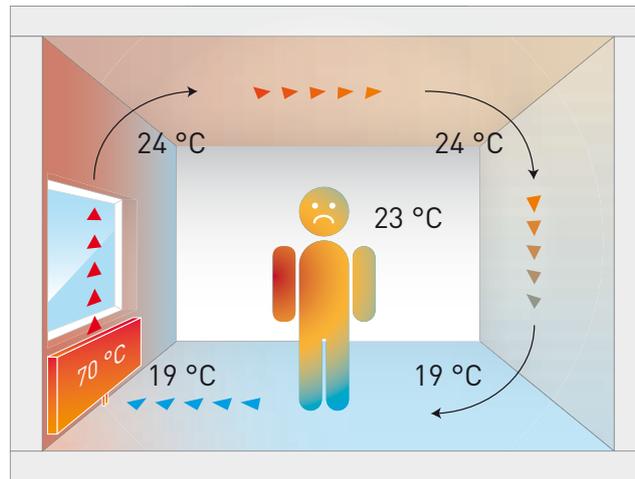
A lowered room air temperature along with increased cosiness significantly minimises energy losses. The approximate heating cost savings per 1 °C lower room air temperature are 6 %. The low room air temperature has the additional great physiological advantage of significantly increasing the absorption of oxygen in the body. The wall heating system is ideal for use with low-temperature energy sources such as condensing boilers, heat pumps and solar collectors because it operates with low surface and heating medium temperatures. With Variotherm wall heating you can achieve energy savings of up to 30 % compared to conventional heating systems.

### 1.3 Adapts to suit your home

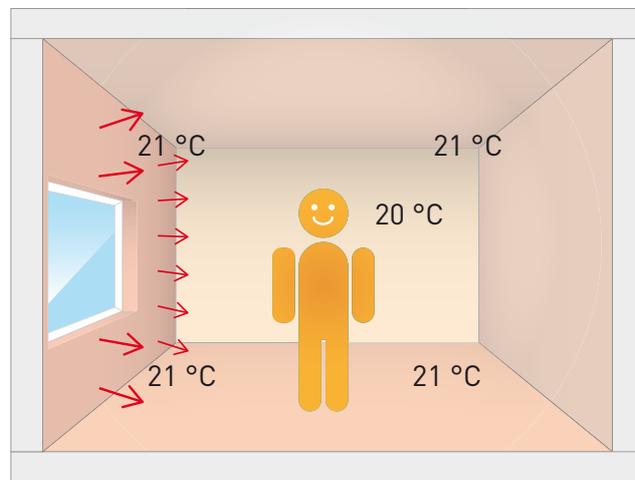
The Variotherm modular wall heating surfaces can be individually adapted to suit the local situation (windows, doors etc.). Visible radiators under the windows are a thing of the past.

### 1.4 Cooling

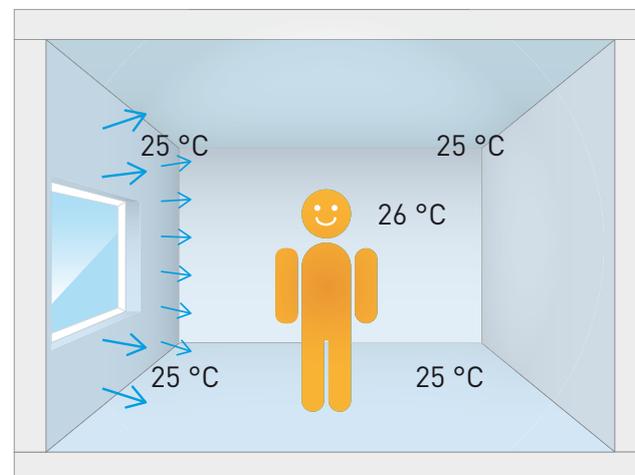
One reason for the frequent lack of satisfaction with air-conditioning systems is the inadequacy of the thermal ambient conditions in the air-conditioned rooms. Most frequently mentioned is the presence of uncomfortable forced air. Cooling via wall surfaces offers the advantage of gentle radiation exchange between the cooled wall surface and the human body. In addition, the room temperature is reduced to a comfortable level.



▲ Discomfort with radiators



▲ Comfort with wall heating



▲ Comfort with wall cooling

### Effects of surface cooling on the room

When a wall surface is cooled, all warmer objects in the room (floor, interior walls, people, equipment, etc.) radiate heat into this cooled surface. This loss of heat through radiation leads to a reduction in the surface temperature of these objects, thus providing a cooling effect. The ambient air in the room is also cooled to a comfortable level.

### Cooling mode

Based on experience, cooling makes sense at a room temperature  $\geq 26$  °C. To achieve a noticeable effect and suitably cool the body, a reduction of the wall surface temperature to approx. 19–22 °C is possible.

### Economy

The necessary cooling performance can be better distributed with water than with air. The pumping costs for surface cooling systems are usually significantly lower than the costs incurred by using fans. A 100 percent coverage of the cooling load, as per VDI 2078 (calculation of the cooling load for air-conditioned rooms), is possible in buildings designed for low energy consumption with shadowing equipment and low internal loads.

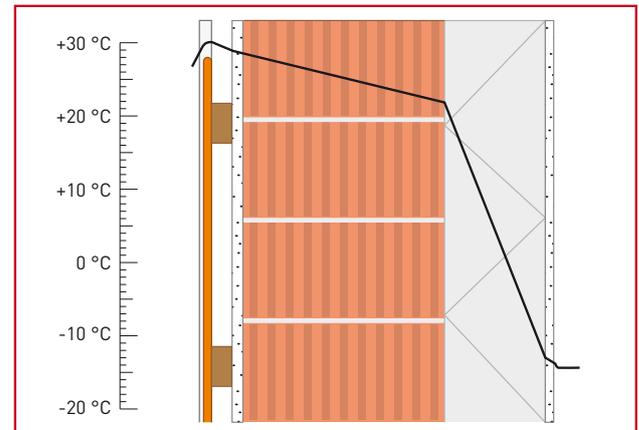
One of the major advantages of wall cooling/heating systems is the low additional investment costs. A single system is used for the cooling and heating modes: the same wall surface, same piping system and the same heating/cooling distribution manifold with supply lines and circulation pump. The generation of cooling (chiller/heat pump/cooling from the floor and ground water) is planned in parallel to the heating unit. Many modern heat pumps already allow switching from heating to cooling mode – without major extra costs. Ambient sources of cooling (deep boreholes, ground collectors, wells ...) can also be used – at zero cost.

### Combination of displacement ventilation and surface cooling

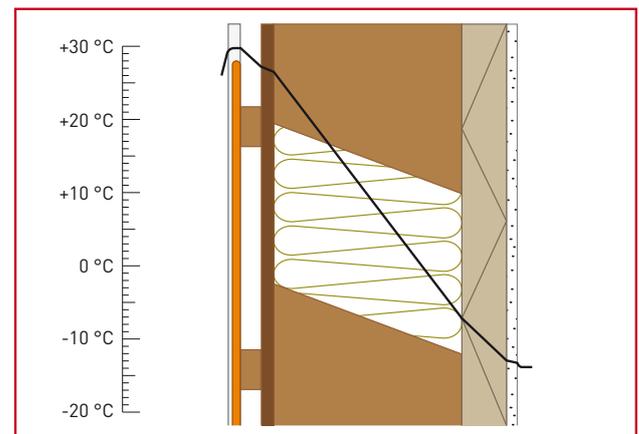
Surface cooling does not replace an air-conditioning system with regard to dehumidification and ventilation. Displacement ventilation is an air-conditioning system with low air exhaust speeds and laminar flow of the escaping air at the exhaust vents. Low turbulence in the air flow through the room is achieved through the type of ducting in the room, blowing of air at floor level at a slightly subnormal temperature and extraction of the exhaust air at the ceiling level. This type of displacement flow, known as “displacement ventilation” can achieve almost complete freedom from draughts. The combination of wall cooling and displacement ventilation allows significantly higher cooling performance to be achieved compared to using only a displacement ventilation system, without exceeding thermally comfortable air speeds. If the supplied air is dehumidified then low wall surface temperatures, and thus high radiant cooling performance, can be achieved without the formation of condensation, even on hot and humid days.

## 1.5 Temperature variations/wall structure

Various different wall fittings at a wall surface temperature of 30 °C and a standard outdoor (air) temperature of -14 °C



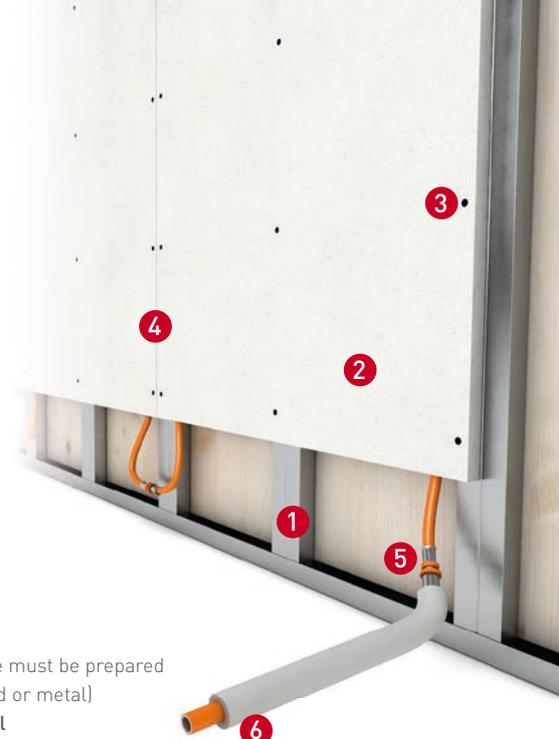
- ▲ Example with solid brick, structure from the inside out:
  - Modular Wall
  - recessed formwork/installation level
  - 300 mm vertically perforated brick
  - 160 mm thermal insulation
  - exterior plaster/coat of paint



- ▲ Example with timber frame construction (diffusion-open), structure from the inside out:
  - Modular Wall
  - recessed formwork/installation level
  - OSB4 18 mm (sealed airtight)
  - 240 mm timber frame and cellulose insulation
  - 60 mm wood insulating fibreboards
  - exterior plaster/coat of paint

# Advantages Modular Wall

- › Heating, cooling and finished wall all in one!
- › Ideal for timber-framed buildings, pre-fabricated houses, attics and renovation
- › Heating system: large-surface, extremely energy-saving low temperature system
- › Cooling system: silent, no draughts, energy-efficient
- › A totally flexible panel system: fulfils all building requirements
- › Gypsum fibreboards and components which have been tested for their healthy building properties
- › Fire protection assessment (IBS Linz)



- 1 Substructure must be prepared on-site (wood or metal)
- 2 ModulePanel
- 3 Dry wall screw
- 4 Joint adhesive
- 5 Press-fit coupling
- 6 Pre-insulated 16x2 Variomodular pipe

## 1.6 Description and advantages of the Modular Wall

The Variotherm Modular Wall is an extremely energy efficient heating and cooling system. As a flexible panel system, it is pre-assembled for installation in walls and pitched ceilings. Here, heating, cooling and complete wall are perfectly combined in a single product. The desired room temperature is achieved by using hot and cold water circulation to make sure you feel completely comfortable all year round.



# 2 PREPARATION

## 2.1 General

This brochure is intended for authorised specialist personnel. Please note that all earlier versions are now invalid! See the QR code on the cover for the most recent valid version, or visit [www.variotherm.com](http://www.variotherm.com).

Local, geographical and climatic regulations/standards for cooling, heating and electrical installations must be taken into account.

## 2.2 Conditions of warranty

If the heating system is installed or commissioned incorrectly, all claims on the basis of the manufacturer's warranty and guarantee become void. Please note that the relevant valid installation instructions are an element of our warranty.

## 2.3 Information on standards

The validity of the standards referred to in these installation instructions was last checked on 11.04.2022. If necessary, amendments to standards must be checked.

## 2.4 Fire protection

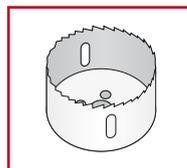
From a fire protection perspective, the 18 mm Variotherm ModulePanels correspond to a 12.5 mm FERMACELL Gypsum fibreboard panel (Test IBS-Linz No. VFA2001-0389.01, fire protection assessment file number 10111710). Please observe the corresponding FERMACELL regulations and FERMACELL fire protection assessments. See also chapter 4.

## 2.5 Load bearing walls

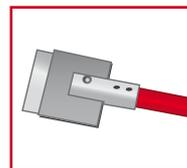
Caution: With load bearing wall construction the Variotherm ModulePanels must not carry any static ceiling loads and must not be used for building reinforcement.

## 2.6 Tools (at the construction site)

The following tools (at the construction site) are required/recommended for installation work:



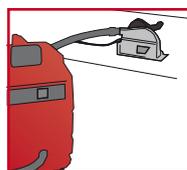
Hole saw



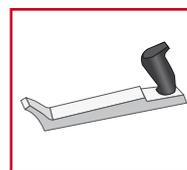
Adhesive scraper



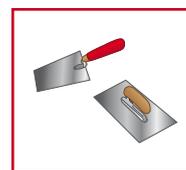
Cartridge gun



Circular saw or jigsaw



Plane for visible edges



Trowel and plastering knife



Power screw gun, preferable with latching depth stop

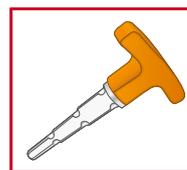


Clean buckets

Variotherm tools for connecting the Variotherm pipes:



Pipe cutting pliers



Calibration and chamfering tool



Pressing tool

## 2.7 Transport/storage of goods

### Pre-insulated VarioModular pipe

Leave the VarioProFile pipe in the box as long as possible to avoid damage from notches and scratches. Damage of this kind will have a detrimental effect on the creep behaviour.

The VarioProFile pipes can be damaged by both atmospheric oxygen and UV rays and must not be stored outdoors.

At low temperatures ( $\leq 5$  °C), the VarioModular pipe must be stored in heated rooms before processing.

### VarioModular pipe 11.6x1.5 (in ModulePanels)

The VarioModular pipe 11.6x1.5 is completely integrated into the ModulePanel.

To prevent the VarioModular pipes being damaged during the construction phase by drilling or stamping, clearly visible warning labels shall be affixed in appropriate places.

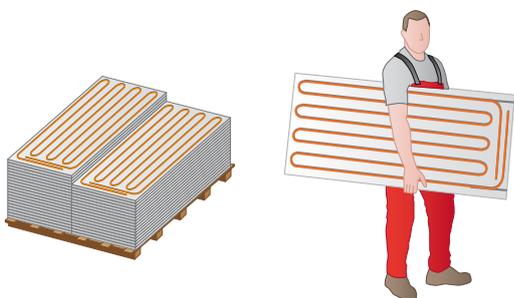
Regarding weather resistance, the same instructions apply to the VarioModular pipe 11.6x1.5 as the pre-insulated VarioModular pipe 16x2.

### ModulePanels

The ModulePanels are delivered on pallets. When storing, observe the load-bearing capacity of the bearing point. The ModulePanels weigh 20.5 kg/m<sup>2</sup> and should always be stored flat on a level surface. When stacking and restacking during transport to construction sites, the visible sides of the ModulePanels are to be placed downwards.

They must be protected from moisture, especially rain. Panels that have become damp for a short time may only be handled after they have completely dried out. When stacking and restacking during transport to construction sites, the visible sides of the ModulePanels are to be placed downwards.

Storing the panels vertically will lead to deformation and damage to the edges. Transporting the panels horizontally within the building is possible using a pallet truck or other panel transport vehicle.



▲ It is best to carry individual ModulePanels vertically

## 2.8 Humidity

During storage, assembly and further processing of the ModulePanels, as well as construction phase and use of the building, the relative humidity must not exceed 70%. Wet plaster and wet coats of paint must be put on and left to dry before the ModulePanels are installed.

The ModulePanels may be installed in rooms up to humidity class W3 in accordance with ÖN B 3407 (or W1-I in accordance with DIN 18534-1).

## 2.9 Other work documents

Please also follow up-to-date FERMACELL planning and installation instructions!



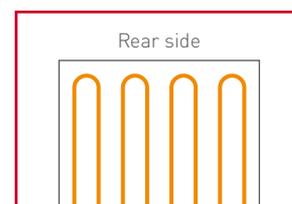
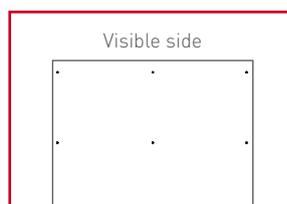
Fermacell –  
Planning and preparation



Variotherm –  
Distribution and control

## 2.10 Visible side/rear side of the ModulePanel

The visible side of the ModulePanel (the smooth side) faces into the room and the rear side (with the integrated VarioModular pipe) faces the substructure.



# 3 SUBSTRUCTURE

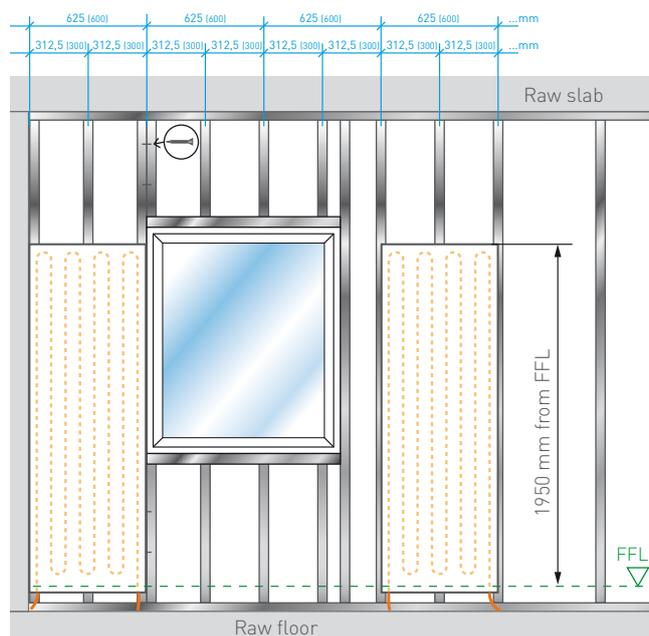
## 3.1 General

Depending on the requirements, substructures are made of wood and/or metal, with or without surface planking, cavity insulation and vapour retarders (vapour barriers). Please observe the planning and installation guidelines of the manufacturer of the wooden or drywall system used for your wall and pitched roof ceiling construction.

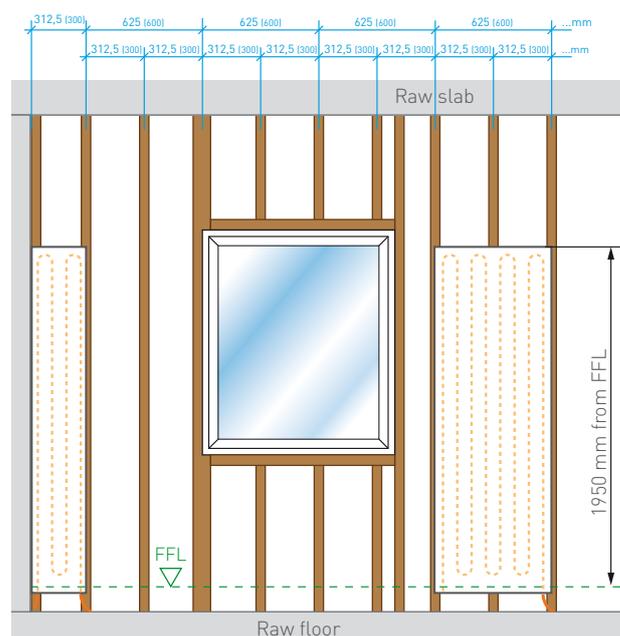
- › With wooden constructions, the timber used must be sufficiently dry and straight, and conform to the Austrian standard EN 338 (sorting class C24)
- › With metal constructions, the profiles must be made of soft, non-alloyed steel with double-sided galvanising of at least 100 g/m<sup>2</sup> according to the ÖNORM DIN 18182-1
- › Before installing the ModulePanels it must be ensured that the construction is designed to carry the weight of the ModulePanels (20.5 kg/m<sup>2</sup>) and any eventual cladding (tiles)
- › Do not glue the ModulePanels directly to solid wall structures (plaster)

## 3.2 Vertical stud construction (standard variant)

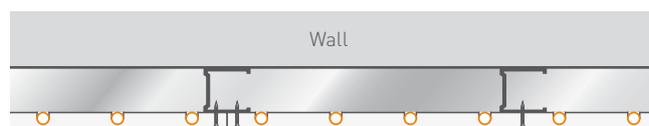
Substructure with wooden or metal profiles, with or without insulation as required. With larger existing stud clearances, extra vertical studs are used at the intended heating/cooling surfaces. Stud spacing: 312.5 mm (panel thickness of 625 mm) or 300 mm (for panel thickness of 600 mm).



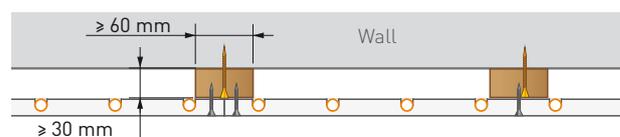
▲ Example of CW stud construction



▲ Example of wooden stud construction



▲ Section through a CW/UW profile steel substructure, without cavity insulation.



▲ Section through a softwood wooden substructure, without cavity insulation.

FFL ... Finished Floor Level

### 3.3 Full-surface FERMACELL planking

Under the following conditions, the ModulePanels can be screwed directly to the FERMACELL planking:

- › The substructure is fully planked with FERMACELL panels (minimum thickness 12.5 mm).
- › The stud clearance of the FERMACELL substructure corresponds to the values in the table:

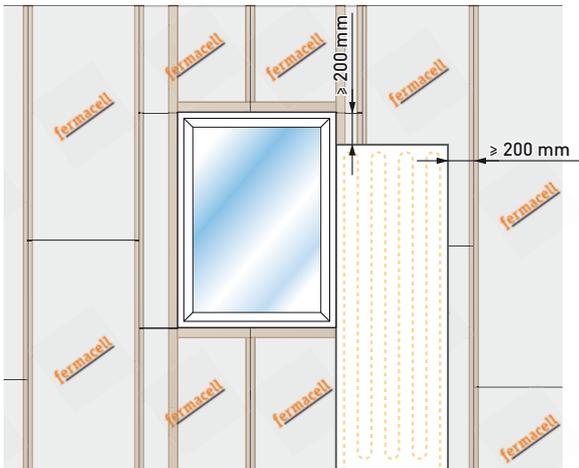
Application area/ Construction type	Max. stud clearances of the substructure in mm for the following thicknesses of FERMACELL panels <sup>1</sup>		
	12.5 mm	15 mm	18 mm
Vertical surfaces (partition walls, wall cladding, single wall panels)	625 mm	750 mm	900 mm
Pitched roof ceiling cladding (10–50° pitch)	420 mm	500 mm	550 mm

<sup>1</sup> Limiting conditions:

In the case of fire protection requirements, the specifications of the test verification/certification should be observed.  
Not possible in rooms where use results in constant high humidity (wet rooms etc.)

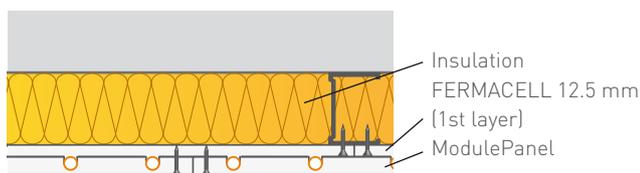
#### Caution:

- › Ensure a minimum seam offset of 200 mm to the FERMACELL planking.
- › Avoid cross joints.
- › With multi-layer Fermacell planking only the ModulePanels (last layer) are glued and stopped.

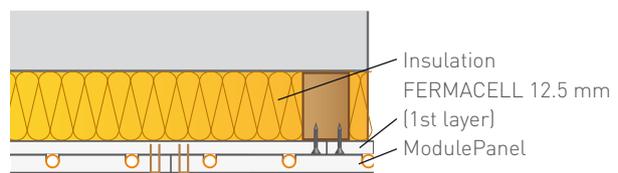


The ModulePanels are attached directly to the FERMACELL planking (minimum panel thickness of the first layer: 12.5 mm) with the following fasteners:

- Dry wall screw
  - › See table on page 18 for the number of screws
- Straddle staples
  - › Galvanised and treated with resin
  - › Wire diameter  $\geq 1.5$  mm
  - › Saddle width:  $\geq 10$  mm
  - › Leg length 2-3 mm shorter than the thickness of both panel layers (ModulePanel + FERMACELL panel)
  - › Distance between staples: max. 150 mm
  - › Distance between rows of staples: as fastening area

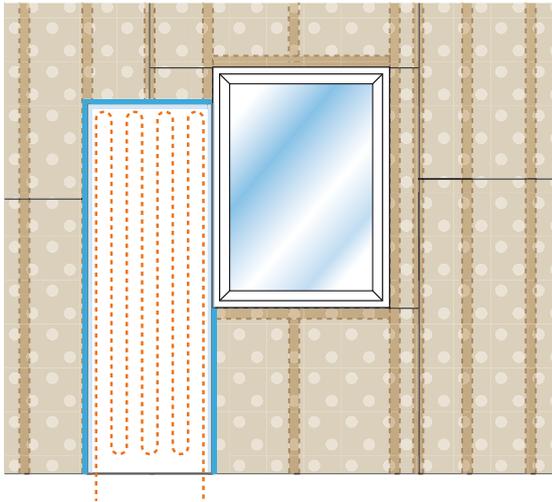


Section through a CW/UW profile **steel construction**, single-sided with **12.5 mm thick FERMACELL** panels, single-layer planking with cavity insulation and installed ModulePanel (**screwed**).



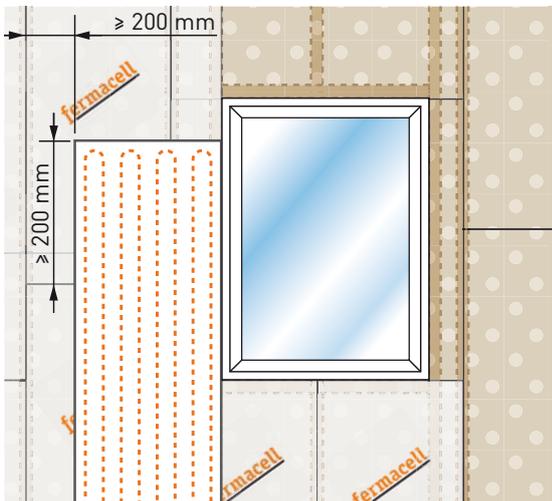
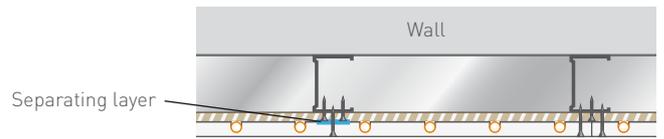
Section through a **softwood wooden construction**, single-sided with **12.5 mm thick FERMACELL** panels, single-layer planking with cavity insulation and installed ModulePanel (**clip fasteners**).

### 3.4 Full-surface plasterboard planking



The lack of screw retention strength in the plasterboard panels means that the ModulePanels can only be directly fastened to the underlying stud construction with offset seams. A separating layer (adhesive tape) is always inserted in the glued seam area.

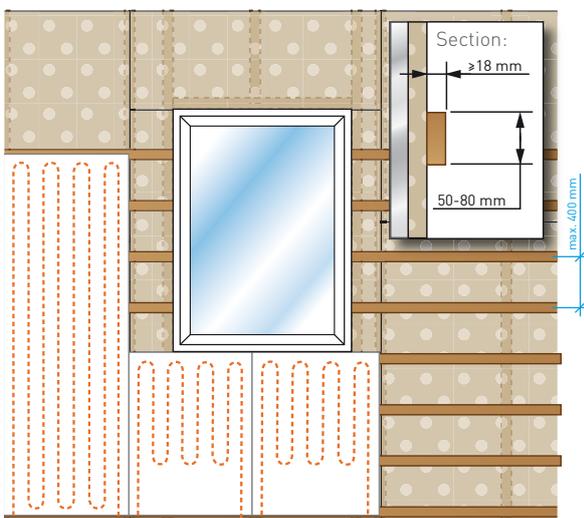
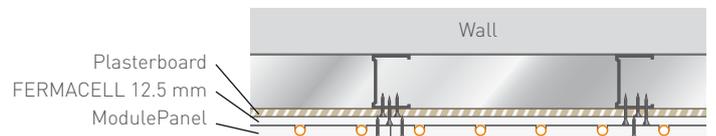
The stud clearance of the plasterboard stud construction must be as specified in section 3.2 (stud clearance of 312.5 mm).



If the substructure can no longer be changed, appropriately thick FERMACELL panels (see table in chapter 3.3) are screwed to the stud construction behind the plasterboard planking.

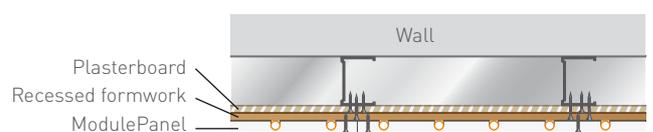
The seams of the FERMACELL planking are not glued or stopped.

**See section 3.3 on fastening the ModulePanels to the FERMACELL planking!**



If the substructure is also unsuitable for full-surface FERMACELL planking, additional horizontal battens (recessed formwork) are screwed to the underlying stud construction instead.

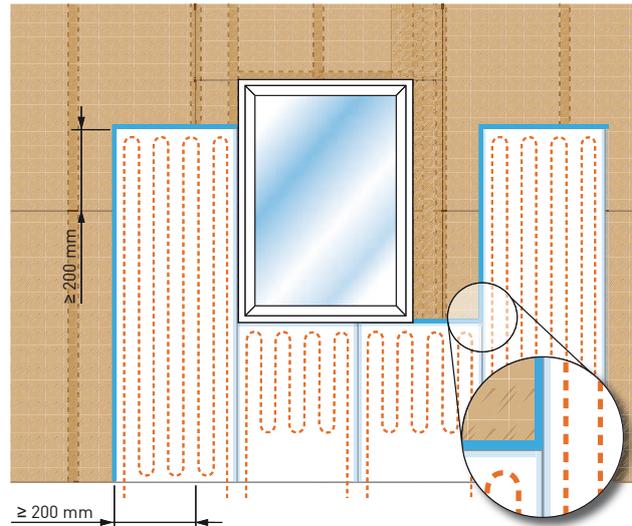
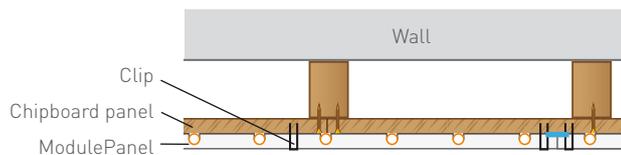
**See section 3.6 for information on installing the recessed formwork and fastening the ModulePanels!**



### 3.5 Full cladding or chipboard panel planking

Chipboard panels and ModulePanels (FERMACELL gypsum fibreboards) have different expansion and contraction behaviour under climatic fluctuations. The fastening variants described below can be recommended when the chipboard panels are not subjected to moisture loads. Caution:

- › Ensure a minimum seam offset of 200 mm to the planking.
- › Avoid cross joints.
- › A separating layer (adhesive tape) is always inserted into the glued seam area.



The ModulePanels are installed with the following straddle staples:

- › Galvanised and treated with resin
- › Wire diameter  $\geq 1.5$  mm
- › Saddle width:  $\geq 10$  mm
- › Leg length 2–3 mm shorter than the thickness of both panel layers
- › Distance between staples: max. 150 mm
- › Distance between rows of staples: as fastening area (see page 19)

The ModulePanels can alternatively be screwed to the planking (special case):

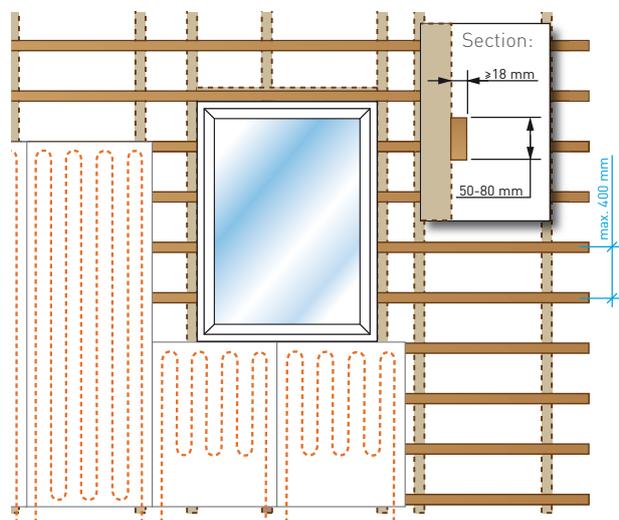
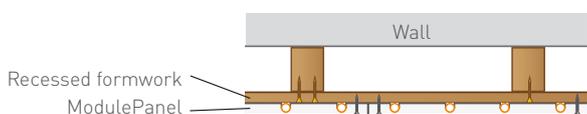
With chipboard panels having expansion and contraction values of max. 0.02 % (for changes to the material moisture of 1 % below the fibre saturation) the Module Panels can also be screwed to the planking. According to DIN EN 1995 Table NA.7 this includes plywood, cross-laminated timber and OSB/4 panels. In this case it is important that the panels have adjusted to the relative humidity of the working climate. The humidity during installation, construction and used of the building must be 30–65 %.

### 3.6 Recessed formwork

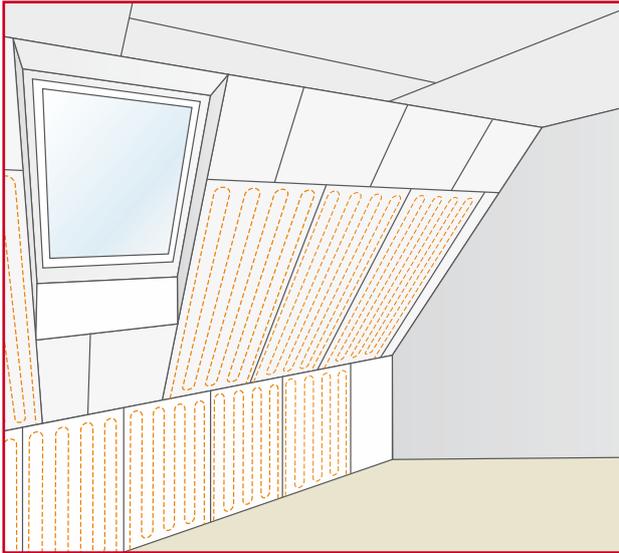
Extra recessed formwork is installed if the substructure does not have the correct batten clearance (300 or 312.5 mm). Horizontal wooden battens and ModulePanels have different expansion and contraction behaviour.

Batten guidelines (recessed formwork):

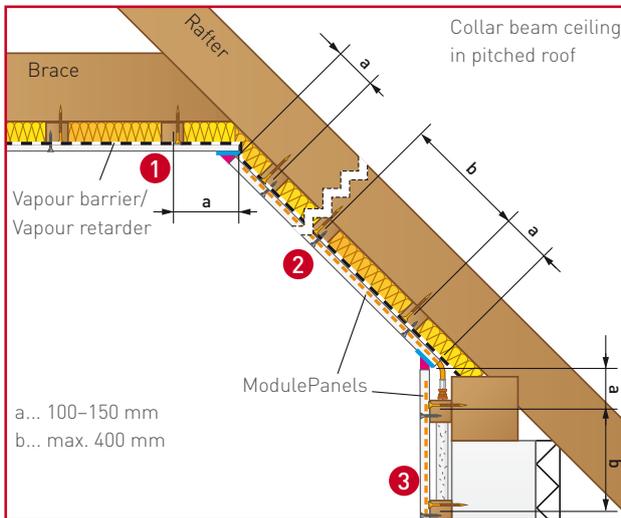
- › Height: 50–80 mm
- › Thickness: min. 18 mm
- › Stud clearance: max. 400 mm, see page 19



### 3.7 Pitched roof substructure

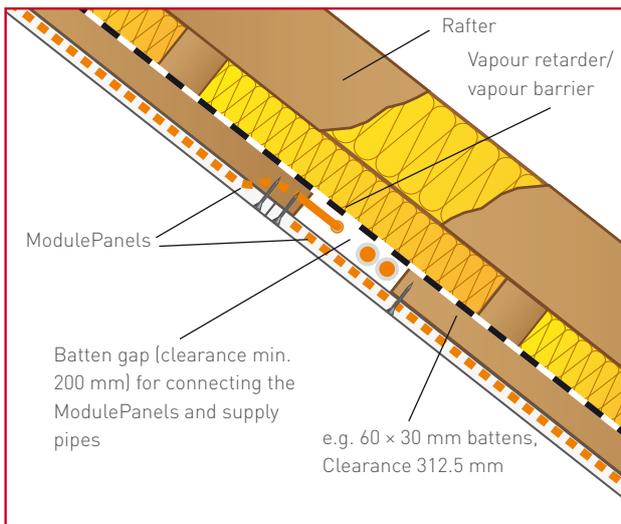


For a pitched roof, the same substructure possibilities apply as for walls.



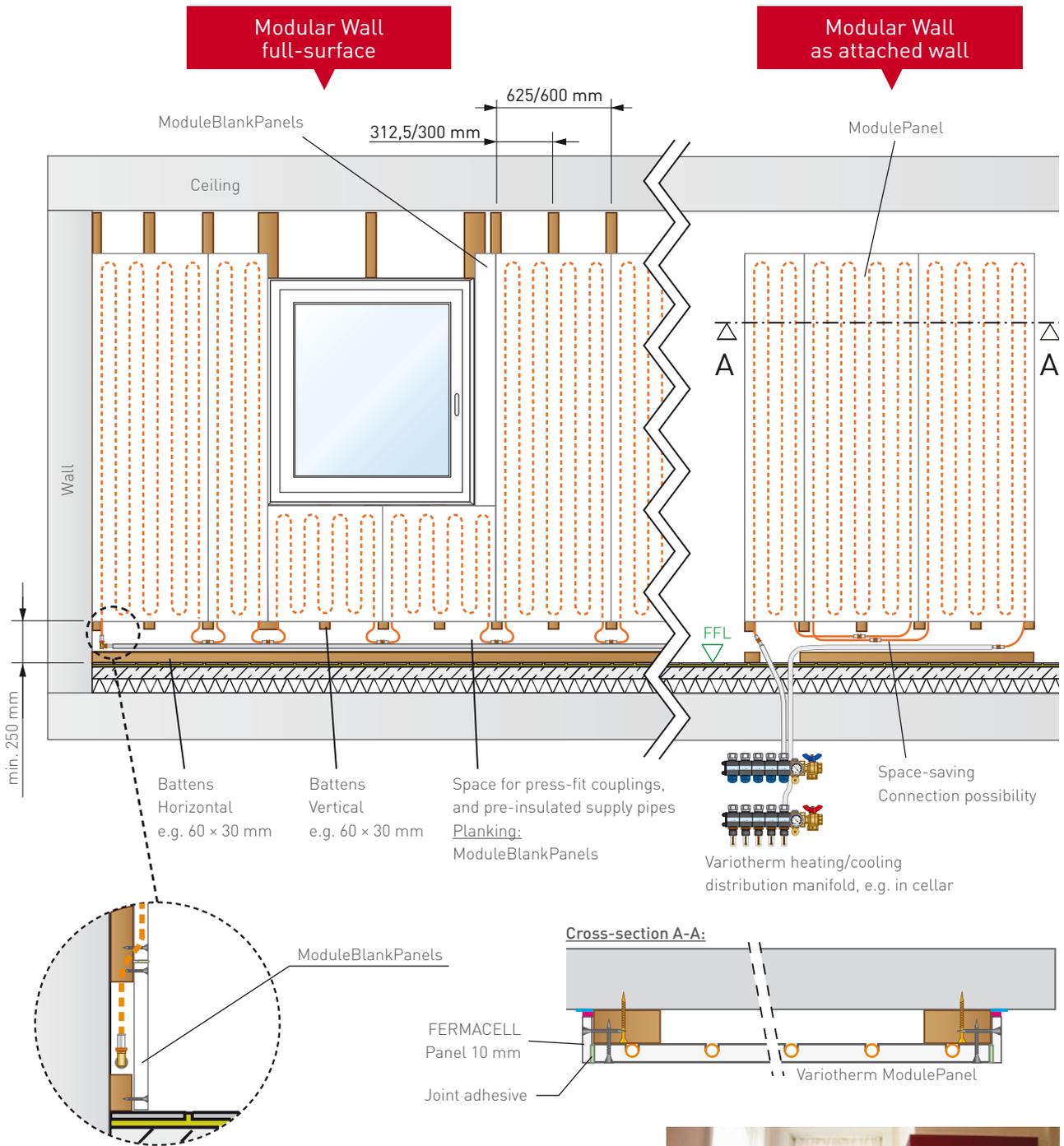
Cross-section – horizontal battens

- Installation process:
- 1 Horizontal surfaces
  - 2 Pitched surfaces
  - 3 Vertical surfaces



When two ModulePanels are abutted above each other in a pitched roof then additional vertical battens for the supply pipes are absolutely necessary!

### 3.8 Substructure variant for existing floors



FFL ... Upper edge of the finished floor



▲ Example of Modular Wall as attached wall



# 5 COMPONENTS

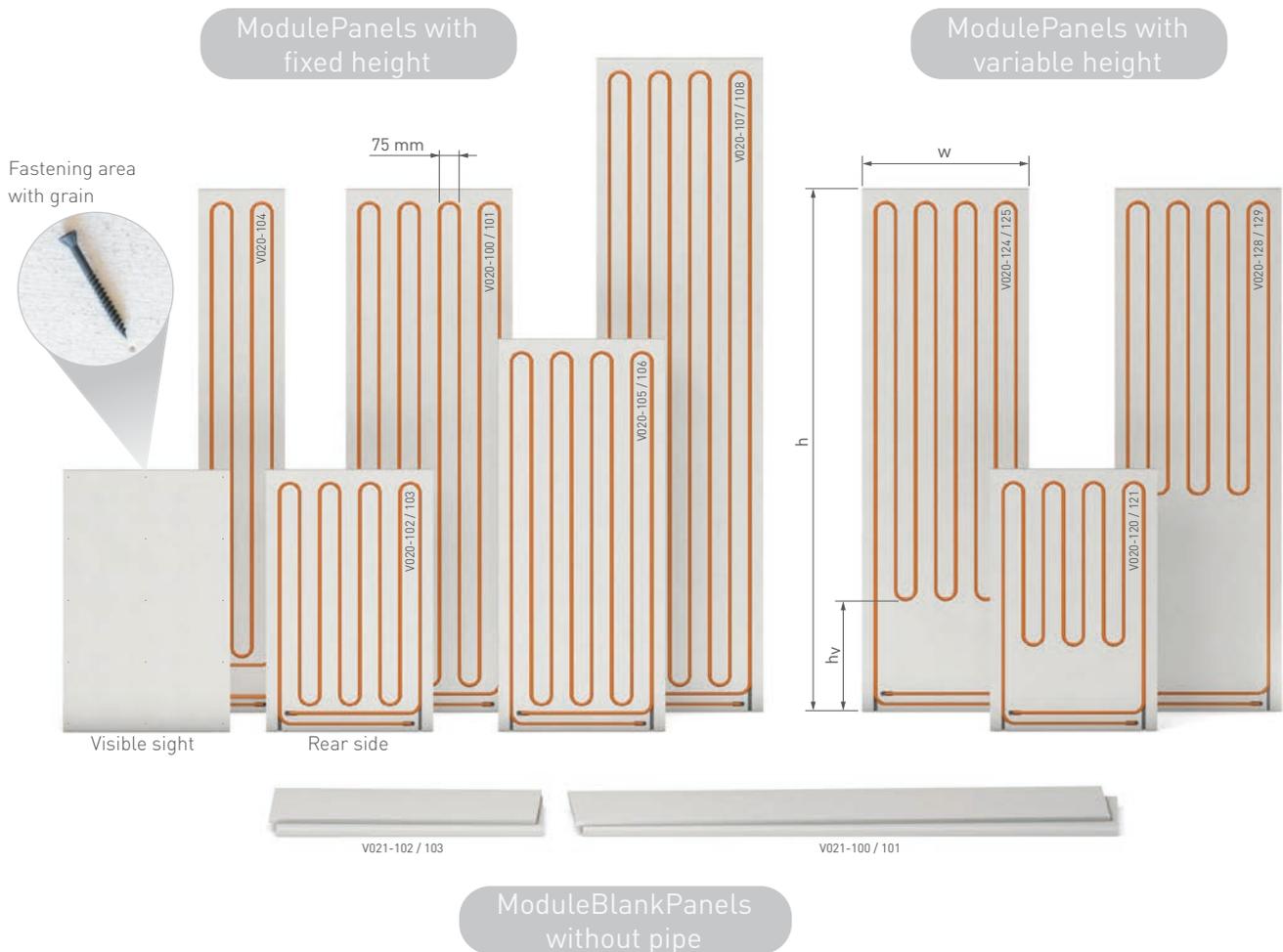
## 5.1 ModulePanels / ModuleBlankPanels

The ModulePanels are 18 mm thick, environmentally safe-tested gypsum fibreboards. The VarioModular pipes 11.6x1.5 are already integrated into the back of the panels. The interval between the pipes is 75 mm.

Panels with either fixed or variable height are available:

Fixed height: The complete surface of the ModulePanel serves as a heating/cooling surface.

Variable height: Only part of the surface serves as a heating/cooling surface, the unoccupied area ( $h_v$ ) can be cut individually or, for example, be used as a recess for sockets.



## Technical data / Overview

### Panel characteristics:

**Panel:** gypsum fibreboard which has been tested for their healthy building properties

**Fire resistance as per DIN EN 13501-1:**

non-flammable, A2

**Identification as per DIN EN 15283-2:**

GF-I-W2-C1

**Thermal conductivity  $\lambda$ :** 0.32 W/mK

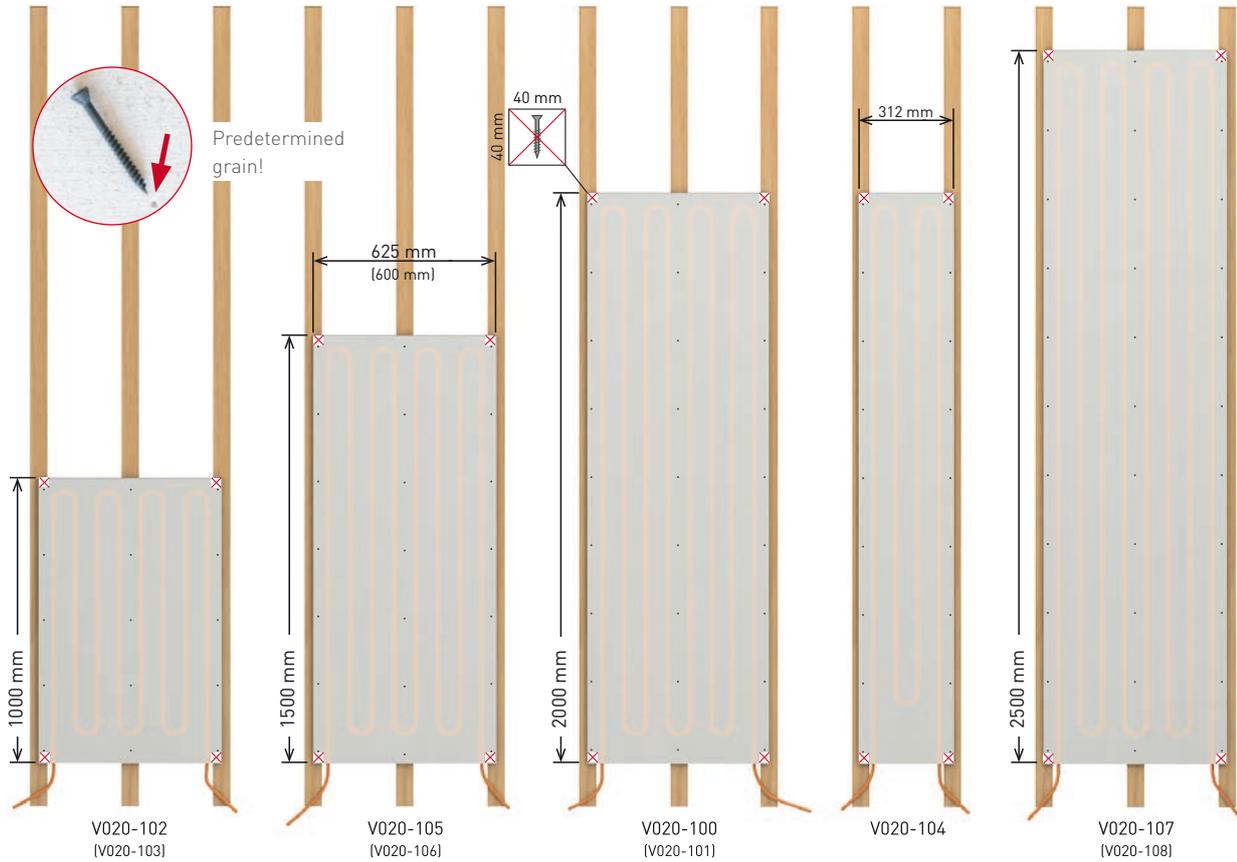
**Apparent density  $\rho_K$ :** 1150  $\pm$  50 kg/m<sup>3</sup>

**Water vapour diffusion resistance factor  $\mu$ :** 13

Part no.	Product code	Dimensions (h × w), [mm]	Height h <sub>v</sub> [mm]	Panel surface [m <sup>2</sup> ]	Effective surface [m <sup>2</sup> ]	Laid pipe in panel	Weight/ panel	Required quantity <sup>1</sup> dry wall screws 3.9 × 40 mm		Colour code
								Longitudinal joists	Transverse joists	
<b>ModulePanels</b>										
<b>V020-100</b>	MWC-2000-625	2000 × 625	–	1.25	1.25	16.2 m	25.5 kg	3 × 9 pcs.	6 × 5 pcs.	
<b>V020-101</b>	MWC-2000-600	2000 × 600	–	1.20	1.20	16.2 m	24.5 kg	3 × 9 pcs.	6 × 5 pcs.	
<b>V020-102</b>	MWC-1000-625	1000 × 625	–	0.63	0.63	8.2 m	12.8 kg	3 × 5 pcs.	4 × 5 pcs.	
<b>V020-103</b>	MWC-1000-600	1000 × 600	–	0.60	0.60	8.2 m	12.2 kg	3 × 5 pcs.	4 × 5 pcs.	
<b>V020-104</b>	MWC-2000-312	2000 × 312	–	0.62	0.62	8.2 m	12.6 kg	2 × 9 pcs.	6 × 3 pcs.	–
<b>V020-105</b>	MWC-1500-625	1500 × 625	–	0.94	0.94	12.2 m	19.2 kg	3 × 7 pcs.	5 × 5 pcs.	
<b>V020-106</b>	MWC-1500-600	1500 × 600	–	0.90	0.90	12.2 m	18.4 kg	3 × 7 pcs.	5 × 5 pcs.	
<b>V020-107</b>	MWC-2500-625	2500 × 625	–	1.56	1.56	20.2 m	33.8 kg	3 × 11 pcs.	8 × 5 pcs.	
<b>V020-108</b>	MWC-2500-600	2500 × 600	–	1.50	1.50	20.2 m	30.6 kg	3 × 11 pcs.	8 × 5 pcs.	
<b>V020-120</b>	MWC-1000-625-V300	1000 × 625	300	0.63	0.48	6.7 m	13.0 kg	3 × 5 pcs.	4 × 5 pcs.	
<b>V020-121</b>	MWC-1000-600-V300	1000 × 600	300	0.60	0.46	6.7 m	12.5 kg	3 × 5 pcs.	4 × 5 pcs.	
<b>V020-124</b>	MWC-2000-625-V400	2000 × 625	400	1.25	1.04	14.2 m	25.8 kg	3 × 9 pcs.	6 × 5 pcs.	
<b>V020-125</b>	MWC-2000-600-V400	2000 × 600	400	1.20	1.00	14.2 m	24.8 kg	3 × 9 pcs.	6 × 5 pcs.	
<b>V020-128</b>	MWC-2000-625-V800	2000 × 625	800	1.25	0.79	11.8 m	26.2 kg	3 × 9 pcs.	6 × 5 pcs.	
<b>V020-129</b>	MWC-2000-600-V800	2000 × 600	800	1.20	0.76	11.8 m	25.1 kg	3 × 9 pcs.	6 × 5 pcs.	
<b>ModuleBlankPanels</b>										
<b>V021-100</b>	MAC-2000-625	2000 × 625	–	1.25		no pipe	27.1 kg	3 × 9 pcs.	6 × 5 pcs.	–
<b>V021-101</b>	MAC-2000-600	2000 × 600	–	1.20		no pipe	26.0 kg	3 × 9 pcs.	6 × 5 pcs.	–
<b>V021-102</b>	MAC-1000-625	1000 × 625	–	0.63		no pipe	13.6 kg	3 × 5 pcs.	4 × 5 pcs.	–
<b>V021-103</b>	MAC-1000-600	1000 × 600	–	0.60		no pipe	13.0 kg	3 × 5 pcs.	4 × 5 pcs.	–

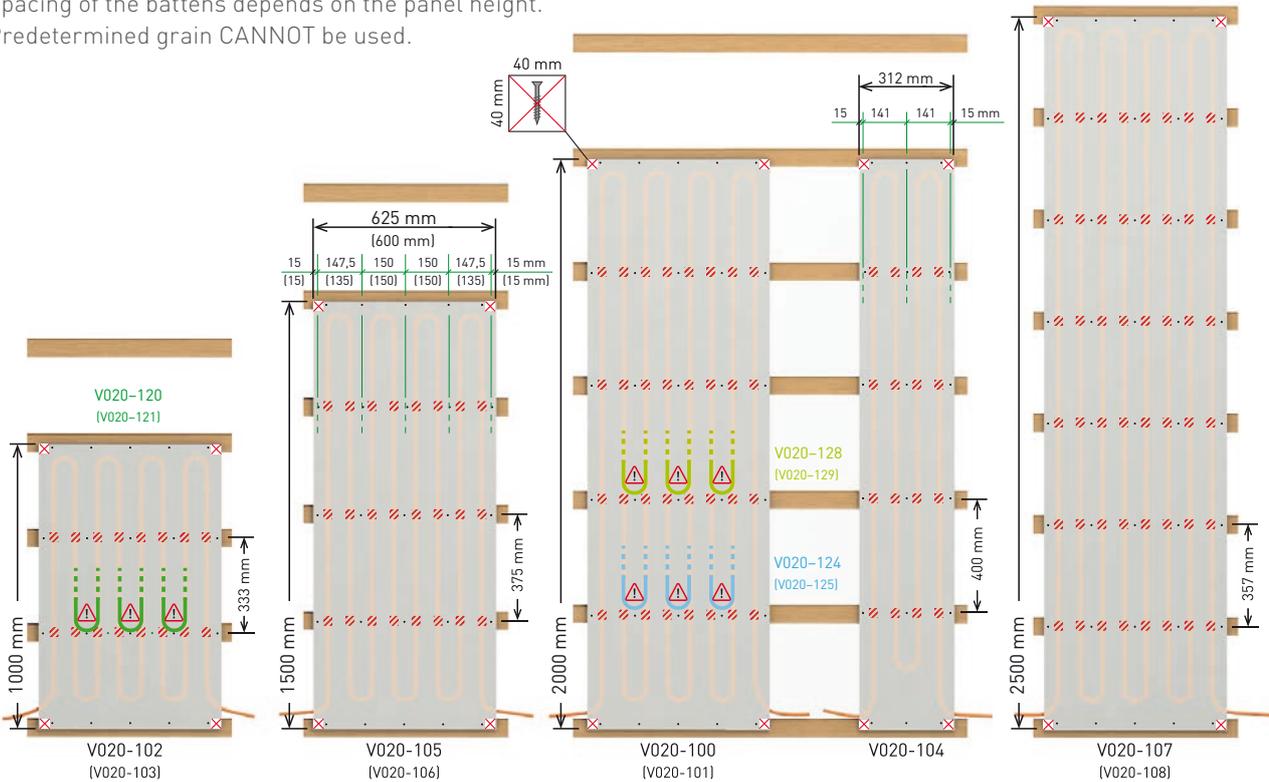
<sup>1</sup> Apart from the quantity, in the case of fire protection requirements test verification/certification may result in different specifications!  
Spread out bolts evenly across the length/width of the panel.

## Fastening area of the ModulePanels - battens length



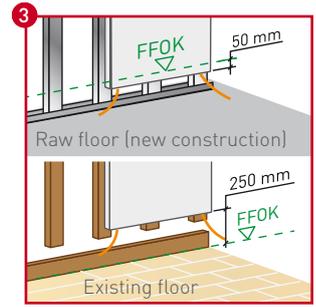
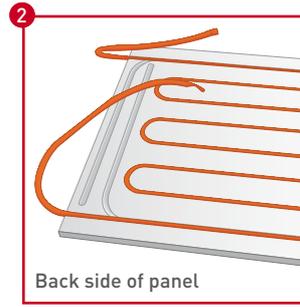
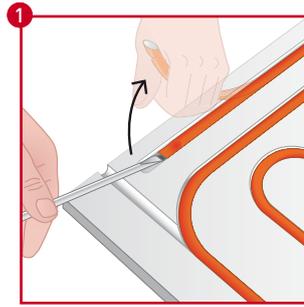
## Fastening area of the ModulePanels - battens across

Spacing of the battens depends on the panel height. Predetermined grain CANNOT be used.

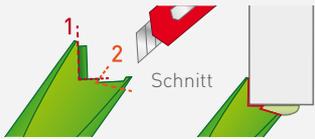


## Installing the ModulePanels

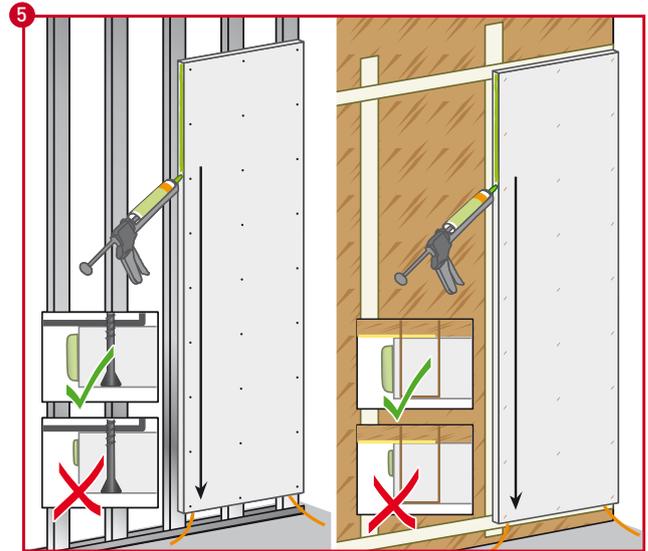
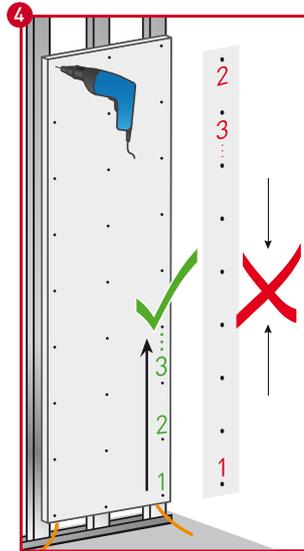
- > Dry wall screws 3.9 x 40 mm
- > Part No.:  
F120-0250 (PKU: 250 pcs.)  
F120-1000 (PKU: 1000 pcs.)
- > Weight:  
0.6 kg (F120-0250)  
2.4 kg (F120-1000)
- > Consumption: 16 pcs./m<sup>2</sup>
- > Optimum shank length
- > Incl. associated bit



- > Greenline joint adhesive
- > Part No.: F111
- > PKU: 1 cartridge  
Carton with 25 cartridges
- > Weight/PKU: 550 g
- > Consumption: ~7 m<sup>2</sup> / cartridge
- > For connecting the blunt adjoining ModulePanels



**A tip from Variotherm:** Cut off the cartridge tip as shown in the illustration.



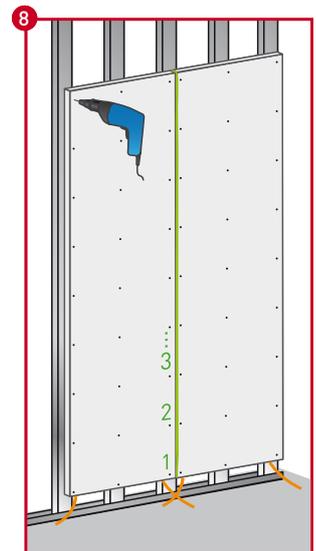
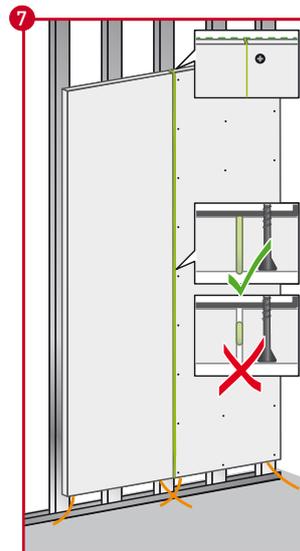
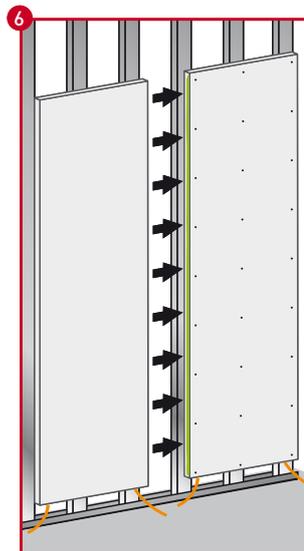
The ModulePanel is installed in the fastening area (see page 19) using dry wall screws 3.9 x 40 mm or staples.

Apply Greenline joint adhesive in flat bulge shapes (width around 14mm) to the well-dusted panel edge. Processing temperature: Glue > 10 °C, room temperature > 5 °C. For solid formwork or wood-based panels as a sub-surface: adhesive tape is necessary in the area of the adhesive seams!

- > Adhesive tape
- > Part No.: V288
- > Weight: 210 g  
PKU: 1 pce.  
Carton with 36 pcs.
- > As a separating layer to joint surfaces or between the panel contact points and the substructure (if required)



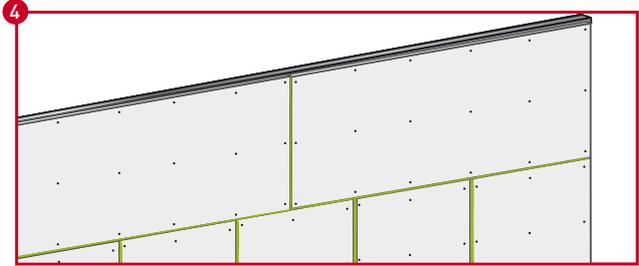
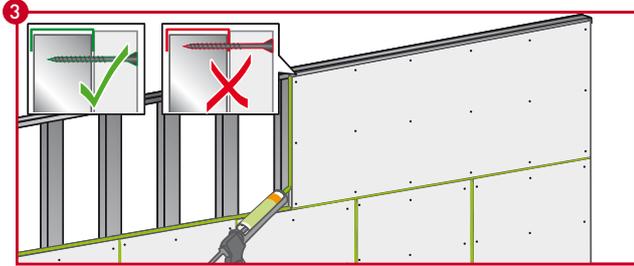
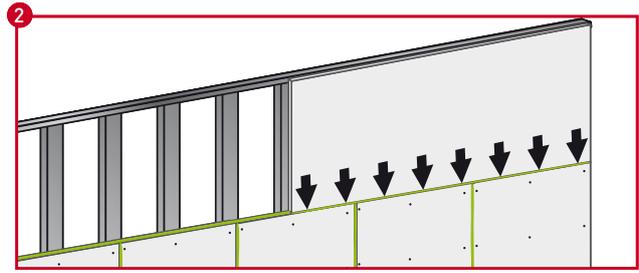
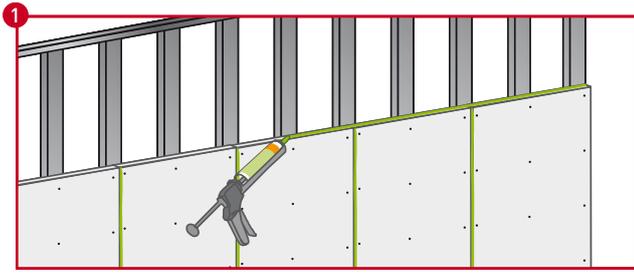
**A tip from Variotherm:** Use a power screw gun if possible and set the penetration depth of the screw head to approx. 0.1 mm.



Press the second ModulePanel against the first so that the seam becomes tight. The seam width must not exceed 1 mm. Leave the seam adhesive approx. 18 to 36 hours to harden and only afterwards scrape off excess (see also Chap. 6.1).

Screw the second ModulePanel in the correct order and repeat with each additional ModulePanel.

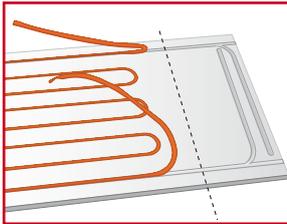
## ModuleBlankPanels



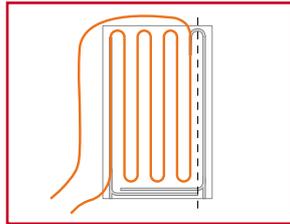
The remaining surfaces to the side of or above the ModulePanels are filled with ModuleBlankPanels with offset seams. The assembly is 1:1, as with the ModulePanels.

For cut board edges (handheld circular saw), it should be noted that cut edges are to be dusted directly and immediately before the application of the joint adhesive. Cross joints should be avoided.

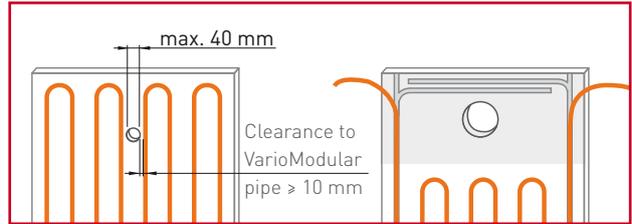
## Adapt ModulePanels



▲ Shorten the variable ModulePanels in length



▲ Shorten the ModulePanels in width



▲ Cut-out for blank piping, sockets, etc.

## Transitions to other panel materials

Different materials expand in different ways. Therefore, a wall surface should be installed with the same panel material throughout.

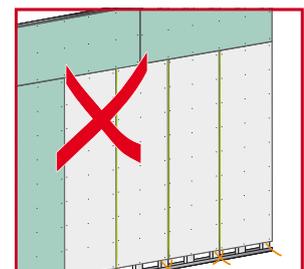
Variotherm provides no warranty for transitions to other board materials (for example gypsum plasterboards). Please observe the guidelines of the respective (panel) manufacturers.

As a possibility for transitions, we can provide the following examples from practice:

- > Grouted joints (approx. 7 mm) ■ with a separating layer ■ (= decoupled connection). Advantage: intentional straight crack (usually hardly visible)
- > Elastic seams (acrylic mass). (maintenance seam, not permitted for fire-resistant constructions)
- > Fascia
- > Wooden strip fixed on one side for covering the transition



▲ Gypsum fibreboards



▲ Gypsum fibreboards and gypsum plasterboards

- > Duo Adhesive
- > Part No.: F115
- > PKU: 1 Cartridge  
Carton with 10 cartridges
- > Weight/PKU: 1 kg
- > Consumption: ~7 m joint  
(4 mm width, 18 mm depth)
- > Special manual applicator W048  
required!



- > Static mixing tube
- > Part No.: F116
- > PKU: 1 pce.  
Carton with 75 pcs.
- > Weight/PKU: 15 g
- > Consumption: ~3 pcs./cartridge



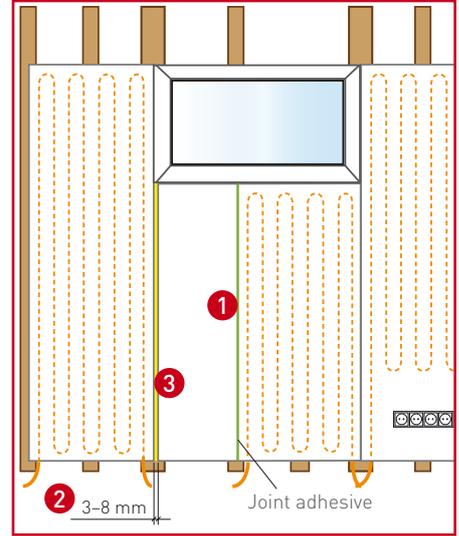
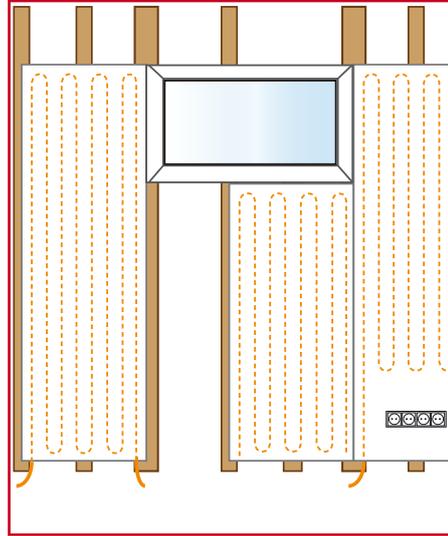
- > Duo manual applicator
- > Part No.: W048
- > PKU: 1 pce.  
Weight/PKU: 1.4 kg
- > The matching manual applicator for  
applying the Duo adhesive.



### Installation of panels between installed ModulePanels

If "drop to drop" installation of the ModulePanels is not possible, proceed as follows:

- 1 Glue one side of the Modular Expansion Panel using joint adhesive
- 2 Leave a 3 to 8 mm gap on the other side.
- 3 Completely fill the gap with **Variotherm Duo adhesive (special manual applicator W048 required!)**.



### Processing the Duo Adhesive:

- > The surfaces of the ModulePanels must be clean, dry, dust-free and grease-free.
- > Open the cartridge – screw on the static mixing tube.
- > Insert the cartridge into the Duo manual applicator.
- > For safety reasons, do not use the first amount of mixed adhesive for gluing (20 g, approx. walnut-sized).
- > Completely fill the joint from the top to the bottom using the static mixing tube.
- > For a better filling result, use a pointing trowel (or similar) to slightly hollow out the fresh joint.
- > Remove excess adhesive when still fresh. Hardened adhesive can only be removed with great effort.
- > The static mixing tube remains on the cartridge unit at the end of work/during breaks – the static mixing tube is then replaced the next time work begins again.
- > The joint can be covered with filler 4 hours after gluing the panels (working temperature > +15 °C).

### Safety information:

Keep out of the reach of children! For further information see the product label or the safety data sheets according to Regulation 1907/2006/EC, Annex II, available at [www.variotherm.com/en/service/info-centre/safety-data-sheets.html](http://www.variotherm.com/en/service/info-centre/safety-data-sheets.html).

Wear suitable protective gloves. Protect your skin, eyes, clothing and tools from coming into contact with unhardened Duo adhesive. In the case of skin contact clean immediately with soap and water. Clean contaminated tools immediately with universal thinner. Hardened adhesive can only be removed mechanically.

### Technical data:

Basis: 2-component PUR reaction adhesive

Colour when hard: beige

Viscosity at +20 °C: low-viscosity paste

Working time (at +10/+20/+30 °C): approx. 60/30/15 minutes

Hardening time (+20 °C, 50 % relative humidity): approx. 24 hours, final hardness after approx. 7 days

Working temperature: minimum of +7 °C to a maximum of +30 °C

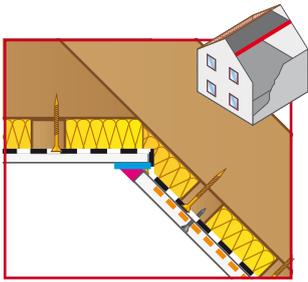
Net weight: 900 g (2 × 310 ml tandem cartridge)

Consumption: 1 cartridge is sufficient for an approx. 7 m joint (4 mm width and 18 mm depth)

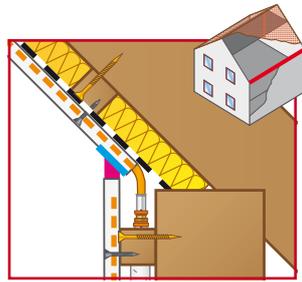
Storage: unopened, in a dry place at +15 °C to +25 °C approx. 15 months

## Panel transitions

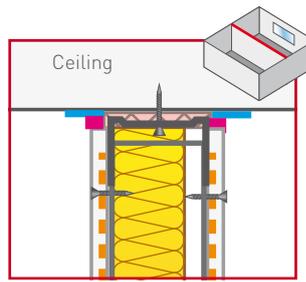
Inner and outer corners and T-joints are to be constructed as grouted joints (approx. 7 mm) ■ with a separating layer ■ (decoupled connection):



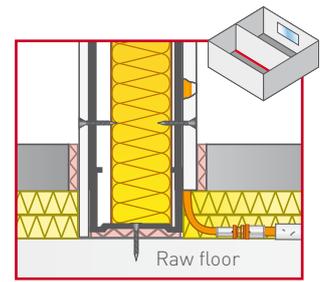
▲ Pitched roof to ceiling



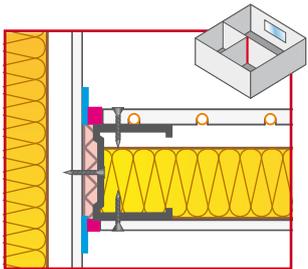
▲ Pitched roof to jamb wall



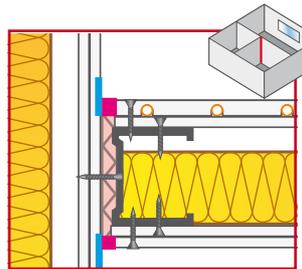
▲ Ceiling connection



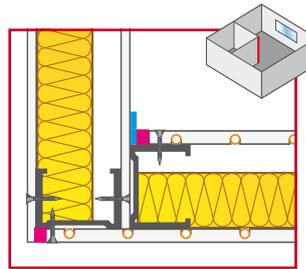
▲ Floor connection



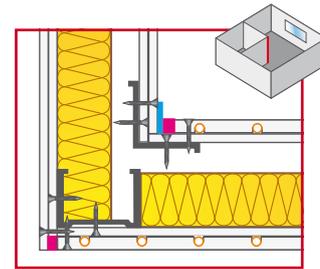
▲ T-connection, single-layer planking



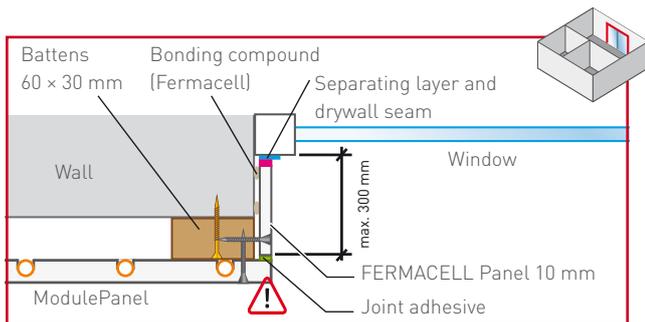
▲ T-connection, double-layer planking



▲ Corner joints, single-layer planking

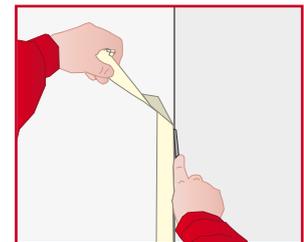


▲ Corner joints, double-layer planking



▲ Reveal area

**⚠ Caution:**  
Pay special attention to the Variomodular pipes when fastening the ModulePanels in the reveal area. (Fastening outside of the fastening area!)



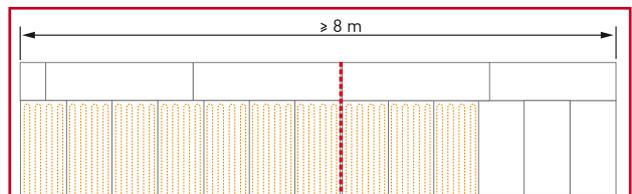
▲ Remove the excess separating layer (adhesive tape) at inner corners after filling.

## Movement joints

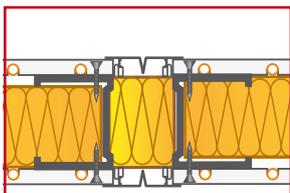
Movement joints are to be provided every 8 m in wall constructions and pitched roofs.

**Caution:** Pay special attention to the Variomodular Pipes when fastening the ModulePanels in the area of the movement joints!

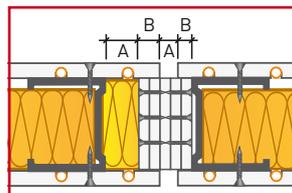
$A \leq 20$  mm (Movement dimension),  $B \geq 20$  mm.



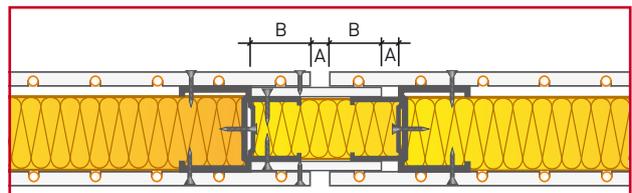
▲ Movement joint at e.g. 10x V020-100 and 3x V021-100  
( $13 \times 0.625$  m = 8.13 m)



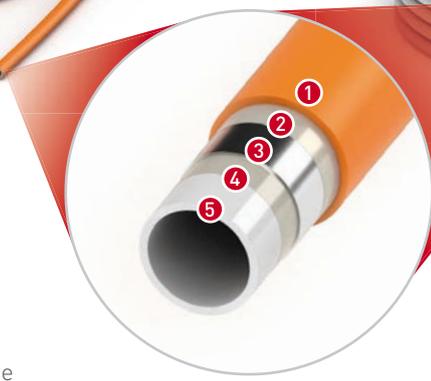
▲ Movement joint with additional profile



▲ Movement joint with panel strip



▲ Movement joint with strip bundle



## 5.2 VarioModular pipes

### Advantages

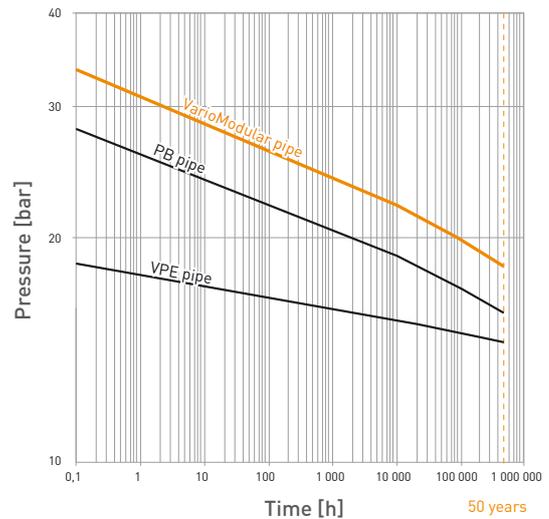
- › Fully corrosion-free
- › Optimum creep behaviour
- › Just as light as a plastic pipe
- › 10-year guarantee with certificate
- › Flexible, easy to bend, extremely stable form
- › Resistant to hot water additives (inhibitors, antifreeze)
- › Mirror-smooth inner surface – less pressure loss – no encrustation
- › High pressure and temperature resistance
- › 100 % oxygen diffusion-tight
- › Low linear coefficient of expansion, low heat expansion forces
- › Tested as per EN 21003

- 1 Temperature-resistance polyethylene (PE)
- 2 Adhesive layer
- 3 Homogeneous and solid aluminium pipe
- 4 Adhesive layer
- 5 Raised-temperature-resistance polyethylene (PE-RT)

Technical data	11.6 x 1.5	16 x 2
Pipe diameter	11.6 mm	16.0 mm
Pipe wall thickness	1.5 mm	2.0 mm
Aluminium pipe thickness	0.15 mm	0.18 mm
Water content	0.058 l/m	0.113 l/m
Special narrow bending radius (use a suitable bending device)	30 mm	40 mm
Max. operating temperature [t <sub>max</sub> ]	70 °C	70 °C
Short-term resistant [t <sub>mai</sub> ]	95 °C	95 °C
Max. operating pressure [p <sub>max</sub> ]	6 bar	6 bar
Linear expansion coefficient	2.3 × 10 <sup>-5</sup> [K <sup>-1</sup> ]	2.3 × 10 <sup>-5</sup> [K <sup>-1</sup> ]
Mean heat conduction coefficient [λ]	0.44 W/mK	0.45* W/mK
Heat transmission resistance	0.0034 m <sup>2</sup> K/W	0.0045* m <sup>2</sup> K/W

\* Values without insulation

### Creep behaviour



### Elongation

with 10 m and temperature difference  $\Delta t$  25 °C (e.g. 20 °C to 45 °C):

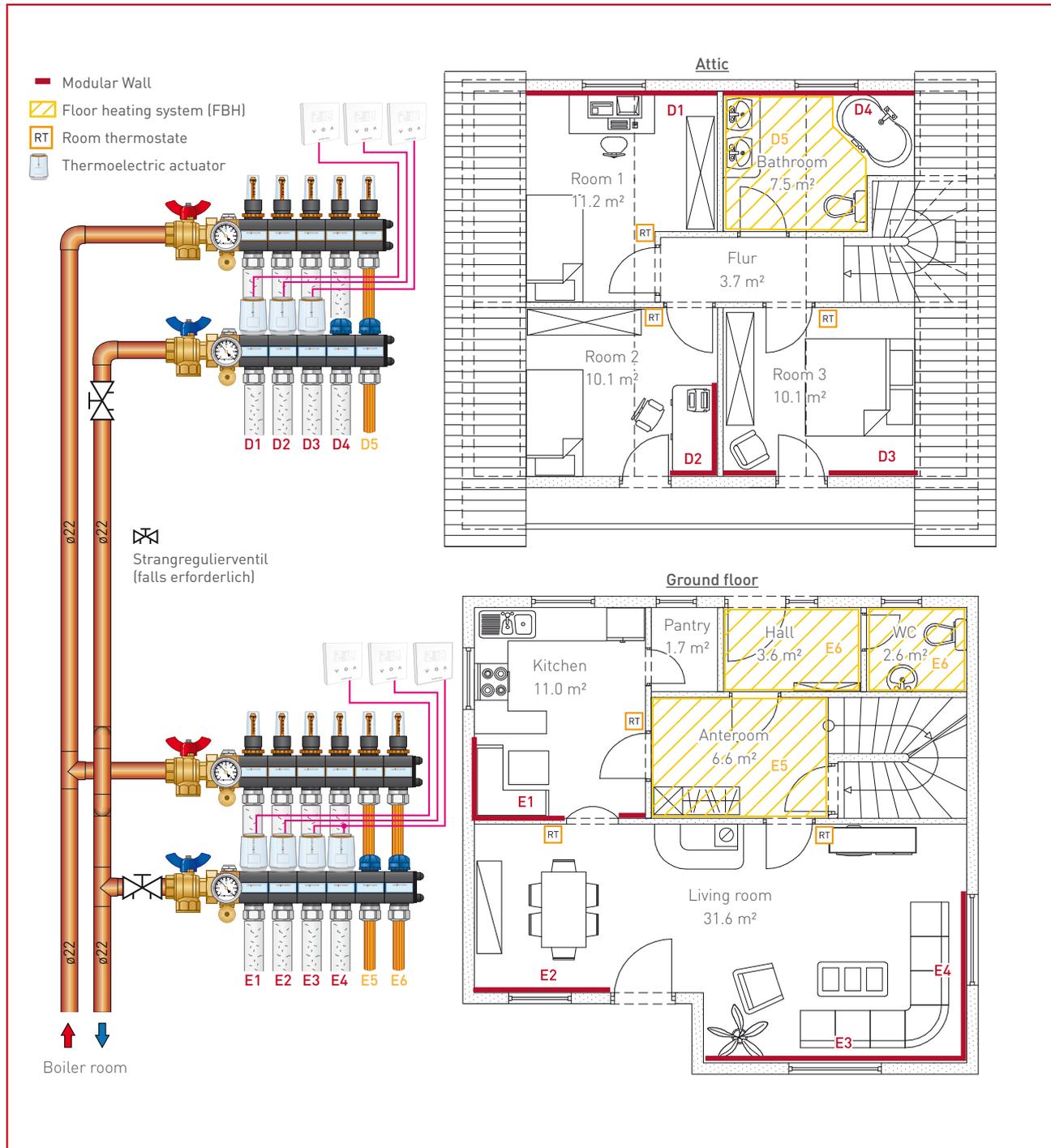
	Tubing	Elongation
Plastics	PEX (VPE)	50,00 mm
	PP	42,50 mm
	PB	32,50 mm
	PVC	20,00 mm
	Variomodular pipe	5,75 mm
Metal	Cu	4,20 mm
	Stainless steel	3,50 mm
	Steel	2,88 mm

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

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

### Single-family house connection example

In the example provided, the heating system has been adapted to suit the rooms: A floor heating system is planned for tiled rooms (anterooms, toilet, bathroom) and wall heating surfaces are planned for living, work and bedrooms. A room thermostat for controlling the room temperature is planned for the kitchen, dining area and living room (influence of external heat sources from kitchen appliances, south-facing glass surfaces and tile stoves).



- > Calibration and chamfering tool
- > Part No.: W042
- > PKU: 1 pce.
- > Weight/PKU: 140 g
- > For calibrating and chamfering the Variotherm pipes



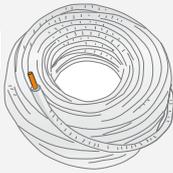
- > Pipe cutting pliers
- > Part No.: W037
- > PKU: 1 pce.
- > Weight/PKU: 230 g
- > For trimming the Variotherm pipes
- > Replacement blade: W0371



- > Cold shrinking tape
- > Part No.: Z1699
- > PKU: 1 pce. | Carton with 20 pcs.
- > Weight/PKU: 990 g
- > Roll: 50 mm x 15 m
- > 1 roll is sufficient for approx. 35 press-fit coupling connections (with a 50 % overlap)



- > Pre-insulated 16x2 VarioModular pipe
- > Part No.: V1226 (6 mm Insulation) V1227 (9 mm Insulation)
- > PKU: Roll with 100 m
- > Weight/PKU: 14.0 kg (6 mm Insulation) 14.9 kg (9 mm Insulation)
- > Insulation: Polyethylene soft foam
- > Fire resistance as per EN 14313: CL-s1,d0



- > Retaining clamp ø35
- > Part No.: V2802
- > PKU: 50 pcs.
- > Weight/PKU: 1 kg
- > for affixing the pre-insulated VarioModular pipes 16x2



- > Retaining clamp ø35
- > Part No.: V2803
- > PKU: 25 pcs.
- > Weight/PKU: 1 kg
- > for affixing the pre-insulated VarioModular pipes 16x2

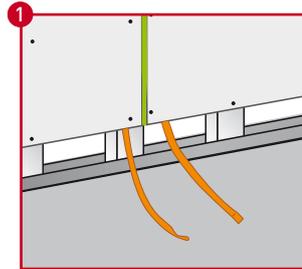


### Connecting pipes

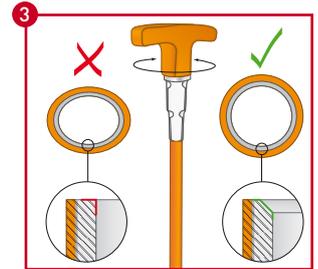
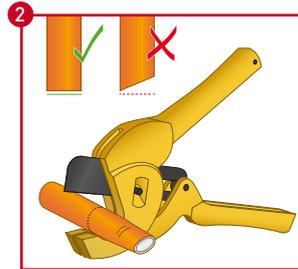
Once the panels and the heating/cooling manifolds are installed, the panels are connected to the desired circuits. The pre-insulated VarioModular pipe 16x2 is used as the supply pipe. A permanent, tight connection is only guaranteed if original Variotherm system components are used:

- > VarioModular pipes
- > Variotherm calibration and chamfering tool
- > Variotherm press couplings + press tool

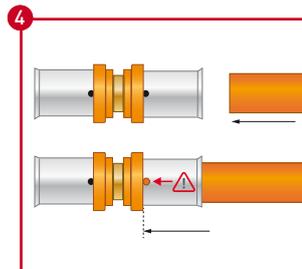
The press-fitting jaws and pressing tool must be checked at least once a year for correct operation by REMS or an authorised REMS customer service workshop.



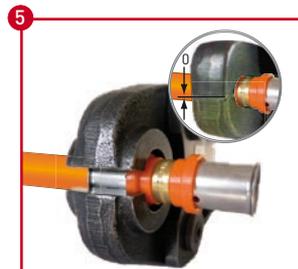
▲ Cut off the crushed pipe end at a right-angle



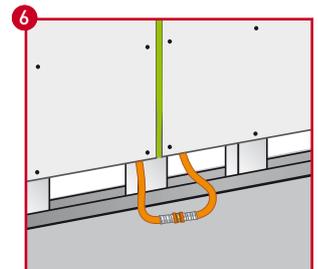
▲ Calibrate and chamfer the pipe



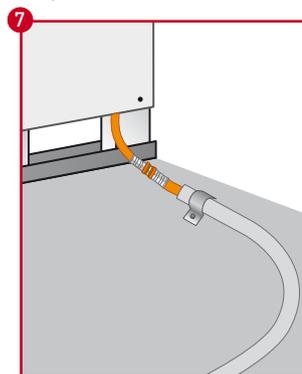
▲ Push on the press-fit coupling until it reaches the stop



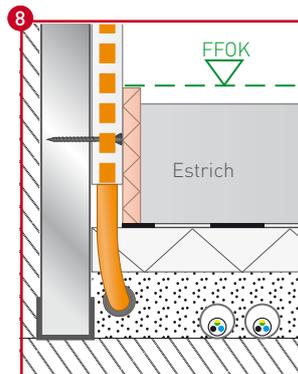
▲ Pressing. The press-fitting jaw must close fully.



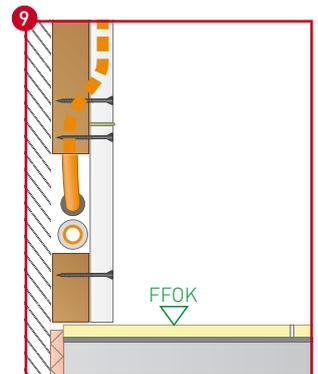
▲ Connected ModulePanels



▲ Pre-insulated VarioModular pipe 16x2 connected with ModulePanel



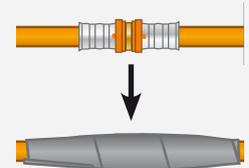
▲ Cross-section – Floor construction in new building



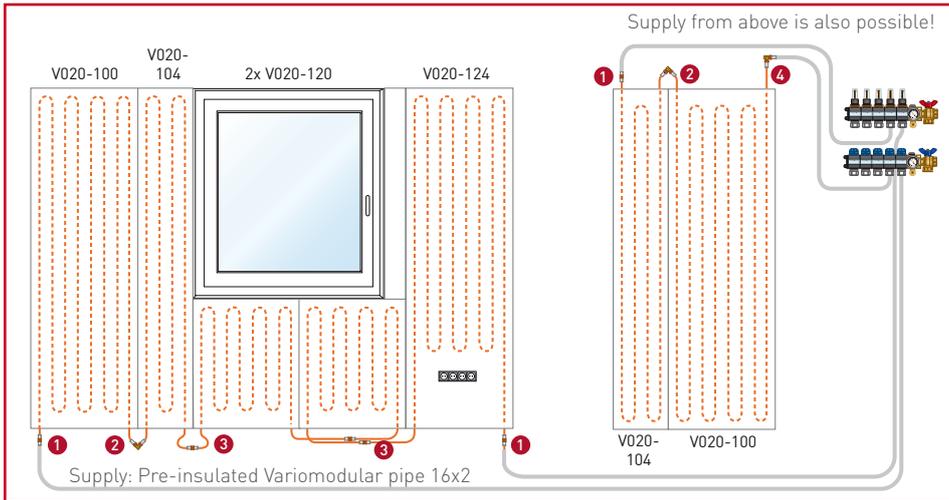
▲ Cross-section – Existing floor

#### Corrosion prevention notice:

The connecting elements are to be protected (after the pressure test) in accordance with ÖN H 5155. For example, using cold shrink tape or corrosion protection tape. This measure is also a pre-requisite for effective dew-point monitoring (see also chapter 7.4).



## ModulePanel connection options

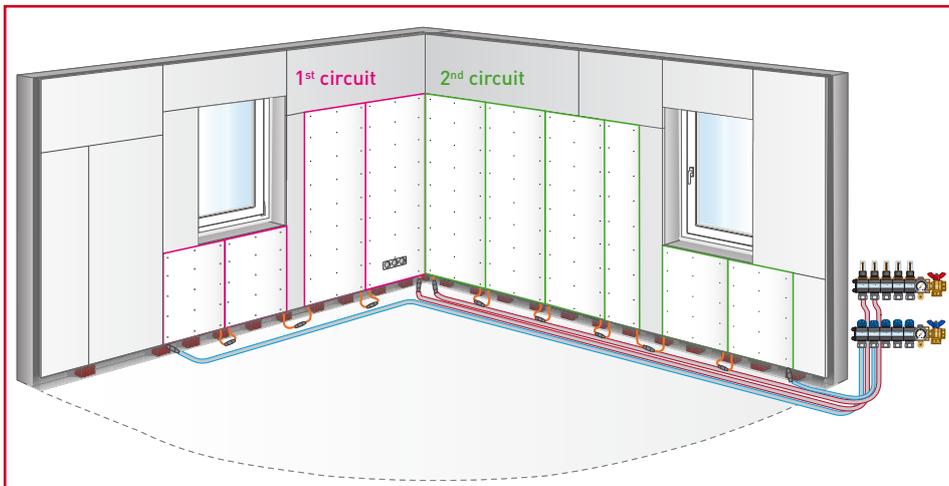


Maximum heating/cooling area per heating/cooling circuit

**6.25 m<sup>2</sup>**  
(e.g. 5 pcs. V020-100)  
pay attention to the pump design!

Pressure loss examples (t <sub>i</sub> = 20 °C)		
t <sub>r</sub> /t <sub>r</sub>	6.25 m <sup>2</sup> / circuit	5.0 m <sup>2</sup> / circuit
40/30 °C	1.9 mWC	1.2 mWC
35/28 °C	2.1 mWC	1.4 mWC
35/30 °C	4.4 mWC !	2.6 mWC

## Laying example



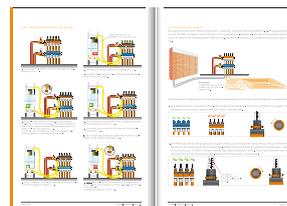
## Pressure test

Once all circuits have been connected to the heating/cooling manifold, the system can be filled downstream of the manifold and pressurised. The pipes are to be kept under water pressure before completion work (screed, plastering, painting, wallpapering, tiling) so that any damage becomes immediately visible.



PDF

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



- > Press-fit coupling 16x11.6 
- > Part No.: Z1610
- > PKU: 1 pce.
- > Weight/PKU: 45 g
- > Press contour: TH11.6 & TH16

- > Press-fit elbow 90° 11.6x11.6 
- > Part No.: Z1630
- > PKU: 1 pce.
- > Weight/PKU: 45 g
- > Press contour: TH11.6

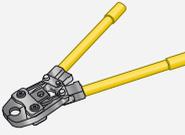
- > Press-fit coupling 11.6x11.6 
- > Part No.: Z1600
- > PKU: 1 pce.
- > Weight/PKU: 30 g
- > Press contour: TH11.6

- > Press-fit elbow 90° 16x11.6 
- > Part No.: Z1620
- > PKU: 1 pce.
- > Weight/PKU: 45 g
- > Press contour: TH11.6 / TH16

- > AkkuPress Mini 
- > Part No.: W019
- > PKU: 1 pce.
- > Weight/PKU: 9.9 kg
- > Incl. sheet steel box, press-fitting jaws TH16 Mini & TH11.6 Mini, battery charger, 2 batteries

- > Mini press-fitting jaw TH11.6 
- > Part No.: W031
- > PKU: 1 pce.
- > Weight/PKU: 1,5 kg

- > Mini press-fitting jaw TH16 
- > Part No.: W032
- > PKU: 1 pce.
- > Weight/PKU: 1.6 kg

- > EcoPress 
- > Part No.: W015
- > PKU: 1 pce.
- > Weight/PKU: 9.7 kg
- > Incl. sheet steel box, press-fitting jaws TH16 & TH11.6

- > Press-fitting jaw TH11.6 
- > Part No.: W025
- > PKU: 1 pce.
- > Weight/PKU: 2.0 kg

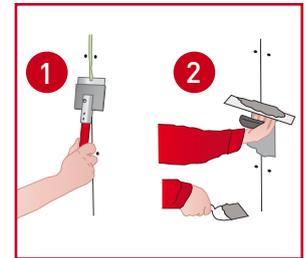
- > Press-fitting jaw TH16 
- > Part No.: W024
- > PKU: 1 pce.
- > Weight/PKU: 2.1 kg

# 6 FINISHED SURFACE

## 6.1 Filling

After installation, the ModulePanels and the ModuleBlankPanels are filled using FERMACELL grouting or fine stopper. However, before this happens the set joint adhesive must be fully scraped off (the joint adhesive hardens after approx. 18 to 36 hours, depending on the room temperature). Attempting to remove joint adhesive that is still soft will result in smearing.

**Caution:** Filling must not be performed until all wet work has dried out (wet screed, plastering work, etc.)!



The following work is to be performed, depending on the surface quality required

Q1 – Minimum requirement	Q2 – Standard requirement	Q3 – High requirement	Q4 – Highest requirement
<b>Necessary for:</b> - Sealing layers and tiling	<b>Necessary for:</b> - Wallpaper and woodchip (medium or coarse grain) - Matt fillers (dispersion coating, thin plaster)	<b>Necessary for:</b> - Fine-textured wall coverings - Matt, non-textured wall coverings	<b>Necessary for:</b> - Smooth or fine-textured wall coatings - Metal or thin vinyl wallpapers - High-quality finishing technologies
<b>Required work:</b> - Scrapping off excess joint adhesive after hardening <b>1</b> - Filling of visible fixings and adhesive joints with Fermacell Joint Filler or Fine Surface Treatment <b>2</b>	<b>Required work:</b> - Q1 - Smooth and continuous filling of joints and fixings. No processing marks or filler burrs must remain visible. If necessary, the smoothed surfaces should be sanded	<b>Required work:</b> - Q2 - If necessary broad filling of joints - Full-surface coating and <b>sharp pull-off</b> of entire surface with Fermacell Fine Surface Treatment or other suitable filling materials. If necessary, the smoothed surfaces should be sanded	<b>Required work:</b> - Q2 - If necessary broad filling of joints - Full-surface coating and <b>smoothing (e.g. with abrasive grid)</b> of entire surface with Fermacell Fine Surface Treatment or other suitable filling materials.
	Settling of joints can't be ruled out, particularly under grazing light	Unevenness visible under grazing light, such as application marks on joints, cannot be excluded, but the unevenness is less than for Q2.	Unevenness at the joints must not be visible.

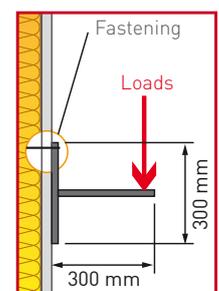
## 6.2 Fastening loads to the Modular Wall

**Single loads hanging on the wall:** Light single loads parallel to the wall surface with low outreaches, such as (e.g.) pictures or decorations, can be fastened directly to the the FERMACELL planking using commonly available fasteners without using an additional substructure. Suitable for this are (e.g.) nails, picture hooks with single or double nail mounts, or screws and dowels.

**Cabinet loads<sup>3</sup> on Modular Wall:** The listed loading values can be added when the dowel clearance is  $\geq 500$  mm. At lower dowel clearances, 50 % of the respective maximum permissible load for each dowel is used. The sum of the individual loads must not exceed 1.5 kN/m for walls and must not exceed 0.4 kN/m for free-standing single wall panels and double stud walls that are not connected to each other. Higher loads must be specially checked and approved.

Picture hooks <sup>1</sup> fastened with nails	Permissible load <sup>2</sup> per hook on ModulePanel ( $\geq 12.5$ mm FERMACELL Panel)
	17 kg
	27 kg
	37 kg

Cabinet loads fastened with dowels <sup>4</sup> or screws	Permissible loads for individual hanging on Module-Panel ( $\geq 12.5$ mm FERMACELL Panel)
	50 kg
	30 kg



<sup>1</sup> Breaking force of the hooks per brand. Hooks fastened corrosion-neutral only in the planking

<sup>2</sup> Safety factor 2 (constant load at rel. humidity up to 80 %)

<sup>3</sup> Introduced as per DIN 4103, safety factor 2

<sup>4</sup> Observe the instructions of the dowel manufacturer

### 6.3 Painting

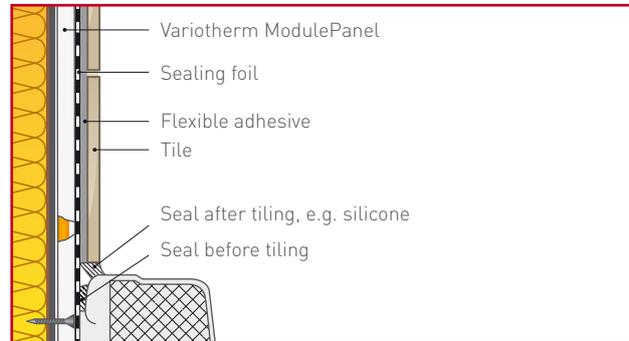
Commonly available paints such as (e.g.) latex, emulsion or enamel paint can be applied to the ModulePanels. Mineral-based paints such as (e.g.) limewash and silicate paints must be approved by the manufacturer for use on gypsum fibreboards. The paint is usually applied in two steps.

### 6.4 Tiling

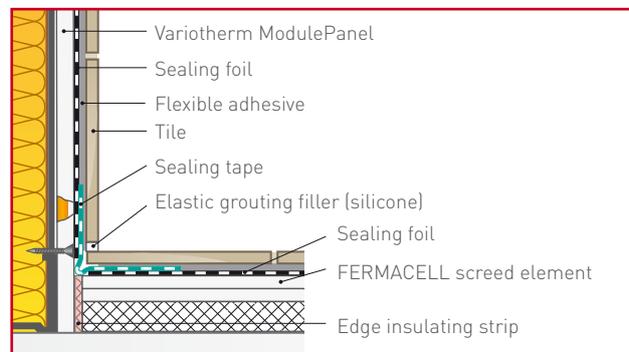
See also the appropriate standards for laying tiles, panels and mosaics.

Points to be observed:

- › The weight of the tiles (incl. adhesive) must not exceed 56 kg/m<sup>2</sup>.
- › The surface of the modular panels must be at least Q1 before tiling/sealing (see table, section 6.1).
- › The moisture content of the ModulePanels must be less than 1.3 % (min. 48 h at 70 % humidity and room temperature > 15 °C).
- › Sealing systems must be used on surfaces subject to the effects of moisture (see table below). The wall boundaries must be sealed using appropriate sealing tape.
- › A flexible adhesive is used to bond the tiles. A primer must be applied if this is stated by the adhesive manufacturer. This is particularly the case for flexible cement adhesives.
- › Flexible grouting mortar must be used for grouting.
- › After laying the tiles, boundaries with the walls are additionally sealed with silicone.



▲ Connections between shower/bathtub



▲ Wall-screed structure in areas subjected to water loads

Use of primer and sealing system (compound sealing):

Stress group according to ÖN B 3407		Adhesive mortar with tile coverings	Primer	Sealing system
W1	Residential sector: living rooms, corridors, toilets, offices and the like	Calcium sulphate flexible adhesive mortar	Not required	Not required
		Cement flexible adhesive mortar	Required	Not required
W2	Residential sector: kitchen and rooms with similar usage Commercial sector: toilet systems	Only cement flexible adhesive mortar	In addition to the sealing system, when recommended by the manufacturer	Recommended
W3	Wall and floor surfaces without drainage (e.g. bathroom with shower tub higher than 20 mm above floor covering), toilet systems without floor drainage, porch			Required
W4-W6	Wall and floor surfaces with drainage (e.g. shower with flush drain at the same level as the floor) Swimming bath area, shower systems, industrial kitchen ...	No Modular Wall possible.		

Product examples for primer or sealing system (compound sealing):

Manufacturer/Brand	Primer	Sealing system
FERMACELL	Deep primer	Waterproofing Application
Ardex	Ardex P51	Ardex 8 + 9
Cimsec	Gipsgrundierung	Dichtflex DU15
PCI	Gisogrund	Lastogum
Schönox	Schönox KH	Schönox HA oder 1K-DS
Mapei	Primer G	Mapegum WPS
Weber	weber.prim 801	weber.sys 822
Ceresit	Lösungsmittelfreier Tiefengrund	Ceresit Dusch- & Badabdichtung

# 7 HEATING/COOLING PRACTICE

## 7.1 Calculation of the heating and cooling load

The EN 12831 standard with the respective national annex applies to the heating load calculations for the heated rooms.

Every room is considered individually. For the outside temperature, the locally acquired and standardised outdoor temperature  $T_{ne}$  is used.

Variotherm also conducts cooling load calculations (subject to a fee) according to the new VDI 2078 guideline (valid since June 2013). For calculation purposes, precise information must be provided on the building and the rooms to be cooled (U-values with layer composition, shading, internal loads). This is the precondition for useful, accurate results.

## 7.2 Variotherm dimensioning software

Key values for individual heating/cooling 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 or cooling load into the Variotherm dimensioning software. It can be found in our Professional Area at [www.variotherm.com/professional](http://www.variotherm.com/professional).

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	$\Theta_{ext}$	$A_{ext}$	$\Phi_{T_e}$	$\Phi_{i}$	$\Phi_{V}$	$\Phi_{R_{ext,ext}}$	$\Phi_{R_{ext,int}}$	$\Phi_{R_{int}}$	$\Phi_{R_{ext}}$	$\Phi_{R_{int}}$
Nr.	Bezeichnung	°C	m²	W	W	W	W	W	W	W
Haus, EG		180,88	5427			3396			9160	0
00.001.001	Eltern	20,0	29,10	833	833	501	46	15	1335	0
00.001.002	Kinder	20,0	20,49	762	762	343	54	19	1106	0
00.001.003	Vorraum	20,0	24,40	571	571	409	40	14	980	0

▲ Extract from a heating load calculation

Bezeichnung	Fläche m²	Kühllast W	Kühllast W/m²	t <sub>Raum</sub> °C	t <sub>op, Raum</sub> °C
Schlafzimmer	21.70	-1601	-73.76	24.0	23.9
Wohnen, Kochen, Essen	84.50	-2906	-34.39	24.0	24.8
Wirtschaftsraum	13.00	-455	-35.01	24.0	24.6
WC	4.80	-73	-15.89	24.0	24.1
Corridor + Stiege	29.40	-1822	-61.96	24.0	25.4
Lounge + Stiege	22.00	-459	-20.85	24.0	24.3
Küche II (Pantry)	30.50	-956	-31.35	24.0	24.8
Vorraum	10.00	-239	-23.94	24.0	24.5
Küche II (Pantry)	14.00	-414	-29.55	24.0	24.6
Gästezimmer 1	23.50	-613	-26.08	24.0	24.6
Flur + Stiege	12.40	-342	-27.59	24.0	24.6
Gästezimmer 2	28.70	-746	-25.98	24.0	24.5
<b>Summe</b>	<b>294.30</b>	<b>-10625</b>	<b>-36.10</b>		

▲ Extract from a cooling load calculation

### Dimensioning of Variotherm Heating Systems

Building project: Joe Bloggs										ZIP: 5244		City: Leobersdorf		Date:		Processed by: as					
No.	Room name	Floor space [m²]	Maximum length [m]	Heating load [W]	Supplement heating load [W]	Room temp. [°C]	Heating system	Floor covering [mm]	Dimensioning temperature [°C]	Mathematical			Practical			Supply pipe [m]	Supply line length [m]	Pressure loss [mWC]	Flow quantity [l/s]	Distribution manifold number	Calculation of pressure loss and flow rate with 2 systems of one heating circuit (see manual)
										Dim.	Unit	Type	No. of circuits	Dim.	Unit						
EG	Zimmer	12,50	566	5%	584	20	ModuleWall MSW	40/30	5,35 m²	MSW	1	6,00 m²	MSW	72	-	1,91	58	1			
	Zimmer	11,50	487	5%	511	20	ModuleWall MSW	40/30	4,61 m²	MSW	1	5,50 m²	MSW	99	-	1,57	53	1			
	Küche	12,00	610	5%	641	20	ModuleWall MSW	40/30	5,77 m²	MSW	1	6,20 m²	MSW	48	-	2,29	66	1			
	Wohnzimmer	25,00	1247	5%	1303	22	ModuleWall MSW	40/30	14,39 m²	MSW	3	5,20 m²	MSW	110	-	1,06	41	1			
	WC	2,50	187	5%	196	20	ModuleWall MSW	40/30	1,77 m²	MSW	1	2,50 m²	MSW	81	-	0,29	24	1			
	Vorraum	10,50	487	5%	511	20	ModuleWall MSW	40/30	4,61 m²	MSW	1	5,60 m²	MSW	110	-	1,65	54	1			
	Bad	8,80	580	5%	620	24	ModuleWall MSW	40/30	6,49 m²	MSW	2	4,80 m²	MSW	81	-	0,70	31	1			

Summary of the heating systems				
Amount	Unit	Heating system	Type	Pipe / Heating element
	m²	System wall heating	SWW43	
	m²	System wall heating	SWW43	714.0 m
	m²	Modular wall heating	MSW	
	m²	EasyFlex wall heating	EWFK115	
	m²	EasyFlex wall heating	EWFK115	
	m²	Modular ceiling heating	MSDMRO	
	m²	Screed floor heating	RA10	
	m²	Screed floor heating	RA15	
	m²	Screed floor heating	RA20	
	m²	Screed floor heating	RA25	
	m²	Screed floor heating	RA30	
	m²	Compact floor heating	RA10	
	m²	Compact floor heating	RA20	
	m²	Industrial floor heating	RA20	
	m²	Industrial floor heating	RA25	
	m²	Industrial floor heating	RA30	
	m²	Industrial floor heating	RA35	
	m²	Industrial floor heating	RA40	
	m	Skirting heating	HL mini	
	m	Skirting heating	HL la	
	m	Skirting heating	HL la	
	m	Skirting heating	HL la	
	m	Ducted channel heating	BKH1 mini	
	m	Ducted channel heating	BKH1	
	m	Ducted channel heating	BKH1 mini	
	m	Ducted channel heating	BKH2	
	m	Supply pipe	16x2	
	m	Supply pipe	11.6x1.5	
	m	Supply pipe	20x2	

Summary of pipe length by line				
Room name	Ø 20 [m]	Ø 16 [m]	Ø 11.6 [m]	HL 18 [m] / HL m18 [m]
Zimmer	94.0			
Zimmer	77.0			
Küche	86.8			
Wohnzimmer	215.4			
WC	35.0			
Vorraum	78.4			
Bad	134.4			
<b>Total</b>	<b>714.0</b>			

	l/s	Number of heating circuits	Flow quantity manifold [l/s]	Pressure loss for manifold [mWC]	Manifold notation according to drawing
Distribution manifold 1	40/30	10	434	2.2	
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:			434 l/s		
Maximum pressure loss from distribution manifold incl. 0.1 mWC for max. opened valve: 2.19 mWC					
<b>Summary of the floor heating surface area:</b>					
Screed floor heating			0.0 m²		
Compact floor heating			0.0 m²		
Industrial floor heating			0.0 m²		
<b>Summary of loads:</b>					
Total heating load			25,044.0 W		
Total installed load			4,987.0 W		
<b>Total filling water:</b>					
Total filling water			41.4 l/s		
<b>Notes:</b>					

▲ Variotherm dimensioning software example for heating

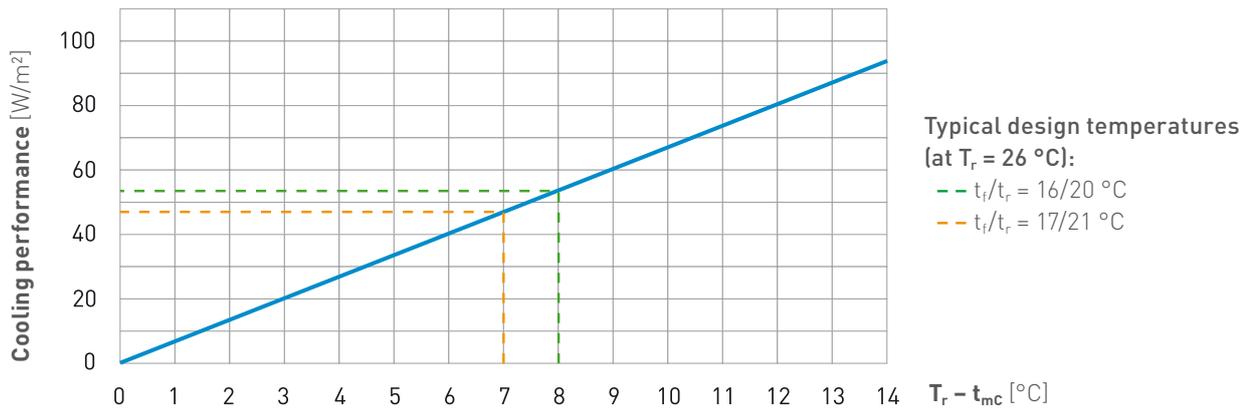
### 7.3 Heat output

$t_i/t_r$ [°C]	$t_{mH}$ [°C]	Heat output [W/m <sup>2</sup> ] at room temperature $T_r$					$T_0$ [°C] (at $T_r = 20$ °C)
		$T_r = 15$ °C	$T_r = 18$ °C	$T_r = 20$ °C	$T_r = 22$ °C	$T_r = 24$ °C	
30/20	25,0	90	59	38	18	-	25
30/25	27,5	108	77	56	36	18	26
35/25	30,0	127	95	74	55	36	28
35/28	31,5	137	105	84	65	46	28
35/30	32,5	144	113	92	73	54	29
37,5/32,5	35,0	162	131	111	91	73	31
40/30	35,0	162	131	111	91	73	31
40/35	37,5	179	149	129	108	91	32
45/35	40,0	197	167	147	126	109	34
45/40	42,5	214	184	164	143	126	35
50/40	45,0	232	201	181	161	143	37
50/45	47,5	239	214	201	181	162	38

<sup>1</sup> The flow temperature must never exceed 50 °C

$t_{mH}$  = mean hot water temperature =  $\frac{t_i + t_r}{2}$  [°C]       $T_0$  = mean surface temperature [°C]  
 $T_r$  = room temperature [°C]       $t_i/t_r$  = flow temperature / return temperature [°C]

### 7.4 Cooling performance



The surface temperature must not reach or fall below the dew point temperature!  
 The mean surface temperature  $T_0$  corresponds approximately to the return temperature  $t_r$ .

Relative humidity [%rF]	Room temperature [ $T_r$ ]				
	24 °C	25 °C	26 °C	27 °C	28 °C
70 %	18.0	19.0	20.0	21.0	22.0
60 %	15.5	16.5	17.5	18.5	19.2
50 %	13.0	14.0	15.0	15.8	16.8
40 %	9.8	10.5	11.5	12.5	13.2

The flow temperature must be selected or ensured in such a way that the surface temperature of the Module-Panel (both on the room side and in the cavity) and the pipe never reaches or falls below the dew-point tempera-

ture at any point. Condensation can form on the pipes and surfaces if the flow temperature selected is too low. Control precautions must be taken to prevent this (e.g. dew-point controller).

$t_{mc}$  = mean cooling water temperature =  $\frac{t_i + t_r}{2}$  [°C]       $T_r$  = Room temperature [°C]       $t_i/t_r$  = flow temperature / return temperature [°C]

## 7.5 Arrangement of the surfaces

Wall heating installations are used for heating occupied areas. For this reason, they should be evenly installed over the interior sides of exterior walls. At normal ceiling heights up to 3 m in buildings with good thermal insulation, designing the Modular Wall to a maximum height of 2 m above the finished floor level is sufficient. For a ceiling height of more than 3 m, (e. g. halls, stairwells, therapy areas) the wall heating installations must be designed higher than 2 m.

Experience has shown that radiant heat can be felt at a distance of up to 5 m from the heated wall. In larger rooms it is therefore advantageous to install a wall heating system on two opposing walls because the radiance effect on the body declines in proportion to the square of the distance.

Estimated values for dimensions:

~ 40 % wall surface of the room area for heating

~ 70–80 % wall surface of the room area for cooling

Caution: Observe the heating/cooling load calculation for precise dimensioning of the area required!

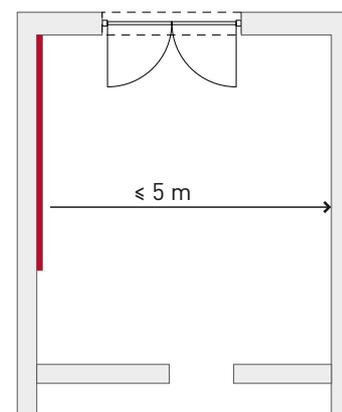
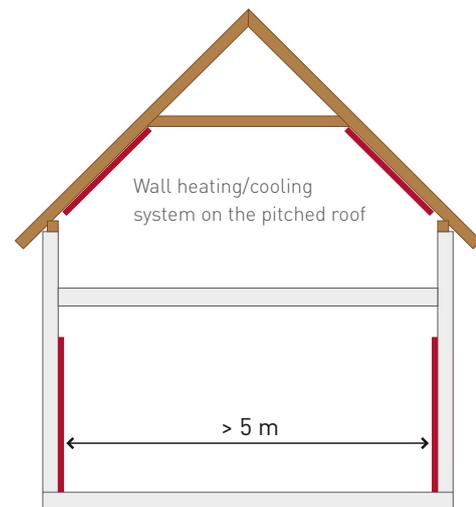
With a good arrangement of the radiant heating surfaces and U-values (exterior wall) of  $\leq 0.3 \text{ W/m}^2\text{K}$ , the room air temperature can be reduced by up to 3 °C while retaining the same perceived temperature (comfort).

Seating and glass surfaces (e. g. windows) must be taken into consideration when choosing the arrangement of wall heating surfaces.

Issues relating to furniture:

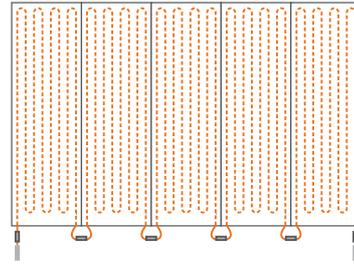
Since the radiant heat should radiate into the living spaces, this is to be taken into consideration in the furniture planning. Wall fittings, full bookcases, built-in cupboards etc. should not be planned in front of wall heating systems. Desks, chests of drawers, open seats, small boxes, kitchen corner banks, pictures etc. usually present no problem. General rule of thumb: maximum of 15 % furnished area.

Tip: Beds (especially the headboard) should not be placed directly in the radiation area of wall heating elements.



## 7.6 Pressure loss

Example: The pressure loss of a 6.25 m<sup>2</sup> Modular wall heating (5 pcs. V020-100 at 1 heating circuit) is to be calculated. The desired flow/return temperature is 40/30 °C resulting in a heat output of 111 W/m<sup>2</sup> at a room temperature of 20 °C.



Calculation of the flow rate  $\omega$  from the pressure loss diagram:

$$Q = 694 \text{ W (111 W/m}^2 \times 6.25 \text{ m}^2)$$

$$\Delta T = 10 \text{ K (} t_f - t_r = 40 \text{ K} - 30 \text{ K)}$$

$$c = 1.163 \text{ Wh/kgK (Specific heat capacity of water)}$$

$$m = Q \div c \div \Delta T$$

$$= 694 \text{ W} \div 1.163 \text{ Wh/kgK} \div 10 \text{ K} = 59.6 \text{ kg/h (l/h)}$$

$$Q = m \times c \times \text{delta } T$$

59.6 l/h results, according to the diagram, in:

Flow rate  $\omega = 0.29 \text{ m/s}$

Pressure loss (Variotherm pipe 11.6x1.5) = 205 Pa/m

Pressure loss (Variotherm pipe 16x2) = 36 Pa/m

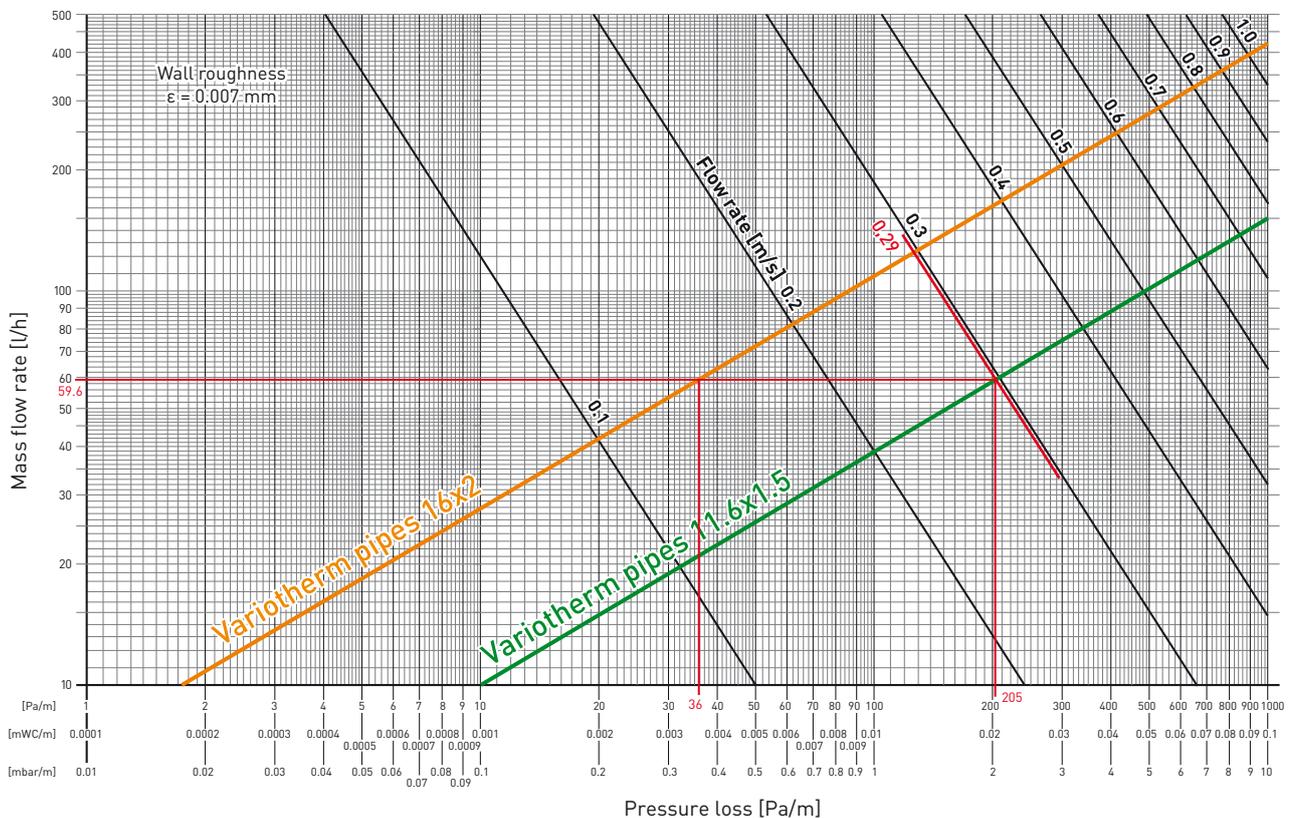
Press-fit coupling	Coefficient of resistance $\zeta$ (Zeta)
11.6 x 11.6	7.2
16 x 11.6	6.9

Pipe length for 6.25 m<sup>2</sup> heating surface = 81 m

(1 pce. V020-100 = 16.2 m pipe, see table on page 18)

- $\Delta p$  for 6.25 m<sup>2</sup> Modular Wall: 205 Pa/m  $\times$  81 m = **16 605 Pa**
- $\Delta p$  for 15 m pre-insulated VarioModular pipe 16x2: 36 Pa/m  $\times$  15 m = **540 Pa**
- $\Delta p$  for 4 pcs. press-fit couplings 11.6x11.6:  $\zeta \times \rho/2 \times \omega^2 = 7.2 \times 500 \text{ kg/m}^3 \times (0.29 \text{ m/s})^2 = 303 \text{ Pa} \times 4 \text{ pcs.} =$  **1212 Pa**
- $\Delta p$  for 2 pcs. press-fit couplings 16x11.6:  $\zeta \times \rho/2 \times \omega^2 = 6.9 \times 500 \text{ kg/m}^3 \times (0.29 \text{ m/s})^2 = 290 \text{ Pa} \times 2 \text{ pcs.} =$  **580 Pa**

$$\Delta p_{\text{Total}} = 16\,605 \text{ Pa} + 540 \text{ Pa} + 1212 \text{ Pa} + 580 \text{ Pa} = 18\,937 \text{ Pa} = 1.89 \text{ mWC}$$



# 8 PROTOCOLS

## 8.1 Leak-tightness test in accordance with EN 1264-4

Construction project: \_\_\_\_\_

Building owner/Occupant: \_\_\_\_\_

Client: \_\_\_\_\_

Heating installation technician: \_\_\_\_\_

Architect: \_\_\_\_\_

Other: \_\_\_\_\_

After installation and before completion work (screed, plastering, painting, wallpapering, tiling), the circuits of the Variotherm Modular Wall are to be checked for leak-tightness via a water pressure test. The test pressure should be min. 4 bar and max. 6 bar. If there is a risk of freezing, appropriate measures should be taken, e.g. use of antifreeze and controlling the building's temperature.

- › Installation of ModulePanels finished on: \_\_\_\_\_
- › Installation of pipe connections finished on: \_\_\_\_\_
- › Pressure test started on: \_\_\_\_\_ with test pressure \_\_\_\_ bar
- › Pressure test finished on: \_\_\_\_\_ with test pressure \_\_\_\_ bar
- › Start of completion work (plastering, painting, wallpapering, tiling) on: \_\_\_\_\_
- › System pressure during the completion work was \_\_\_\_ bar
- › The system water was treated (e.g. per ÖNORM H 5195-1)  Yes  No
- › Antifreeze was added to the system water  Yes  No
- › The system was checked for leak-tightness on: \_\_\_\_\_ and approved

Approval:

\_\_\_\_\_  
Building owner/Occupant/Client

\_\_\_\_\_  
Construction management/Architect

\_\_\_\_\_  
Heating installation technician

## 8.2 Preheating Protocol

Construction project: \_\_\_\_\_

Building owner/Occupant: \_\_\_\_\_

Client: \_\_\_\_\_

Heating installation technician: \_\_\_\_\_

Architect: \_\_\_\_\_

Other: \_\_\_\_\_

### Preheating of the Variotherm Modular Wall

- › Completion work finished on: \_\_\_\_\_
- › Preheating started on: \_\_\_\_\_
- › Supply temperature set to 23 – 30 °C and retained for 1 day completed
- › Increase to a supply temperature of 30 – 40 °C and maintained for ½ day completed
- › Set to maximum calculated supply temperature plus 5 °C completed   
(Caution: The maximum supply temperature of the Modular Wall is 50 °C)
- › Maintained for ½ day, set falling supply temperature to 30 °C, maintain for 1 day completed
- › Heating switched off on: \_\_\_\_\_
- › Operating state and outdoor temperature on handover:

Approval:

\_\_\_\_\_  
Building owner/Occupant/Client

\_\_\_\_\_  
Construction management/Architect

\_\_\_\_\_  
Heating installation technician

## 8.3 Commissioning

Please note that the flow temperature (heating water) of the Modular Wall may not exceed  $t_f = 50$  °C. The main stop valves at the distributor station, and the heating circuit shut-offs are to be opened. The entire system is to be deaerated thoroughly. The circulation pump may be switched on after deaeration. After commissioning, the Variotherm surface heating/cooling system can be considered maintenance-free.  
(Subject to technical modifications without notice.)

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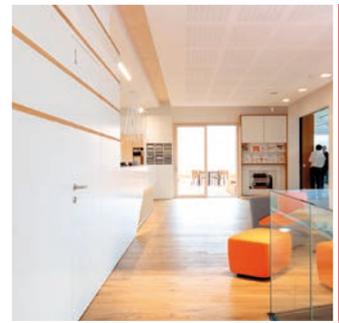
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